



# Structures Assessment Re-Review Report

Boxted Bridge  
Bridge No. 59  
November 2024

# Document Control Sheet

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# 1. Executive Summary

## **Purpose**

Ringway Jacobs have been commissioned by Essex County Council to carry out a Assessment Re-Review of Boxted Bridge (ECC Structure No. 0059) to validate the recommendations of the latest structural review undertaken in October 2023, in accordance with CS 451 – Structural review and assessment of highway structures. This assessment re-review is based on the information contained in the latest inspection reports and previous assessment report.

## **Structure Information**

Boxted Bridge (ECC Structure No. 0059) is located in Boxted, Colchester (OS Grid Reference TM 01244 34419) and carries Wick Road, an unclassified Road over the River Stour. The structure was built in 1897.

The superstructure is comprised of a simply supported single span half-through steel deck. The substructure is comprised of brick abutments, but the foundation type is unknown.

Currently there is a road closure over the bridge (vehicular and pedestrian) following the findings of a Principal Inspection in June 2023. The navigation beneath the structure is also closed.

## **Re-Review Assessment Summary**

The assessment re-review considered the assumptions made in the 1992 assessment as well as the change in condition to the structure since. The re-review concludes that the U-frame action assumed for the 1992 assessment is no longer considered to be valid for this assessment.

## **Conclusions**

The assessment of the structure dated March 1992 undertook a sensitivity analysis and determined that the structure's capacity is 3 Tonnes when U-frame action is effective and less than Dead load when the U-frame action is not considered to be fully effective. Based on the current condition of the structure it is considered that the U-frame action is no longer fully effective. Thus, the bridge current capacity is less than dead load. Therefore, it is recommended that the closure of the bridge remains in place while other options, including the replacement of the structure, are explored.

## 2. Introduction & Purpose

Ringway Jacobs have been commissioned by Essex County Council to carry out an Assessment Re-Review of Boxted Bridge (ECC Structure No. 0059) to validate the recommendations of the latest structural review undertaken in Oct 2023, in accordance with CS 451 – Structural review and assessment of highway structures.

This assessment re-review is based on the information contained in the latest inspection reports and previous assessment report. Therefore, no inspection for assessment has been undertaken for the purpose of this assessment.

The primary objective of this assessment is to confirm by desk study, whether the latest assessment is still valid taking the current structure condition into account, as well as any changes to the assessment standards since 1992 assessment.

It is certified that all reasonable professional skill and care has been used in the preparation of this assessment.

### 3. Structure Information

Structure Name	Boxted Bridge
ECC Structure Number	ECC Br. No. 0059
Location	Boxted, Colchester (OS Grid Reference TM 01244 34419)
Bridge Carries	Wick Road, an unclassified road.
Obstacles Crossed	River Stour, a main river.
Date of Construction	Boxted Bridge was constructed in 1897.
Form of Construction	<p>The superstructure is comprised of a simply supported single span half-through steel deck. The deck is trapezoidal in plan, being wider at the south abutment than the north, and has an effective square span of 12.50 m. The width of the structure varies from 4.77m on the north side to 6.75m on the south side, dictated by the proximity to the junction. It comprises riveted plate primary edge girder and transverse secondary beams, with tertiary longitudinal rolled I-beam/channel sections and hogging plates.</p> <p>Brick retaining walls (with brick pilasters and stone copings) are located on the approaches to (and departures from) the bridge which support the highway above the level of the adjoining riverbanks. The thickness of the abutments is approx. 1.0m in accordance with coring investigations undertaken in 2018.</p> <p>The substructure is comprised of brick abutments, but the foundation type is unknown.</p>
Principal Dimensions	<p>Span: 12.50m</p> <p>Width: 4.77m (north side) -6.75m (south side)</p>
Parapet Type	The parapet of the structure formed from by the main edge girder.
Current Assessed Capacity	3 Tonnes
Current Condition	The BCI Ave score for the bridge is 52.64 and the BCI Crit score is 22.12.

## 4. Previous Assessment Summary

### 4.1. Previous Assessment Report used in Re-Review

From available records the following assessment report has been identified as the most recent for Boxted Bridge (ECC Structure No. 0059):

- Assessment Report (doc. ref. 1992-05-01 Assessment Report) dated May 1992, by Taywood Engineering Limited.

### 4.2. Previous Assessment Methodology including Standards Used & Condition Factors Adopted

#### **Assessment Methodology**

The assessment was undertaken by Taywood Engineering Limited in accordance with BD34/90.

The superstructure was analysed using hand calculations in accordance with BS5400 part 3 to ascertain the capacities of the structural elements.

A steel yield stress of  $300\text{N/mm}^2$  was adopted in the analysis, which was determined through testing. With the lower bound stress of  $230\text{N/mm}^2$ , a 3 tonne capacity could not be achieved unless the bridge was limited to a single lane.

Assumptions were made regarding the determination of the effective length of the structure.

A small enough effective length and subsequently an adequate limiting stress in the top flange could only be achieved by assuming that the transverse beams and double-T web stiffeners of the plate girder act as U-frames restraining the top flange. The connection detail between transverse beams and stiffeners is unknown but without the assumption of U-frame action being present the bridge girders were shown to have inadequate capacity for dead loading, be this only slightly. For the 3 tonne loading the stiffeners were marginally overstressed but the assistance of alternate transverse beams and single T stiffeners had been ignored.

There was a fair degree of corrosion to the structure which contributed to its reduced loading capacity. The longitudinal channels in each corner of the structure are badly corroded which has resulted in a considerable reduction of load capacity. Consequently, they were assessed to be overloaded under 3 tonne loading but the

spread of the loads was conservatively estimated and the overstress was not considered significant.

The following condition factors were considered for the structural elements:

<b>Structural Element</b>	<b>Condition Factor</b>
Plate Girders	0.9
Transverse Beams	0.8 (0.95 in shear)
Longitudinal beams	0.9
Longitudinal channel beams	0.5 (0.75 in shear)

### **Structure Condition**

An inspection for assessment was undertaken on 12<sup>th</sup> March 1992, and found the structure to be in reasonable / fair condition.

The main girders appeared to be in reasonable condition, with localised severe corrosion and section loss of the bottom flanges. The connecting angles between the bottom flanges and webs of the girders appeared to have corroded but remained intact around the rivet connections. The girder webs, T-section stiffeners and channel top flanges appeared to be in good condition. The end plate stiffeners appeared to have suffered impact damage causing buckling of the plates.

The RSJ's suffered severe localised corrosion. Where the bottom flanges have been reinforced with plates, the plates have buckled. The plates appear to be quite pitted, and corrosion was visible at their edges. The hogging plates were in reasonable condition except for severe corrosion at the junction with the flanges of the RSJ's.

The abutments appeared to be in a reasonable condition. There were slight vertical cracks at the ends of the abutments. There is a crack on the east end of the south abutment. All other cracks were hairline.

The foundations were not inspected; however, a scour survey was undertaken. A scour hole exists on the west side of the structure approx. 3m away from the south abutment.

Since then, the structure has been inspected many times, the most recent being a Principal Inspection undertaken in June 2023.

- During the inspection it was noted that the corrosion on the primary and secondary elements had progressed. The riveted plate girders (both primary and secondary elements) are exhibiting significant corrosion with section loss through the web and flange. Also, one rivet head has become detached to the furthest south transverse beam. The riveted plate sections in the upper areas of the secondary deck elements have deteriorated further, with small areas having complete loss of the bottom flange while in other areas loss due to corrosion ranges between 15-45mm on the bottom

flange. The web of the stiffener at midspan was also corroded completely on the east edge girder.

- Notable during the inspection was that the east edge girder had rotated inwards by 65mm measured midspan. The west edge girder had rotated inwards by 30mm measured at the north end. No measurements of any deflection were present in previous inspections.
- Further deterioration is not notable in the abutments since the 1992 inspection.

### 4.3. Summary of Previous Results

The assessment found the structure to be capable of withstanding 3 tonnes assessment live loading.

#### 4.3.1. Superstructure

<b>Element</b>	<b>Previous Assessment Result</b>
Plate girders	3 tonnes both in bending and shear
Longitudinal RSJ's	3 tonnes both in bending and shear
Longitudinal Channel	3 tonnes both in bending and shear
Transverse beams (double flange)	40 tonnes both in bending and shear
Transverse beams (triple flange)	40 tonnes both in bending and shear

#### 4.3.2. Substructure

The sub-structure was not included in the assessment.

## 5. Re-Review Assessment

### 5.1. Discussion

The method of analysis used in the 1992 assessment would still be appropriate today, however, the following considerations should be taken into account:

- Modification of the condition factors considered in the original assessment to reflect the current condition of the structure, refer to section 5.1.1 for more details.
- Due to the rotation of the edge girders, U-frame action is no longer considered to be fully effective.

#### 5.1.1. Change in Structure Condition since Previous Assessment

As noted in the June 2023 Principal Inspection, the condition of the primary and secondary elements has deteriorated as highlighted below:

- The riveted plate girders (both primary and secondary elements) are exhibiting significant corrosion with section loss through the web and flange. In areas of the east edge girder the bottom flange has deteriorated completely with total section loss. In other areas, in both the east and west edge girder there is corrosion present in the range of 15-45mm.
- A rivet head has become detached to the secondary element. This is the first rivet head that has become detached.
- Riveted plate sections in upper areas of the secondary deck elements have deteriorated further. The deflection ranges up to 80mm, although most of the deflection appears to be historic as it has been painted over previously.
- Rivet heads within the secondary elements which are subject to expansive corrosion have deteriorated further and are at increased risk of failure.
- The east edge girder had rotated inwards by 65mm measured midspan. The west edge girder had rotated inwards by 30mm measured at the north end. No measurements of any deflection were present in previous inspections.
- 

### 5.1.2. Changes to Assessment Criteria

BA34/90 and BD21/84 were used in the assessment which have now been superseded by CS451 and CS454 respectively. BS 5400 was used for the calculation of the capacities. The standard is still current when incorporating amendments listed in CS 456. ALL Model 1 should also be considered as part of the assessment criteria.

## 5.2. Re-Review Findings

### 5.2.1. Superstructure

The following condition factors to be considered for the structural elements:

<b>Structural Element</b>	<b>Condition Factor</b>
Plate Girders	0.8
Transverse Beams	0.7 (0.95 in shear)
Longitudinal beams	0.9
Longitudinal channel beams	0.5 (0.75 in shear)

The corrosion present to the bottom flanges of the transverse beams and longitudinal beams and the plate girder beams has been measured in recent Principal Inspections undertaken in 2018 and 2023. Because of these measurements the condition factors have been amended. This led to the reduction of conditions factors listed above.

The analysis undertaken in 1992 is still valid today as the standards used still apply. The assessment includes calculations for both U-frame being effective and not being effective. No further calculations have been undertaken as part of the re-review, the

capacities shown in Section 5.3 are taken as the same as in the assessment amended by the condition factor stated above. Because of the rotation of the edge beams it is considered that U-frame action is no longer applicable for the beam anymore. The results from the 1992 assessment are considered to be valid without U-frame action, which gives the capacity as less than dead load.

### 5.2.2. Substructure

The substructure has not been considered as part of this re-review. Due to the condition of the abutments it is considered that a quantitative assessment should be undertaken to determine the capacity of the abutments.

### 5.3. Conclusion

<b>Element</b>	<b>Previous Assessment Result</b>	<b>Re-Review Assessment Result</b>
Plate girders	3 tonnes both in bending and shear	less than dead load
Longitudinal RSJ's	3 tonnes both in bending and shear	3 tonnes both in bending and shear
Longitudinal Channel	3 tonnes both in bending and shear	3 tonnes both in bending and shear
Transverse beams (double flange)	40 tonnes both in bending and shear	40 tonnes both in bending and shear
Transverse beams (triple flange)	40 tonnes both in bending and shear	40 tonnes both in bending and shear

The assessment of the structure dated March 1992 undertook a sensitivity analysis and determined that the structure's capacity is 3 Tonnes when U-frame action is effective and less than Dead load when the U-frame action is not considered to be fully effective. Based on the current condition of the structure it is considered that the U-frame action is no longer fully effective. Thus, the bridge current capacity is less than dead load. Therefore, it is recommended that the closure of the bridge remains in place while other options, including the replacement of the structure, are explored.

### 5.4. Recommendation

Currently there is a road closure over the bridge (vehicular and pedestrian) following the findings of a Principal Inspection in June 2023. The navigation beneath the structure is also closed.

Considering the capacity of the plate girders, the main structural element of the bridge, it is recommended that the bridge remains closed to all vehicular and pedestrian users. A CS470 review should be produced to explore the need for

monitoring of the structure. CS 470 is used to ascertain how a bridge is to be managed as a sub-standard highway structure. The navigation closure under the structure to also remain, while other options, including the replacement of the structure are explored. Due to the capacity of the structure, it is not recommended that a full assessment of the abutments take place as this would not increase the capacity.

## 6. Assessment Re-Review Approval Form

THE ABOVE IS SUBMITTED FOR ACCEPTANCE

Signed

Name

Position held

Engineering Qualifications

Name of Organisation

Date

Team Leader

BEng(Hons), CEng, MI Struct E

Ringway Jacobs

THE ABOVE IS REJECTED / ACCEPTED AND RECOMMENDED FOR ACCEPTANCE

Signed

Name

Engineering Qualifications

Name of Organisation

Date

BEng CEng MICE

On behalf of Ringway Jacobs

THE ABOVE IS REJECTED / AGREED SUBJECT TO THE AMENDMENTS AND  
~~CONDITIONS SHOWN BELOW~~

Signed

Name

Position Held

TAA

Structures Manager

Essex County Council

Date

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