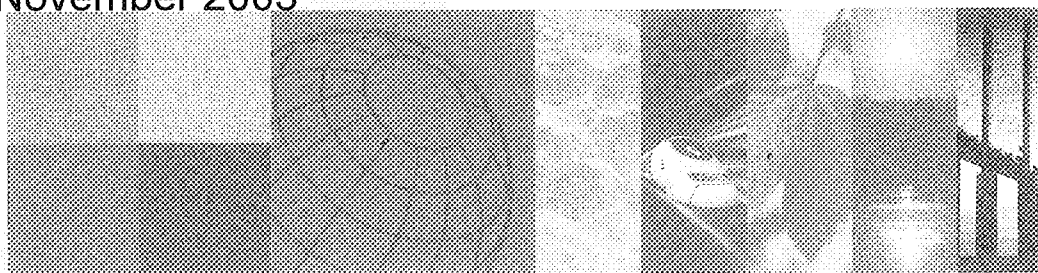


Gloucestershire County Council
Rail Property Ltd Bridge Assessments

Dumpers Bridge FFD 88m 48ch
Assessment and Inspection Report
November 2003



Halcrow Group Limited

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Gloucestershire County Council

Rail Property Ltd Bridge Assessments

Dumpers Bridge FFD 88m 48ch

Assessment and Inspection Report

November 2003

Halcrow Group Limited

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Gloucestershire County Council
Rail Property Ltd Bridge Assessments
Dumpers Bridge FFD 88m 48ch
Assessment and Inspection Report

Contents Amendment Record

This report has been issued and amended as follows:

Issue	Revision	Description	Date	Signed
1	0	First Issue	Nov 03	Aw

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**Appendix A – Location Plan TB.2116.B562.SK01
– Drawing TB.2116.B562.SK02**

Appendix B – Assessment Calculations

Appendix C – Form AA and Form AA/1

1

Executive Summary

1.1

Background

Halcrow Group Limited were commissioned by Gloucestershire County Council (GCC) to undertake an inspection and assessment of Dumpers Bridge in accordance with Department of Transport Standard BD 21/01 "The Assessment of Highway Bridges and Structures".

The bridge is currently owned and maintained by Rail Property Ltd who are also the Technical Approval Authority. The bridge carries an unclassified county road over a disused railway line at FFD 88m 48ch and OS grid reference SP 173 011. A location plan is included in Appendix A.

This report provides a description and summary of the inspection and includes the results of the assessment.

1.2

Assessment Capacity

Based on the assumptions made in this report the structure has a capacity of 3 tonnes Assessment Live Loading (ALL) in accordance with BD 21/01. Whilst the internal sections of the trough deck have a capacity of 40 tonnes Assessment Live Loading (ALL), the edge trough sections have a capacity of 3 tonnes due to inadequacy in bending.

A qualitative assessment of the abutments and wingwalls was carried out in accordance with BD21/01. Vertical cracking in the south abutment is considered to be the result of rotation of the abutment due to settlement in the southwest corner of the bridge. Cracking of the northwest and southwest wingwalls is also believed to be as a result of settlement. These cracks are not considered to affect the load capacity of the structure significantly.

The foundations were not inspected but cracking in the south abutment, northwest and southwest wingwalls indicated some settlement of these elements.

The existing parapets were not assessed but by observation they would not provide vehicular containment to meet current standards.

2

Introduction

2.1

Structure Details

General information about the structure is contained in Table 1.

COUNTY BRIDGE NAME:	Dumpers Bridge
COUNTY BRIDGE No:	562
RAILTRACK PROPERTY LTD Ref:	
BRIDGE ELR & MILEAGE:	FFD 88m 48ch
MAP REFERENCE:	SP 173 011
DIMENSIONS	
No of spans:	1
Clear span:	3.800m (square)
Skew:	13° (approx.)
Width of carriageway:	3.200m
Width of verges:	1.550m (east), 1.600m (west)
Headroom:	4.70m (approx)
Total width between parapets:	6.350m
LOADING	
Is structure subject to a weight restriction order:	No
If yes give details:	N/A date order made: N/A
CONSTRUCTION	
General Construction:	The bridge is a single span, steel trough deck with stone abutments and brick wingwalls.
Trough deck:	Steel (assumed)
Bearings:	N/A
Parapet material:	Metal Kee-Clamp parapets supported on timber beams.
Average depth of fill:	0.175m
Type of fill:	Road surfacing (bituminous) approx. 100mm thick. Poor grade concrete infill.

Table 1: General Details of Dumpers Bridge, FFD 88m 48ch

2.2

History of Structure and Record Drawings

Record drawings of the structure are not available, but a brief maintenance history was provided by Rail Property Ltd.

2.3

Current Loading

The vehicular loading permitted on the structure is currently 38 tonne under the Construction & Use Regulations.

3 Inspection Details

3.1

Introduction

Halcrow Group Limited carried out the inspection of Dumpers Bridge (see Figure 1) on 28 May 2003. The weather was dry and sunny.

All accessible parts of the structure were visually examined within touching distance. A portable aluminium scaffold tower was used to access the steel trough deck and masonry abutments.

The structure was inspected for defects and corrosion, which may affect its load carrying capacity.



Figure 1: Dumpers Bridge

3.2

Foundations

The foundations were not inspected but cracking in the south abutment, northwest and southwest wingwalls indicated some settlement of these elements.

3.3

Wingwalls

All visible parts of the wingwalls were in reasonable condition with some localised areas of mortar loss. Large areas were covered in vegetation (see Figure 2), particularly along the coping stones. This growth had caused localised spalling of



Figure 11: View from south approach



Figure 12: Trial hole exposing end of steel trough

3.6

Parapets

The parapets comprise steel Kee-Clamp fence with mesh infill between stone pilasters. This is in good condition although it is apparent it would not meet current containment standards. Vegetation growth prevented the inspection of the pilasters (see Figure 10) except at the northeast corner, which had been repaired. Each parapet is supported on a timber edge beam, which spans between the abutments. There is no connection between the timber edge beams and the steel trough deck.



Figure 10: East parapet

3.7

Carriageway inspection

The road surface was in reasonable condition except for longitudinal and transverse cracking on both approaches. Transverse cracking on the road surface coincides with the end of the deck suggesting settlement of the fill behind each abutment. The longitudinal cracking is also considered to be a result of settlement behind the abutments. The vertical alignment of both approaches to the bridge is steep but is relatively flat over the deck, this is considered to affect the sight distance of on-coming traffic (see Figure 11).

A trial hole was excavated at each end of the bridge. The depth of cover to the top of the steel trough was approximately 175mm and from inspection the quality of concrete fill was sub standard (see Figure 12).

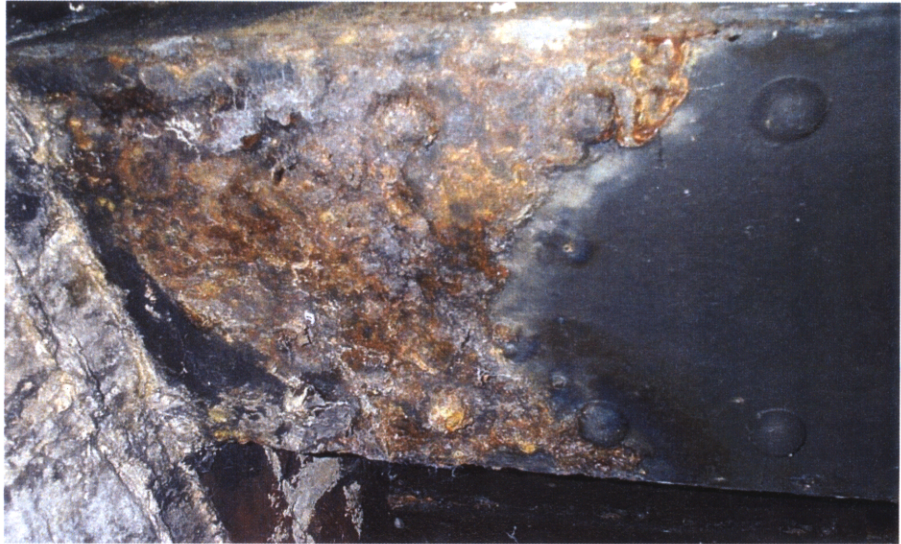


Figure 8: Severe corrosion to plate and rivets on southeast trough



Figure 9: West side of trough deck and timber parapet beam.

Severe corrosion and section loss up to 5mm was also evident on the beam soffits towards each abutment (see Figure 8). Most of the webs were in reasonable condition except for isolated areas. In these areas the paint system had broken down and there was some surface corrosion. On the east side of the bridge the edge deck plate was severely corroded over its entire length (see Figure 9). Delamination of the plate had occurred with complete section loss in places. Exposed rivet holes at the edge of the plate were severely corroded. The edge plate on the west side was in a similar condition.



Figure 6: Break down of paintwork and surface corrosion



Figure 7: Calcite build up indicating water seepage

Corrosion was most severe at the joints between the Z-beams and the flat plates where water seepage had occurred. Section loss here was approximately 3-4mm (see Figure 6). Calcite deposits in this area indicated water seepage through the deck material and between the steel elements. The paint system had broken down on many of the rivets causing extensive surface corrosion but this is not considered to affect their overall capacity.



Figure 5a: Cracking on south abutment

Figure 5b

3.5

Steel Trough Deck

Main recorded defects are shown on Drawing No TB.2116.B562.SK02.

The steel trough deck is built up of Z-beams and flat plates, which are riveted together, refer to Drawing No. TB.2116.B562.SK02. Over the majority of the soffit the paint system was in poor condition and had broken down leaving large areas of the steel exposed (see Figure 6).

Abutments

Both abutments were constructed of stone but some localised areas have been repaired in brick (see Figure 4). Stonework was generally in good condition except for some localised spalling. Mortar joints were approximately 10mm wide with 5mm mortar loss on average. Vegetation growth covered the top corners of the abutment.

On the south abutment, there was a significant full height vertical crack at the east end (see Figure 5a). This is assumed to be the result of settlement and rotation at the interface with the southeast wingwall. It appears the crack has been monitored since 1979 and that movement has taken place since (see Figure 5b). Repairs to the stonework had been carried out using brick, but there were areas of missing masonry generally in the region of the crack. Spalling up to a depth of 100mm of the stone had occurred in localised areas.



Figure 4: View of north abutment.

the brickwork and cracking in the coping stones. Cracking at the intersection of the southwest and northwest wingwalls with the abutment (see Figure 3) is considered to be the result of rotation and settlement of the wingwalls.



Figure 2: Southwest wingwall



Figure 3: Cracking between north abutment and northwest wingwall

3.8

Summary of Inspection

Generally the structure was in a poor condition. Cracking on the south abutment, northwest and southwest wingwalls is considered to be the result of settlement and rotation of the wingwall foundations.

Cracking in the carriageway on both approaches to the bridge indicates settlement of fill behind each abutment.

Water seepage through the deck is widespread, causing the break down of paint, corrosion and section loss. Areas of reduced sections due to corrosion and delamination of the trough deck were considered in the assessment as detailed on Drawing No. TB.2116.B562.SK02.

4

Public Utilities

4.1

Services

Initial service enquiries for Dumpers Bridge were sent out in April 2002. Enquiry responses are as follows:

British Telecom

Reported no apparatus present.

Thames Water

Reported no apparatus present.

National Grid

Reported no apparatus present.

Scottish and Southern Energy plc

Reported no apparatus present.

Transco

Reported no apparatus present.

Energis

Reported no apparatus present.

Cable and Wireless

Reported no apparatus present.

Readers of this report are reminded that the statutory bodies have supplied information with no guarantee of accuracy. Any person who uses information relating to apparatus does so at their own risk. Planners of future works are advised to verify the presence of statutory apparatus at that time.

5

Assessment

5.1

Assessment Details and Assumptions

The steel trough deck was assessed in accordance with BD 21/01 and BD 56/96. Simple load distribution and dispersal techniques for trough decks were used in accordance with Chapter 6 of BD21/01.

An intrusive investigation carried out on the top of the bridge, revealed the fill material comprised bituminous road surfacing and poorly graded concrete. It was assumed this was representative across the entire bridge deck.

The following assumptions were also made:

- Dead and superimposed dead loads used in the assessment were determined from information collected during the inspection.
- The trough deck was laterally restrained along its full length by the infill concrete.
- All deck surfaces masked by the fill material were in similar condition to exposed surfaces. An intrusive investigation to expose the top plate and webs indicated the masked surfaces were in reasonable condition.
- Web, top and bottom plate thickness were based on measurements taken on site and were assumed to remain constant.
- All trough sections were steel.

Areas of reduced section due to corrosion and delamination of the steel were considered in the assessment.

A qualitative assessment was carried out for all other parts of the structure.

5.2

Assessment results

Based on the above assumptions the structure has the following capacity: -

Steel Trough Deck (Internal elements)

Bending	40 tonnes Assessment Live Loading (ALL)
Shear	40 tonnes Assessment Live Loading (ALL)

Steel Trough Deck (Edge elements)

Bending	3 tonnes Assessment Live Loading (ALL)
Shear	40 tonnes Assessment Live Loading (ALL)

Other parts of structure

A qualitative assessment of the south abutment, northwest and southwest wingwalls indicated that there was settlement and rotation of the foundations. The north abutment and other wingwalls showed no significant defects and these are assumed to be adequate with no further assessment considered necessary.

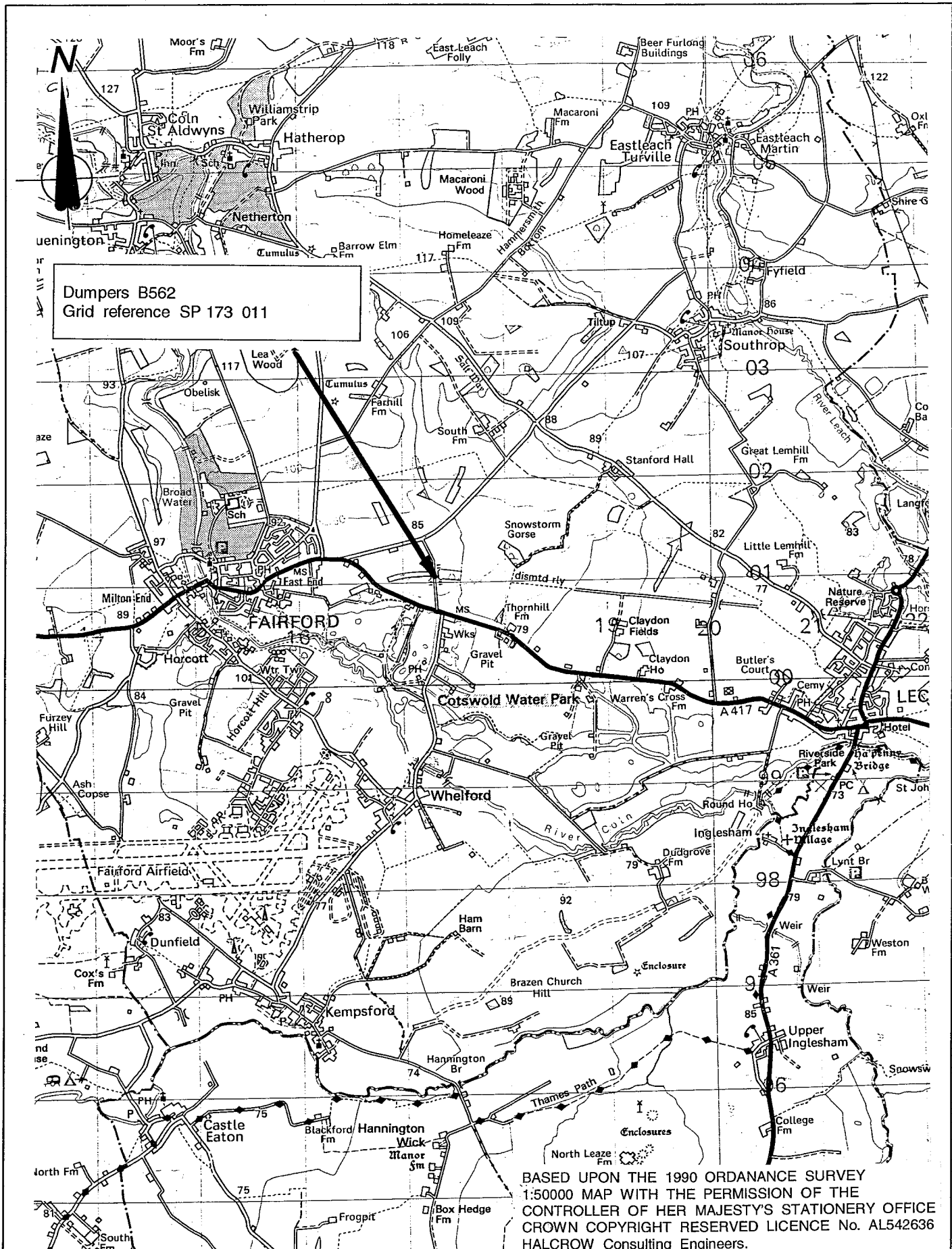
The foundations and parapets were not assessed.

6

Conclusion

Based on the assumptions within this report, the assessment capacity of the trough deck is 3 tonnes Assessment Live Loading (ALL) in accordance with Department of Transport Standard BD 21/01. This is a result of the edge trough sections being inadequate in bending. The internal trough sections had an assessment capacity of 40 tonnes Assessment Live Loading (ALL). Vertical cracking on the south abutment, northwest and southwest wingwalls is considered to be a result of settlement and rotation of the foundations.

Appendix A – Location Plan TB.2116.B562.SK02
– Drawing TB.2116.B562.SK02



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Project

RAIL PROPERTY
BOARD BRIDGE
ASSESSMENTS

Drawing

DUMPERS
LOCATION PLAN

Drawn by CJT
Checked by AW
Authorised by AW

Date: 03/02
Date: 11/03
Date: 11/03

Drawing No.

TB.2116.B562.SK01

Revision

Drawing Scale: AS SHOWN

Plot Scale:


CAD Filename: NOT APPLICABLE

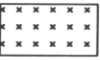
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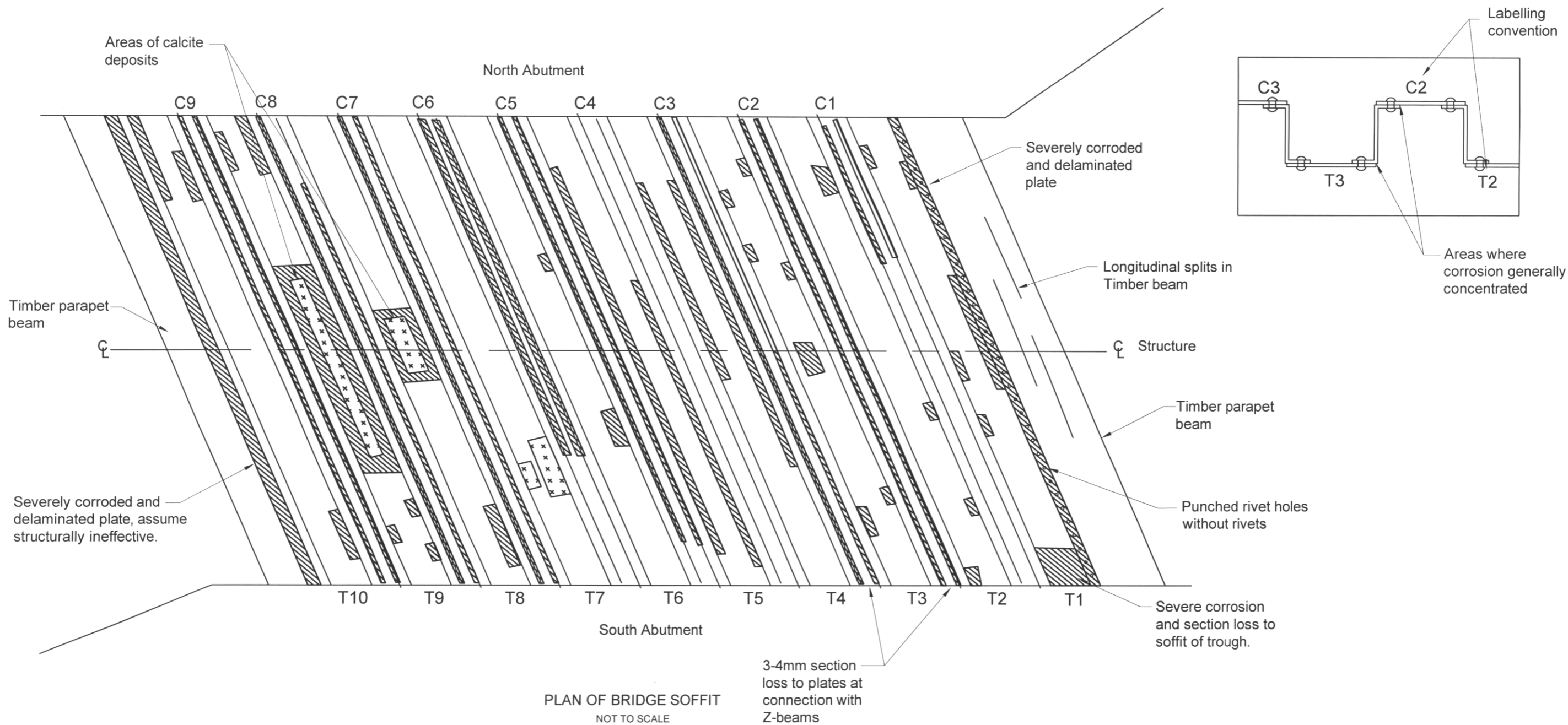
CAD PATH: P:\2K\2116\pro\acaduser\frames.dwg (Printed at 11:23 02/04/2002)



Key Plan:

 Areas of significant corrosion of steel,

 Significant calcite deposits



FOR INFORMATION

Appendix B – Assessment Calculations

Project Title	Rail Property Board - Bridge Assessments	Project Code:	2116
Calculation Title:	Dumpers Bridge B562	Serial No:	
Project Manager		No. of Sheets:	27
Status		Prepared by:	AM
Schematic <input type="checkbox"/>	Preliminary <input type="checkbox"/>	Date:	06/03
Tender <input type="checkbox"/>	Other (state) <input checked="" type="checkbox"/>	Checked by:	AC
Final for Construction <input type="checkbox"/>	ASSESSMENT	Date:	10/03

Levels of Verification		Approved by:	AW
1 Self-check by originator and approval <input type="checkbox"/>	3B Comparison with similar proven designs and approval <input type="checkbox"/>	Date:	11/03
2 Calculation Review and approval <input type="checkbox"/>	4 External check and internal approval <input type="checkbox"/>	Computer Analysis: Yes: X No: Program(s): EXCEL Hardware:	
3 Detailed check and approval <input type="checkbox"/>	5 Other verification as stated in Management Plan <input checked="" type="checkbox"/>		
3A Alternative calculations and approval <input type="checkbox"/>	Cat 2 - Client Required		

Contents (continue on calculation sheet if necessary)

1.0 Summary.
 2.0 → 2.1 Description of Structure.
 3.0 References.
 4.0 → 4.1 Assumptions.
 5.0 → 5.8 Loading
 6.0 → 6.5 Moment Capacity
 7.0 → 7.1 Shear Capacity.
 8.0 Rivet Capacity.
 9.0 Accidental Wheel Load.
 10.0 Conclusion.

NB: Calculations should state or refer to design input data and methodology

CONTENTS AMENDMENT RECORD

Rev	Status	Date	Description	Page	By	Chk'd	App'd

No:	1.0.	Rev:	
By:	AM	Date:	06/03
Check by:	AC	Date:	10/03

Project: RAIL PROPERTY BOARD ASSESSMENTS

Subject: DUMPERS STATION BRIDGE B562

References/Results

Summary:

The overall strength of the trough deck is 40T ALL, The edge troughs have a 3T ALL capacity.

The timber edge beams are considered to be inadequate from inspection.

The Key Clamp parapet with wire mesh infill was in good condition but would not meet the required containment standards.

The vertical profile of the carriageway is steep on the approaches and flat over the bridge deck. There is a definite 'crease' transversely in the carriageway indicating the edge of the troughing deck. Axle Tilt-off is possible because the profile is considered 'hump back'.

Project: RAIL PROPERTY BOARD ASSESSMENTS

By:

AM

Date:

06/03

Subject: DUMPERS STATION BRIDGE B562

Check by:

AC

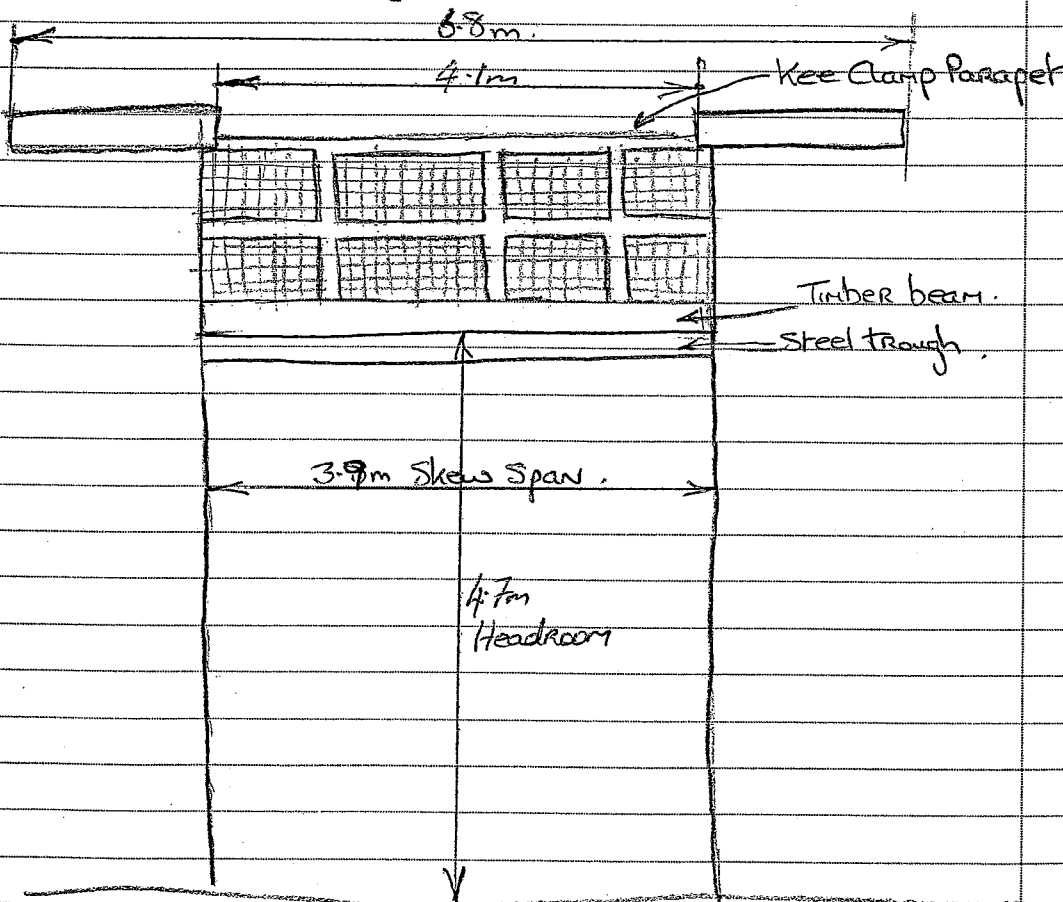
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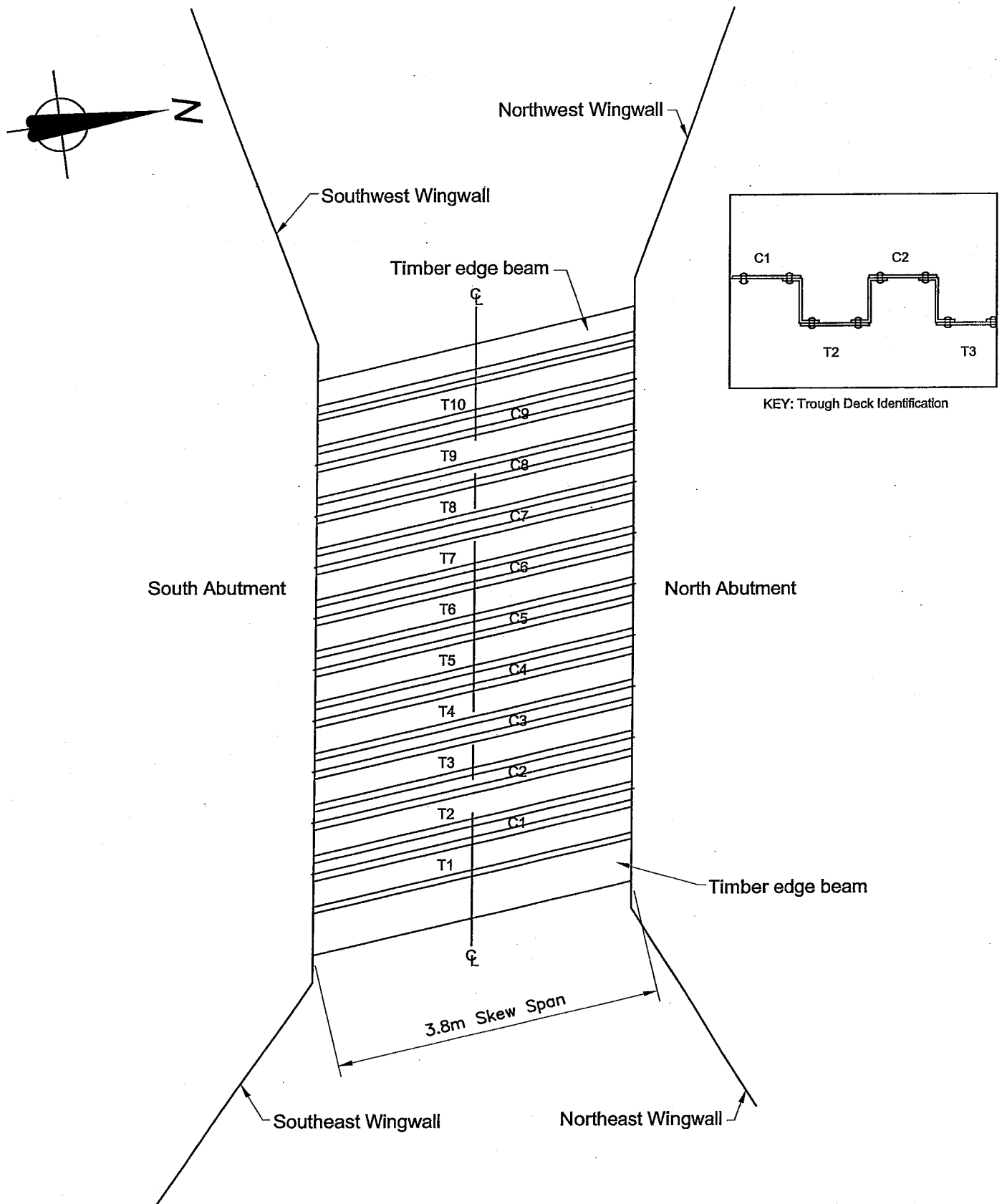
10/03

References/Results

Description of Bridge.

Dumpees Bridge consists of a steel trough deck which spans between stone abutments. The wingwalls are constructed of brick. Kee Clamp parapets with wire mesh infill are supported on timber beams. The vertical alignment over the bridge is significant and axle lift-off is possible. The trough deck is encased in concrete over the abutments but the poor composition of this concrete and lack of fill material above the troughing dictates that the deck should be analysed as being simply supported.





Plan View of Bridge Soffit

Not To Scale

Project: RAIL PROPERTY BOARD ASSESSMENTS

By:

AM

Date:

06/03

Subject: DUMPERS STATION BRIDGE B562

Check by:

Ac

Date:

10/03

References/Results

References

BA 16/97 : 'The assessment of Highway Bridges and Structures'

BD 21/01 : 'The assessment of Highway Bridges and Structures'

BD 56/96 : 'The assessment of steel Highway Bridges and Structures'

'BA 56/96 : 'The assessment of steel Highway Bridges and Structures'

Project: RAIL PROPERTY BOARD ASSESSMENTS

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Check by:

AC

Date:

10/03

References/Results

Assumptions for Assessment.

- In the absence of definite information a characteristic yield stress of 230 N/mm^2 may be assumed for steel produced before 1955. BD 21/01 cl 4.3.
- Assume deck acts simply supported, concrete encasing above abutments inadequate to provide full restraint.
- Depth of fill material based on average levels above exposed trough beam (exposed in trial holes)
- Assume that timber beam is insufficient to resist accidental wheel load.
- Axle-lift off is possible because of the 'hump back' profile of the bridge.
- Assume rivet dimensions (shaft diameter = 22.5 mm) as shown on drawings.
- Road surfacing 100 mm in depth & remaining fill = miscellaneous material.
- Parapets inadequate against required containment.
- Assume unexposed steel (those troughs containing concrete) are uncorroded & no loss of section.
- Average section loss accounted for in assessment.
- Cl 9.1 of BA 16/97 - grillage not required; edge of carriage way > 3 webs of troughing away from edge.

9. TROUGH DECK BRIDGES

Analysis

9.1 The BD 21 (DMRB 3.4.3) rules regarding the dispersal of live load to a number of troughs are considered to be adequate or conservative for bridges where the carriageway is at least 3 webs of troughing away from the edge. However, where live loading is required to be closer to the edge, a grillage analysis, with each web and its associated flanges modelled individually, is recommended. Grillage analysis is also recommended for bridges of spans of 4m or less and for bridges with transversely spanning troughs having a fill depth of 300 mm or more. In these latter cases, the BD 21 (DMRB 3.4.3) rules may be unconservative.

Transverse Bending Rigidity

9.2 When using a grillage analysis, in areas of the deck where the transverse bending moment is sagging, the transverse bending rigidity may be enhanced in alternative elements to take account of the composite action of the concrete trapped within the webs.

Compact/Non-compact Designation

9.3 The sections of Lindsay troughing as adopted by Dorman Long are considered to be essentially compact. Built up sections, however, may not be. In such cases, it may still be possible to calculate the ultimate resistance of members using the plastic modulus of the section provided it is certain that the fill will provide restraint against buckling after the onset of plastic flow.

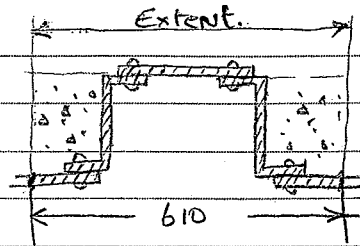
Project: RAIL PROPERTY BOARD ASSESSMENTS

By:
AMDate:
06/03

Subject: DUMPERS STATION BRIDGE B562

Check by:
AcDate:
10/03Loading:

Dead Load —



References/Results

1) Selfweight of Trough deck per trough

Unit weight of steel = 7850 kg/m^3 .Area of steel / metre width = $17.48 \times 10^3 \text{ mm}^2$ + 5% for rivets etc = $0.874 \times 10^3 \text{ mm}^2$.

$$\text{Loading} = (7850)(9.81)(17480 + 874) \times 10^{-9} = 1.413 \text{ kN/m}$$

BD 21/01
T4.1

2) Weight of Miscellaneous fill above deck

Unit weight of miscellaneous fill = 2200 kg/m^3 .Average depth of fill = 75 mm .

$$\text{Loading} = (2200)(9.81)(75 \times 610) \times 10^{-9} = 0.99 \text{ kN/m}$$

T4.1

3) Weight of Bitumen Surfacing

Unit weight of Macadam = 2400 kg/m^3 Average depth of surfacing = 100 mm .

$$\text{Loading} = (2400)(9.81)(100 \times 610) \times 10^{-9} = 1.436 \text{ kN/m}$$

T4.1

4) Weight of Concrete fill

Unit weight of Concrete = 2300 kg/m^3 .Area of concrete = 61.048 mm^2 .

$$\text{Loading} = (2300)(9.81)(61.048) \times 10^{-9} = 1.377 \text{ kN/m}$$

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By:	AM	Date:	06/03
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Project: RAIL PROPERTY BOARD ASSESSMENTS

Subject: DUMPERS STATION BRIDGE B562

References/Results

Live loading -

BD 21/01
clb-10

Carriageway width = 3.2m
= 1 national lane of 2.5m

Type HA Live loading UDL shall be taken as two longitudinal strip loads and the KEL as two wheel loads applied in each national lane. HA shall be derived by dividing UDL & KEL values of ALIL by 2.

Clear span = 3.8m

Assuming a triangular pressure distribution at the abutment, take $L = 3800 + \frac{2}{3}(220) = 3947$ say 4000mm

UDL - $W = 336 \left(\frac{L}{L} \right)^{0.67}$

cl 5.18

$L = 4m$

$W = 132.73 \text{ kN/m}$ of lane width 3.65m.

UDL = 132.73 kN/m.

KEL = 120 kN.

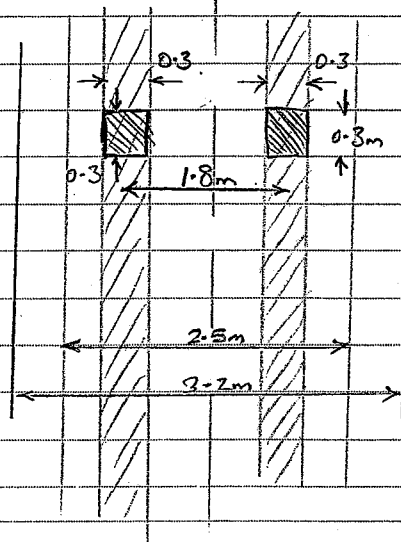
Adjustment Factor (AF) for UDL & KEL

cl 5.23.

$L = 4$ $0 < 4 \leq 20$

$a_L = 3.65m$.

$AF = a_L / 2.5 = 3.65 / 2.5 = 1.46$.



No: 5.2

Rev:

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References/Results

$$\text{Adjusted UDL} = 132.73 / 1.46 = 90.911 \text{ kN/m}$$

$$\text{KEL} = 120 / 1.46 = 82.192 \text{ kN}$$

HA loading applied to each strip in national lane
UDL

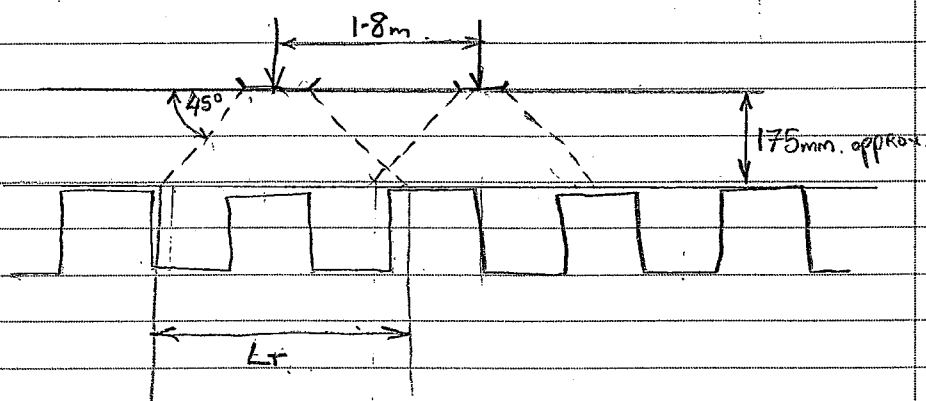
$$\rightarrow 90.911 / 2 = 45.46 \text{ kN/m over } 0.3 \text{ m wide strip}$$

KEL

$$\rightarrow 82.192 / 2 = 41.1 \text{ kN over } (0.3 \times 0.3) \text{ strip}$$

Dispersal and Distribution of loads.

cl 6.10, 6.11.

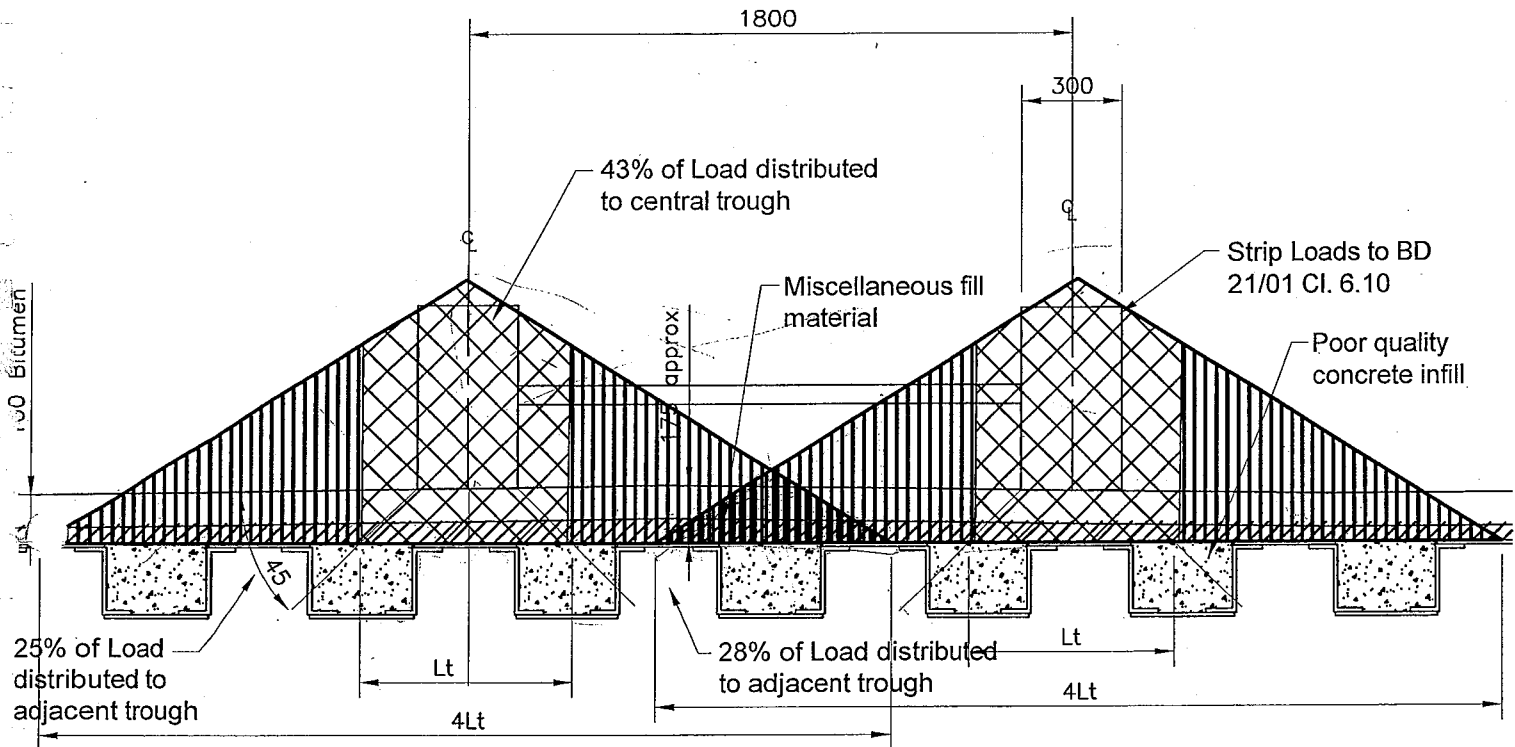


Load can be assumed to be carried by width of
troughing = $4L_t$ provided it is adequately connected.

From AutoCAD drawing on pg 5.3, percentage of
loading affecting trough under consideration.

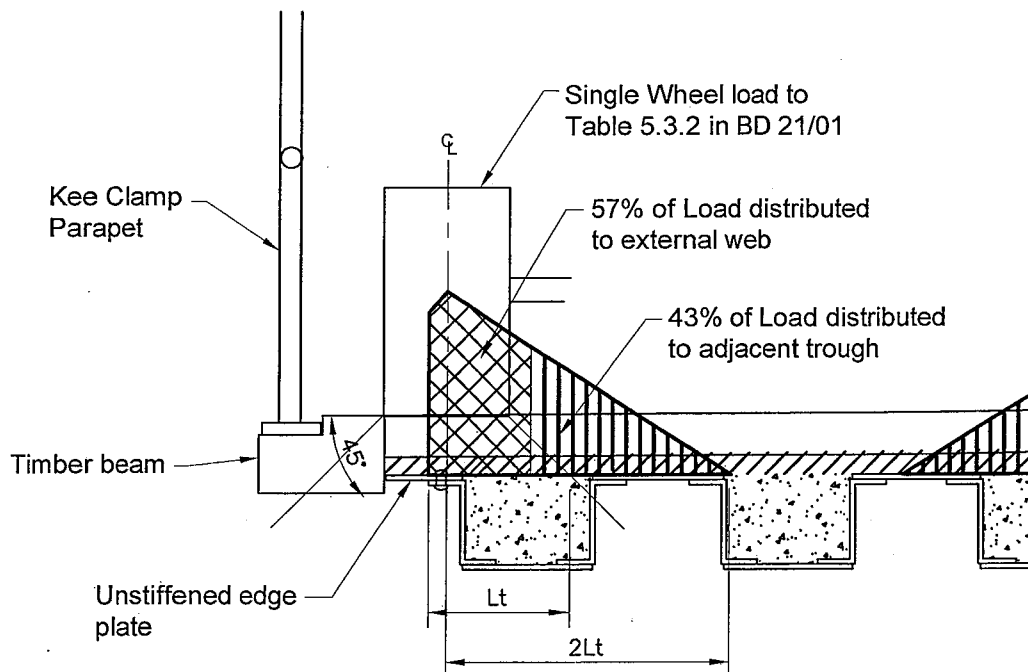
Central trough $\rightarrow 43\%$

Adjacent troughs $\rightarrow 25, 28\%$



Dispersal of Strip Loads to Trough Deck

NOT TO SCALE



Dispersal of Single Wheel Load to Trough Deck

NOT TO SCALE

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References/Results

Summary of Loadings γ_{FL} taken from Table 3.1 BD 21/01

Description	Load (kN/m)	γ_{FL}	Factored Load (kN/m)	
Dead.:				
Steel Trough	1.413	1.05	1.484	pg 5.0
Miscellaneous Fill	0.99	1.2	1.188	pg 5.0
Surfacing	1.436	1.75	2.513	pg 5.0
Concrete Fill	1.377	1.15	1.584	pg 5.0
<u>Total Dead Load</u>	<u>5.216</u>	<u>—</u>	<u>6.769</u>	
Live :				
UDL	45.46	1.5	68.19	pg 5.2
KEL	41.1 kN.	1.5	61.65 kN.	pg 5.2
<u>Total Live Load</u>	<u>—</u>	<u>—</u>	<u>—</u>	
<u>Total Load (UDL)</u>	<u>50.676</u>	<u>—</u>	<u>74.959</u>	
Single Wheel -40 T ALL	90 kN.	1.5	135 kN.	pg 5.7
Single Wheel -3 T ALL	21 kN.	1.5	31.5 kN	pg 5.8

Project: RAIL PROPERTY BOARD ASSESSMENTS

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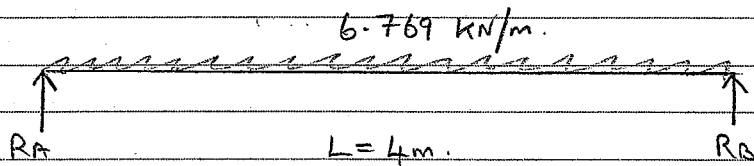
Check by: AC

Date: 10/03

References/Results

Bending Moments & Shear Forces on Trough Section
under Dead + Live Loading.

Span = 4m.



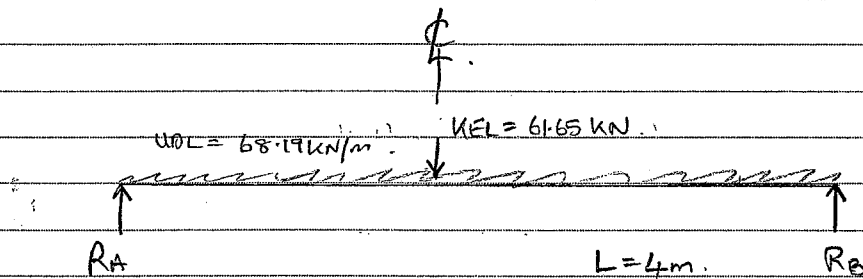
DEAD LOAD ONLY

$$R_A = 13.538\text{ kN}$$

$$R_B = 13.538\text{ kN}$$

$$M_{\text{max}} = 13.538\text{ kN}$$

$$SF_{\text{max}} = 13.538\text{ kN}$$



LIVE LOAD ONLY

$$R_B = \frac{[68.19(4)(2) + (61.65)(2)]}{4} = 167.205\text{ kN}$$

$$R_A = 167.205\text{ kN}$$

$$M_{\text{max}} = 167.205(2) - 68.19(2)(1) = 198.03\text{ kNm}$$

$$SF = 167.205\text{ kN}$$

Max SF when KEL over support.

$$SF_{\text{max}} = 198.03\text{ kN}$$

$$M_{\text{om}} = 136.38\text{ kNm}$$

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Check by:

Ac

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References/Results

Maximum Combined Bending Moment:

Dead BM $\rightarrow 13.538 \text{ kNm}$

pg 5.5

Live BM $\rightarrow (198.03) (0.43)$ Distribution of loads

pg 5.5

Total BM $\rightarrow 98.691 \text{ kNm}$ BM_{max} = 98.691 kNm

Maximum Combined Shear Force:

Dead SF $\rightarrow 13.538 \text{ kN}$ Live SF $\rightarrow 198.03 (0.43)$ Distribution of loadsTotal SF $\rightarrow 98.691 \text{ kN}$ SF_{max} = 98.691 kNSingle Wheel Load

Nominal Single wheel loads in Table 5.3.2.

cl 5.32

The Carriageway under consideration is lightly trafficked therefore a value of 90 kN shall be used for the nominal single wheel load from table 5.3.2. (40T ALL)

Wheel Contact Area

cl 5.33

load shall be uniformly distributed over a square contact area, with an effective pressure of 1.1 N/mm^2 .

$$P = F/A$$

$$P = 1.1 \text{ N/mm}^2, F = 90,000 \text{ N}, A = (300 \times W)$$

$$W = F/P(305) = 272.73 \text{ say } 275 \text{ mm}$$

Take single wheel as point load for assessment.

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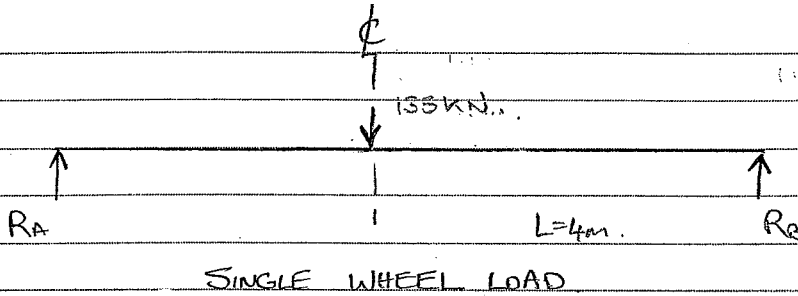
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References/Results



Nominal Single wheel load = 90 kN

Factored wheel load = 135 kN

pg 5.4

$$R_B = 67.5 \text{ kN}$$

$$R_A = 67.5 \text{ kN}$$

$$BM_{\max} = 135 \text{ kNm}$$

$$SF_{\max} = 135 \text{ kN (when load at support)}$$

Distribution of single wheel load (see drawing on page 5.3) = 57%

Maximum Combined Bending Moment due to Single Wheel Loading:

$$\text{Dead} \rightarrow 13.538 \text{ kNm}$$

$$\text{Live} \rightarrow 135 (0.57) \quad (\text{Distribution of loads})$$

pg 5.5

$$\text{Total} \rightarrow 90.488 \text{ kNm}$$

$$BM_{\max} = 90.488 \text{ kNm}$$

$$\text{Max. Shear Force} = 90.488 \text{ kN}$$

$$SF_{\max} = 90.488 \text{ kN}$$

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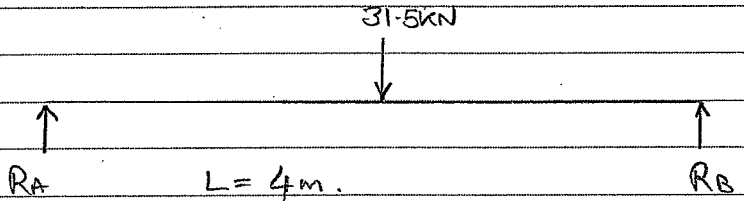
References/Results

Nominal Single Wheel Load - 3T ALL

BD 21/01.

Single wheel load = 21 kN

TS.3.2



$$R_A = R_B = 15.75\text{ kN.}$$

$$BM_{\text{max}} = 31.5\text{ kNm.}$$

$$SF_{\text{max}} = 31.5\text{ kN.}$$

Taking 57% distribution of load as before - total combined Bending Moment for 3T ALL

$$\text{Dead} \rightarrow 13.538\text{ kNm.}$$

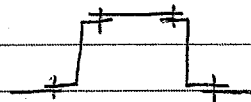
$$\text{Live} \rightarrow 31.5(0.57)$$

$$\text{Total} \rightarrow 31.493\text{ kNm.}$$

$$31.493 < 32.207\text{ kNm. (pg 6.4)}$$

Single Z-beam has a 3T capacity for single wheel loading.

Single wheel loading for double Z-beam including connecting plates

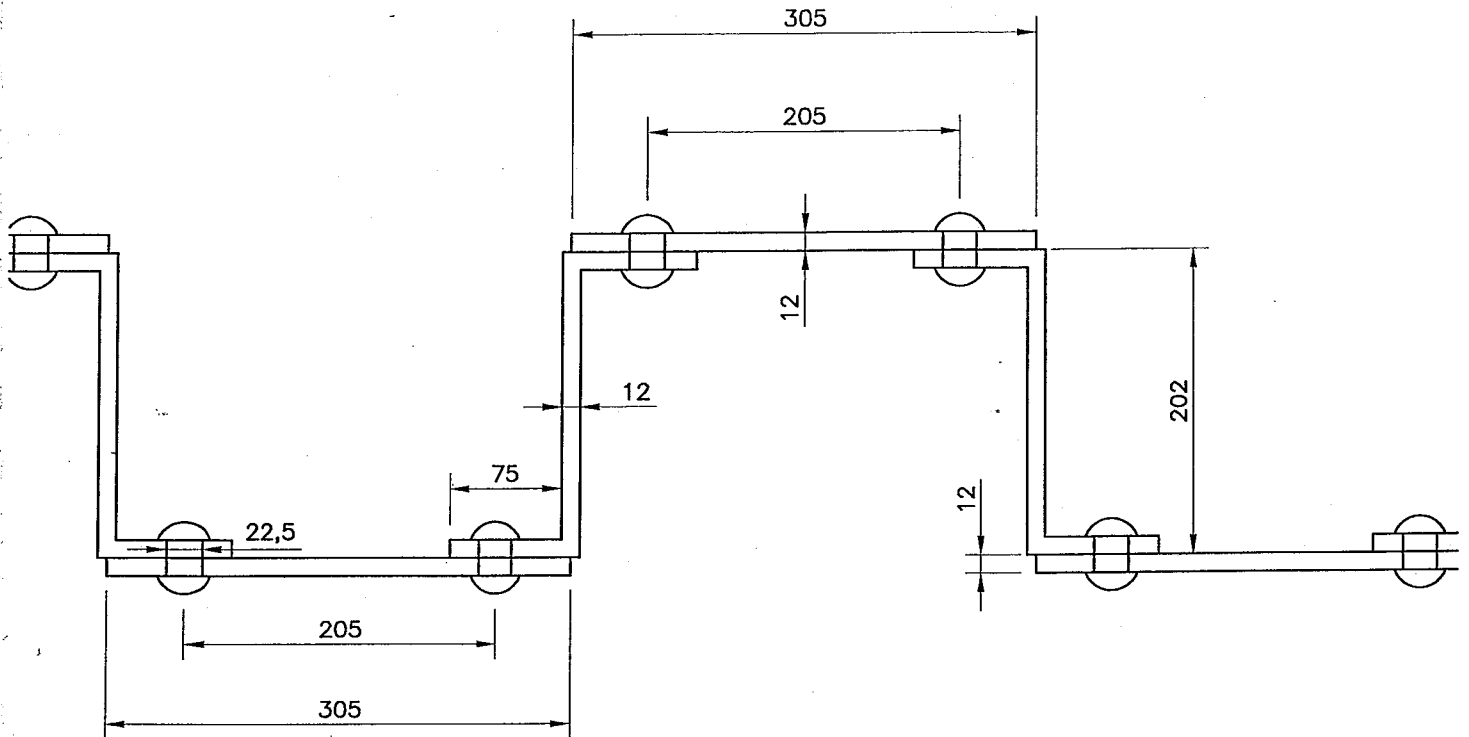


$$Z_{pe} = 844.3 \times 10^3\text{ mm}^3$$

$$M_0 = 147.113\text{ kNm. (pg 6.5)}$$

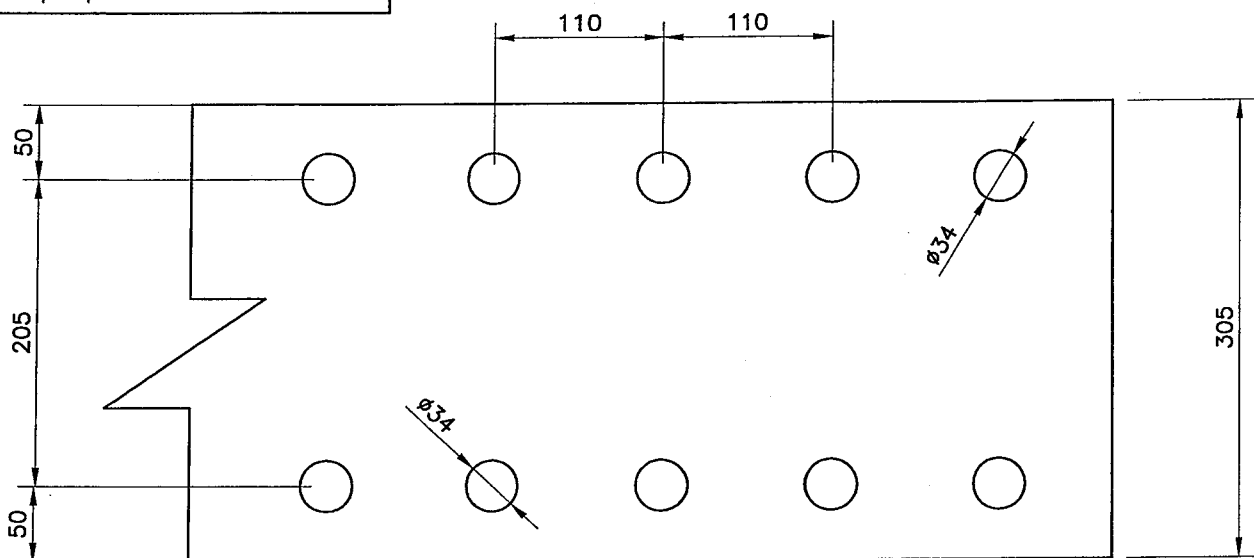
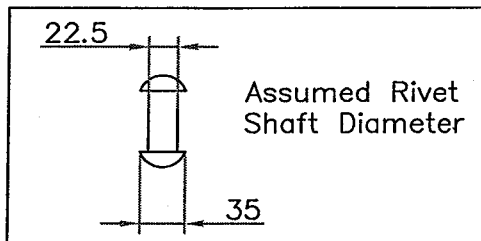
$$147.113\text{ kNm} > 90.488\text{ kNm}$$

Double Z-beam trough section has 40T single wheel capacity.



Trough Deck Elevation

SCALE 1: 5



Trough Deck Plan

SCALE 1: 5

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AC

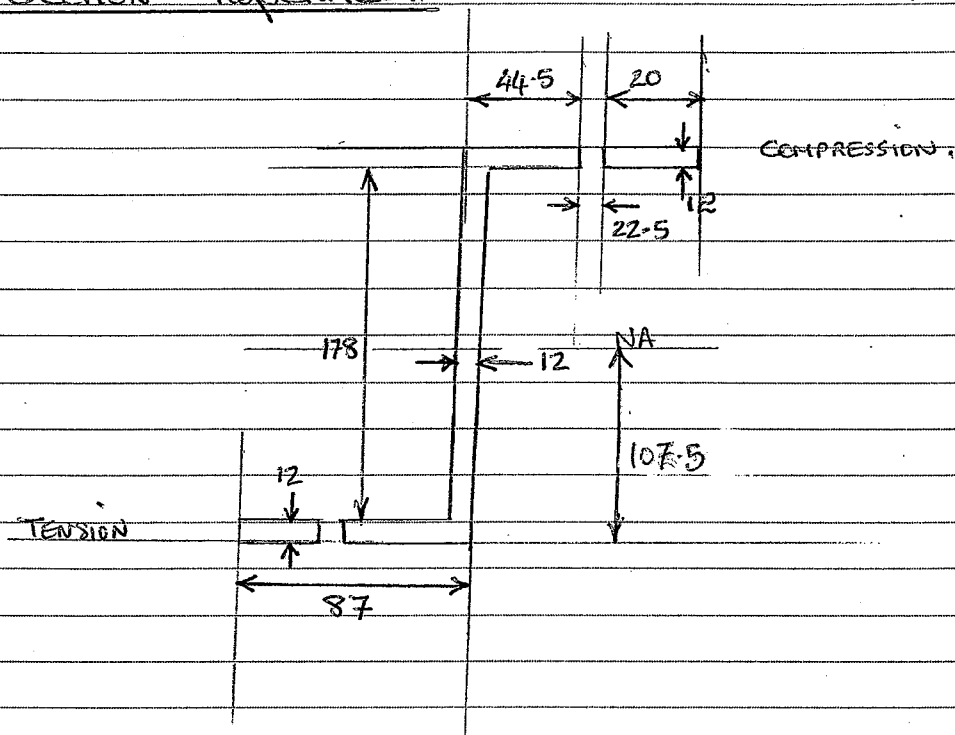
Date:

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References/Results

Section Properties.

BD 56/96



Deduction for holes

cl 9.4.2.2

Holes in tension shall be deducted

cl. 11.3.3

Holes in compression where rivets are used need not be deducted.

cl 10.5.2

Gross X-Sectional area = $4,224 \text{ mm}^2$ Nett X-Sectional area = $3,954 \text{ mm}^2$ Position of Neutral axis (NA) = 107.5 mm $I_{xx} = 219,026,245 \text{ mm}^4 = 21.903 \times 10^6 \text{ mm}^4$ $I_{yy} = 780,256,125 \text{ mm}^4 = 780.256 \times 10^3 \text{ mm}^4$ $S_p = 184,839 \text{ mm}^3 = 184.839 \times 10^3 \text{ mm}^3$ (plastic modulus) $Z_T = 231,773,804 \text{ mm}^3 = 231.774 \times 10^3 \text{ mm}^3$ (elastic mod) $Z_B = 203,745,344 \text{ mm}^3 = 203.745 \times 10^3 \text{ mm}^3$ (elastic mod)

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Subject: DUMPERS STATION BRIDGE B562

References/Results

BD 56/96.

Characteristic yield stress $\sigma_{yc} = 230 \text{ N/mm}^2$.

Flanges - Outstands in Compression.

For an unstiffened outstand $b_{fo} / t_{fo} \not\geq 12 \sqrt{355 / \sigma_{yc}}$

cl 9.3.2.1.

$$b_{fo} = 20 + 22.5/2 = 31.25 \text{ mm.}$$

$$t_{fo} = 12 \text{ mm.}$$

$$\sigma_{yc} = 230 \text{ N/mm}^2.$$

$$31.25/12 = 2.6 \not\geq 12 \sqrt{355/230} = 14.91.$$

Flanges comply.

Outstands in tension - not applicable

cl 9.3.2.2.

Compact Sections.

Webs partly in compression & partly in tension

cl 9.3.7.2.1.

The depth between the elastic neutral axis of the beam & the compressive edge of the web should not exceed

$$28 t_w \sqrt{\frac{355}{\sigma_{yw}}}$$

$$t_w = 12 \text{ mm.}$$

$$\sigma_{yw} = 230 \text{ N/mm}^2.$$

$$D = (178 + 12) - 107.5 = 82.5 \text{ mm.}$$

$$82.5 \not\geq 28(12) \sqrt{\frac{355}{230}} = 417.44 \text{ mm}$$

Web is compact.

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References/Results

Compression Flange Outstands

The projection of a compression flange outstand b_{fo} should not exceed:

$$7 t_{fo} \sqrt{\frac{355}{\sigma_{yf}}}$$

$$t_{fo} = 12 \text{ mm}$$

$$\sigma_{yf} = 230 \text{ N/mm}^2$$

$$b_{fo} = 31.25 \text{ mm}$$

$$31.25 \not\geq 7(12) \sqrt{\frac{355}{230}} = 104.36 \text{ mm}$$

Flange is Compact.

Section is Compact.

Effective SectionEffective Compressive flange $A_e = A_c$

cl 9.4.2.4.

Effective web $t_{we} = t_{wi} = 12 \text{ mm}$

cl 9.4.2.5.1.

Effective Length for Lateral Torsional Buckling

L-beams fully restrained along compression flange by riveted plate.

$$l_e = 0$$

Limiting Compressive Stress $= \sigma_y = 230 \text{ N/mm}^2$

cl 9.8.2.

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References/Results

Bending Resistance - Beams without longitudinal stiffeners.

Compact - Sections.

9.9.1.2

$$M_D = \frac{Z_{pe} \sigma_{tc}}{\gamma_m \gamma_{f3}}$$

$$Z_{pe} = 184.839 \times 10^3 \text{ mm}^3$$

$$\sigma_{tc} = 230 \text{ N/mm}^2$$

$$\gamma_m = 1.2$$

$$\gamma_{f3} = 1.1$$

T2 8056/96.

$$M_D = \frac{(184.839 \times 10^3)(230)}{1.2 \times 1.1} = 32.207 \times 10^6 \text{ Nmm}$$

$$= 32.207 \text{ kNm.}$$

32.207 kNm < 90.488 kNm for Single Wheel load pg 5.7.

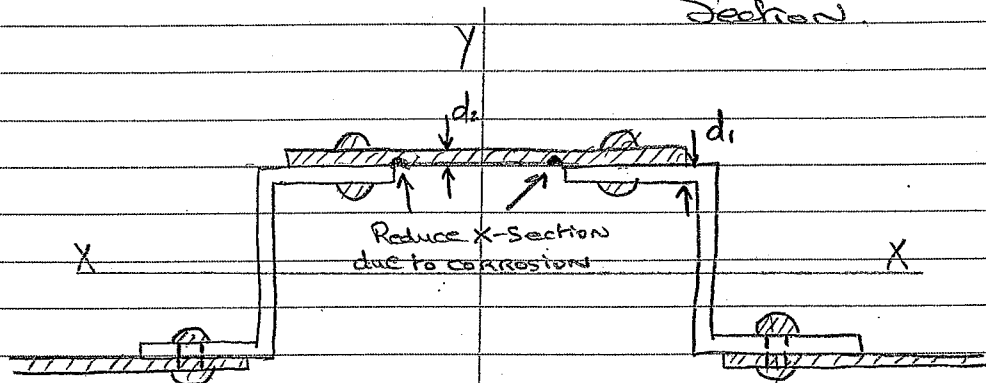
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References/Results

Section Properties of Double Z-beam Section



Reduce Depth of top & bottom plates due to corrosion, $d_2 = 8\text{mm}$
 Section loss around some rivets is localised & not considered in the assessment.

(Deduct holes in tension)

$$\text{Nett area} = 12,428 \text{ mm}^2$$

$$N.A = 116.2 \text{ mm}$$

$$I_{xx} = 93.356 \times 10^6 \text{ mm}^4$$

$$Z_{pe} = 844.3 \times 10^3 \text{ mm}^3 \quad (\text{plastic modulus})$$

Assuming section is compact and the effective length $\equiv 0$ as calculated previously.

$$M_0 = \frac{(844.3 \times 10^3)(230)}{(1.2 \times 1.1)} = 147.113 \text{ kNm}$$

$$147.113 \text{ kNm} > 98.691 \text{ kNm}$$

Internal Girder Section Properties

Overall Depth of Section (mm) = 218

Section	Breadth (mm)	Depth (mm)	Ax (mm ²)	Dx (mm)	1st Mom. (mm ⁴)	Centroid from Soffit	Yx (mm)	Ixx. (mm ⁴)	Iyy (mm ⁴)	Zp (mm ³)
1	87	12	1044	204	212976	116.2	87.8	8060556.96	658503	91663.2
2	12	178	2136	109	232824	116.2	-7.2	5750482.24	25632	15379.2
3	44.5	12	534	14	7476	116.2	-102.2	5583952.56	88121.125	54574.8
4	20	12	240	14	3360	116.2	-102.2	2509641.6	8000	24528
5	87	12	1044	204	212976	116.2	87.8	8060556.96	658503	91663.2
6	12	178	2136	109	232824	116.2	-7.2	5750482.24	25632	15379.2
7	44.5	12	534	14	7476	116.2	-102.2	5583952.56	88121.125	54574.8
8	20	12	240	14	3360	116.2	-102.2	2509641.6	8000	24528
9	305	8	2440	214	522160	116.2	97.8	23351222.93	18915083.33	238632
10	260	8	2080	4	8320	116.2	-112.2	26195880.53	11717333.33	233376
			12428		1443752			93356370.19	32192928.92	844298.4

Elastic Modulus Top Section 917056.682
Elastic Modulus Bottom Section = 803411.103

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References/Results

Shear Resistance of Trough Deck

Shear Resistance under pure shear

cl 9.9.2.2

$$V_o = \left[\frac{t_w (d_w - h)}{\gamma_m \gamma_{f3}} \right] \gamma_e$$

$$t_w = 12 \text{ mm}$$

$$d_w = 202 \text{ mm}$$

$$h = 0$$

 γ_e = limiting shear strength of web

$$\gamma_m = 1.05$$

$$\gamma_{f3} = 1.1$$

BS54/96.

Table 2.

To find γ_e :

$$\lambda = \frac{d_{we}}{t_w} \sqrt{\frac{\sigma_{yw}}{355}} = \frac{202}{12} \sqrt{\frac{230}{355}} = 13.55$$

$$m_{fw} = \frac{(\sigma_{yf})(b_{fo})(t_f)^2}{2(\sigma_{yw})(d_{we})^2(t_w)}$$

$$\sigma_{yf} = \sigma_{yw} = 230 \text{ N/mm}^2$$

$$t_f = t_w = 12 \text{ mm}$$

$$b_{fo} = 81 \text{ mm}$$

$$d_{we} = 202 \text{ mm}$$

$$m_{fw} = \frac{(230)(81.0)(12)^2}{2(230)(202)^2(12)} = 0.012 \sim 0.01$$

$$b_{fe} = 10 t_f \sqrt{355 / \sigma_{yf}} = 10(12) \sqrt{355 / 230} = 149.08 \text{ mm}$$

$$\text{or } b_{fe} = 81 \text{ mm}$$

$$\text{or } t_{fe} = 152.5 \text{ mm}$$

$$\phi = 9 / d_{we} = \frac{400}{202} = 19.8 \sim 20$$

$$\gamma_u / \gamma_y = 1.0$$

$$\gamma_y = \sigma_{yw} / \sqrt{3} = 230 / \sqrt{3} = 132.79 \text{ N/mm}^2$$

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References/Results

$$\sigma_c = 132.79 \text{ N/mm}^2$$

$$V_0 = \left[\frac{12(202)}{1.05(1.1)} \right] 132.79 = 278.7 \text{ kN}$$

Shear Capacity of Single web = 278.7 kN.

$$SF_{\text{max}} = 98.691 \text{ kN} / 2 = 49.35 \text{ kN!}$$

pg 5.6.

Shear force on Single web from Single wheel load = 90.488 kN. (pg 5.7)

$$90.488 \text{ kN} < 278.7 \text{ kN} \quad \text{ok}$$

Single & double webs have sufficient shear capacity.

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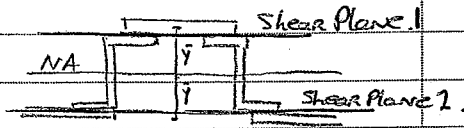
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References/Results

Shear Flow

$$V_f = \frac{VA\bar{y}}{I}$$



$$V = 98.691 \text{ kN. (40 T ALL)}$$

$$A = 2440 \text{ mm}^2$$

$$\bar{y} = 130 \text{ mm}$$

Consider Shear Plane 1.

$$I = 93.356 \times 10^6 \text{ mm}^4$$

Pg. 6.6

$$\text{Shear Plane 1: } V_f = \frac{1/2(98.691 \times 10^3)(2440)(130)}{93.356 \times 10^6} = 167.663 \text{ N/mm}$$

10 Rows of 2 Rivets per metre run = 20 Rivets.

$$\tau = V_f / n A_{eq} = 167.663 \times 10^3 / \left[20 \left(\frac{\pi (22.5)^2}{4} \right) \right] = 21.08 \text{ N/mm}^2 \text{ per Rivet. cl. 14.5.3.4}$$

$$\text{X-Sectional area of Rivet} = \frac{\pi (22.5)^2}{4} = 397.61 \text{ mm}^2$$

$$\sigma_y = 230 \text{ N/mm}^2$$

Assume shear flow similar across shear plane 2

Fasteners subjected to shear only

cl 14.5.3.4

$$\tau \text{ should not exceed } \sigma_y. \Rightarrow \frac{0.85(230)}{\gamma_m \gamma_{f3} \sqrt{2}} = 114.25 \text{ N/mm}^2$$

$$\sigma_y = 0.85 \sigma_y \text{ for hand driven Rivets} = 195.5 \text{ N/mm}^2$$

$$21.08 \text{ N/mm}^2 < 114.25 \text{ N/mm}^2 \therefore \text{Rivets have 40 T ALL Capacity}$$

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References/Results

Accidental Wheel Loading

Since there are no barriers (ie kerbs, grass verge) to protect the edge beams of the structure, they are required to have adequate capacity to carry a full HA loading.

The capacity of the external Z-beam is 3T single wheel loading as calculated on pg 5.8.

The parapets are connected to timber beams which span simply supported between the abutments.

The timber beam is ^{partially} protected from a full wheel loading by the parapet. However, based on a qualitative assessment of the beam it does not have sufficient capacity.

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References/Results

Conclusion.

ALL capacity of Bridge elements:

- 1) External trough (single Z-beam) — 3T ALL (pg 5.8, 6.4)
- 2) Internal trough (whole section less Section loss) — 40T ALL (pg 6.5)
- 3) Shear Capacity of single web — 40T ALL (pg 7.1)
- 4) Shear Capacity of Double web — 40T ALL (pg 7.1)
- 5) Capacity of Rivets — 40T ALL (pg 8.1)

Appendix C – Form AA and Form AA/1

FORM 'AA' (BRIDGES)**GC/TP0356**

Appendix: 4

Issue: 1

ELR/ Bridge No: FFD 88m 48c

Revision: B (Nov 2000)

APPROVAL IN PRINCIPLE FOR ASSESSMENT

- | | |
|---|--|
| 1. Bridge/Line Name | Dumpers Bridge
Disused railway |
| 2. ELR/Bridge No. | FFD 88m 48c
County bridge number 562 |
| 2.1 Location and grid reference | Unclassified County road over
disused rail bridge at OS grid
reference SP 173 011 |
| 3. Brief Description of Existing Bridge: | |
| 3.1 Span Arrangement: | Single span steel trough deck (built
up) on masonry abutments.
3.80m (skew span)
Skew 13° (approx) |
| 3.2 Superstructure Type: | Steel trough deck (built up) on
masonry abutments.

Timber beam supporting Kee-Clamp
parapet on both sides of bridge
Square width between parapets:
6.130m

Carriageway width: 3.200m
Verge widths: 1.550m and 1.600m |
| 3.3 Substructure Type: | Masonry abutments. Brick wing walls.
Foundations unknown |
| 3.4 Details of any Special Features: | None |
| 3.5 Statutory Undertakers Plant: | From the inspection and information
provided by statutory bodies there is
no reason to believe that any
apparatus will affect the assessment |

FORM 'AA' (BRIDGES)**GC/TP0356**

Appendix: 4

Issue: 1

ELR/ Bridge No: FFD 88m 48c

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APPROVAL IN PRINCIPLE FOR ASSESSMENT**4. Assessment Criteria****4.1 Loadings and Speed:**

Speed not applicable to assessment of superstructure.

HA Live assessment loading as detailed in BD21/01.

Unit weights of superimposed dead loads shall be in accordance with BD21/01.

Footway live loading not applicable to assessment.

Calculation of abnormal load capacity shall not be undertaken.

4.2 Codes to be used

BD 21/01 The Assessment of Highway Bridges and Structures

BA 16/97 The Assessment of Highway Bridges and Structures

BD 56/96 The Assessment of Steel Highway Bridges and Structures

BA 56/96 The Assessment of Steel Highway Bridges and Structures

4.3 Proposed Method of Structural Analysis

There are no record drawings available for this structure

The superstructure shall be analysed in accordance with BD 56/96. Simple load distribution and dispersal techniques for trough decks shall be used in accordance with Chapter 6 of BD 21/01. A diagram of the idealised structure is shown on page (vi)

Initially a simple analysis shall be carried out based on the layout of structural elements recorded from the inspection.

FORM 'AA' (BRIDGES)**GC/TP0356**

Appendix: 4

ELR/ Bridge No: FFD 88m 48c

Issue: 1

Revision: B (Nov 2000)

APPROVAL IN PRINCIPLE FOR ASSESSMENT

4.3 Proposed Method of Structural
Analysis (continued)

Calculation of section properties shall
consider any loss of section due to
corrosion.

Parameters to be used for
assessment:

Characteristic yield stress of steel
230N/mm² from Cl. 4.3, BD 21/01.

A qualitative assessment shall be
made of other parts of the structure.

The parapets will not be assessed.

4.4 Details of any Special
Requirements

None

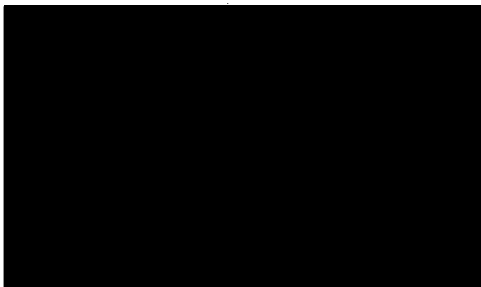
FORM 'AA' (BRIDGES)**GC/TP0356**

ELR/ Bridge No: FFD 88m 48c

Appendix: 4

Issue: 1

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APPROVAL IN PRINCIPLE FOR ASSESSMENT**5. THE ABOVE IS SUBMITTED FOR ACCEPTANCE**

le/Professional Qualification:

ENGINEER MICE CENG

te: 14 JULY 2003

6. Senior Civil Engineer's Comments

.....
None ..
.....
.....
.....

Proposed Category for Independent Check 1

Superstructure

Substructure

Name Of Checker Suggested If Cat 2 Or 3

FORM 'AA' (BRIDGES)**GC/TP0356**

Appendix: 4

ELR/ Bridge No: FFD 88m 48c

Issue: 1

Revision: B (Nov 2000)

APPROVAL IN PRINCIPLE FOR ASSESSMENT**Category 1**

The above assessment, with amendment

Signed

Title

Date

Category 2 and 3

The above assessment, with amendments shown, is approved in principle:

Signed

Title

Date

Signed

Title

Date

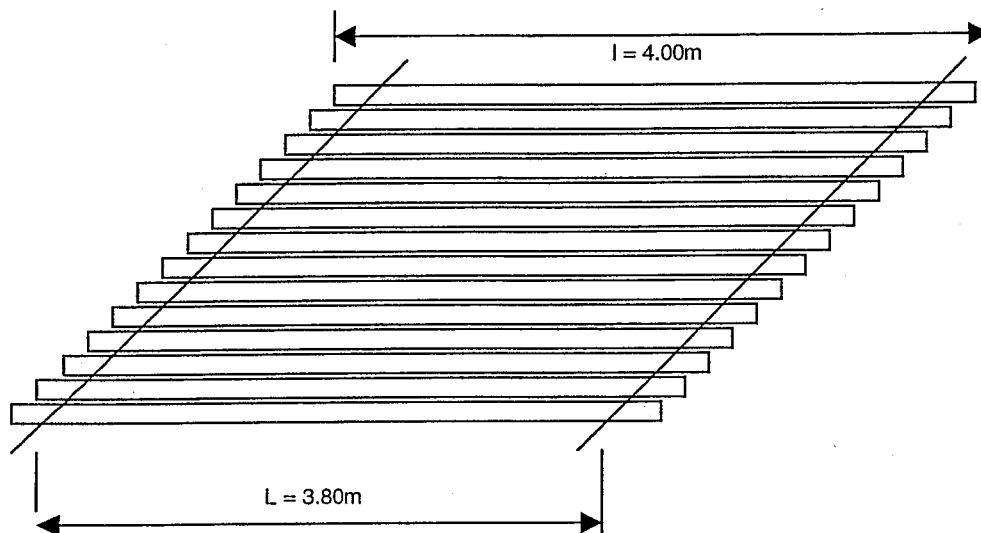
FORM 'AA/1' (BRIDGES)**GC/TP0356**

Appendix: 4

Issue: 1

ELR/ Bridge No: FFD 88m 48c

Revision: B (Nov 2000)

APPROVAL IN PRINCIPLE FOR ASSESSMENT**Diagram Showing the Idealised Structure****Parameters for Assessment:**

Span between points of support (I):	4.00m
Clear Span between abutments (L):	3.80m
Characteristic yield stress of steel:	230N/mm^2

FORM 'AA/1' (BRIDGES)**GC/TP0356**

ELR/ Bridge No: FFD 88m 48c

Appendix: 4

Issue: 1

Revision: B (Nov 2000)

APPROVAL IN PRINCIPLE FOR ASSESSMENT**Additional Information Required For BRB (Residuary) Limited Owned
Public Road Overbridges Assessed As Part Of Bridgeguard III**

- | | |
|--|---|
| 1. Bridge/Line Name | Dumpers Bridge
Disused railway line |
| 2. ELR/Bridge No. | FFD 88m 48c
County bridge number 562 |
| 3. Scope Of Assessment | Initially a simple analysis shall be carried out based on the layout of the structural elements recorded from the inspection.

A qualitative assessment of the spandrel walls, abutments and wingwall will be undertaken.

The parapets will not be assessed. |
| 4. Assessment Criteria | |
| (a) Standards And Codes Of Practice To Be Used In Assessment | BD 21/01 The Assessment of Highway Bridges and Structures

BA 16/97 The Assessment of Highway Bridges and Structures

BD 56/96 The Assessment of Steel Highway Bridges and Structures

BA56/96 The Assessment of Steel Highway Bridges and Structures |
| (b) Proposed Method Of Structural Analysis | There are no record drawings available for this structure.

The superstructure shall be analysed in accordance with BD 56/96. Simple load distribution and dispersal techniques for trough decks shall be used in accordance with Chapter 6 of BD 21/01. A diagram of the idealised structure is shown on page (vi) |

FORM 'AA/1' (BRIDGES)**GC/TP0356**

Appendix: 4

Issue: 1

ELR/ Bridge No: FFD 88m 48c

Revision: B (Nov 2000)

APPROVAL IN PRINCIPLE FOR ASSESSMENT

(b) Proposed Method Of Structural
Analysis (continued)

Calculation of section properties shall
consider any loss of section due to
corrosion.

Parameters to be used for
assessment:

Characteristic yield stress of steel
 230N/mm^2 from Cl.4.3, BD 21/01.

A qualitative assessment shall be
made of all other parts of the
structure.

The parapets will not be assessed.

(c) Planned Highway
Works/Modifications At This Site

There are no known planned highway
works/modifications at the site.

(d) Road Designation Class And
Whether Classed As A Heavy Load
Route

Unclassified County road

(e) Any Other Requirements

None

FORM 'AA/1' (BRIDGES)**GC/TP0356**

Appendix: 4

ELR/ Bridge No: FFD 88m 48c

Issue: 1

Revision: B (Nov 2000)

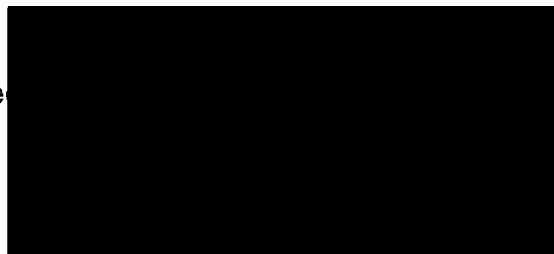
APPROVAL IN PRINCIPLE FOR ASSESSMENT

The Above Is Agreed Subject To The Amendments And Comments Shown Below.

*Signe

Title

Date



*A Team Leader, Consultant Or Chief Officer Employed By An Agent

Authority May Sign "For And On Behalf

Of".....Where Authorised To Do So.

**Structure: Dumpers Bridge
Grid Ref: SP 173 011
Date: December 2003**

CERTIFICATE OF ASSESSMENT AND CHECKING

**TECHNICAL APPROVAL FOR
ASSESSMENT OF BRIDGES AND OTHER BRIDGES**

1 Identification of Bridge

Name	Dumpers Bridge
Location and grid reference	SP 173 011
Engineers Line Reference	FFD 88m 48c

2 Certification of assessment and category I check

We certify that reasonable professional skill and care have been used by a competent person in the assessment and checking of the above structure with a view to securing that:-

- (i) it has been assessed and checked in accordance with the Approval in Principle as recorded on Form AA signed by J Clarke dated 11 August 2003
- (ii) the assessment and check comply with the following British Standards and Codes of Practice, with departures as shown:-

BD 21/01	The Assessment of Highway Bridges and Structures
BD 16/97	The Assessment of Highway Bridges and Structures
BD 56/96	The Assessment of Steel Highway Bridges and Structures
BA 56/96	The Assessment of Steel Highway Bridges and Structures

The unique numbers of the drawings used for the assessment are:

Inspection Details TB.2116.B758.SK02

The assessed capacity of the structure is as follows:-

- (a) Single span steel deck trough
3 Tonnes Assessment Live Loading (ALL)

Based on assumptions in the Assessment and Inspection Report (Document Ref. TB.2116.B559.Doc01)

This is a result of the edge trough sections being inadequate in bending under a Single Wheel Loading

GLOUCESTERSHIRE COUNTY COUNCIL
RAIL PROPERTY LTD BRIDGE ASSESSMENTS
DUMPERS BRIDGE FFD 88m 48c GCC No: B562

Sheet: 2 of 3

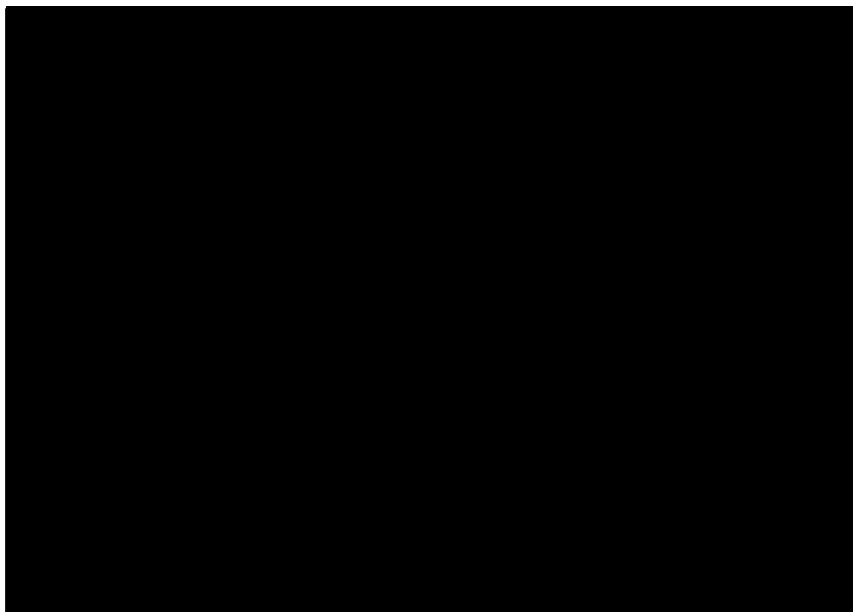
Structure: Dumpers Bridge
Grid Ref: SP 173 011
Date: December 2003

CERTIFICATE OF ASSESSMENT AND CHECKING

- (b) Wingwalls, abutments and foundations
All satisfactory based on a qualitative assessment.
- (c) Spandrel Wall
All Satisfactory based on a qualitative assessment.

The parapets were not assessed.

The HB capacity was not assessed.



n: Assistant Engineer

ent)

n: ENGINEER CENG

(To be signed by the person or team leader carrying out the category I check)

**GLOUCESTERSHIRE COUNTY COUNCIL
RAIL PROPERTY LTD BRIDGE ASSESSMENTS
DUMPERS BRIDGE FFD 88m 48c GCC No: B562**

Sheet: 3 of 3

**Structure: Dumpers Bridge
Grid Ref: SP 173 011
Date: December 2003**

CERTIFICATE OF ASSESSMENT AND CHECKING

3 Certification of categories II and III checks

(NB A category I check shall also be carried out in these cases)

We certify that reasonable professional skill and care have been used on the independent checking of the above structure with a view to securing that the criteria in Section 2 (i) and (ii) above have been met.

Name:.....

Title/Professional Qualification:.....

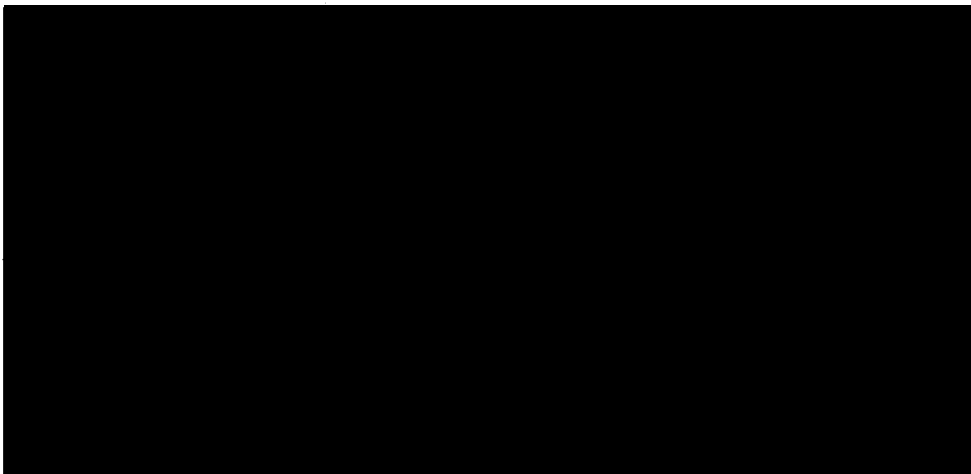
Signed:

Date:.....

(To be signed by the person or team leader carrying out the category II or III check)

4 Acceptance by the Technical Approval Authority

This certificate is accepted on behalf of Rail Property Ltd



g MICE