

NCC BRB Assessments

**Assessment Report**  
**60045644-010-AR-01**

*AKC*  
Bridge Name: **Rugley Railway**  
BRB Ref: *ACK/99*  
NCC Bridge No.: U3053/01RY

Northumberland County Council  
April 2009



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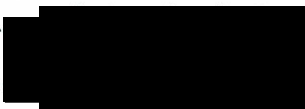
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# Report Preparation

Prepared by:

Name



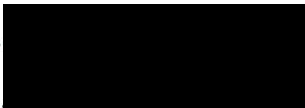
Title Engineer

Signed

Date 17-06-09

Checked by:

Name



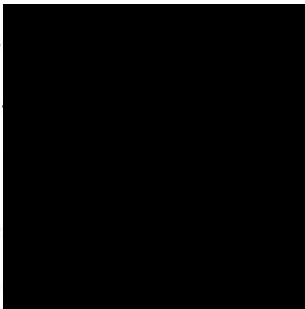
Title Senior Engineer

Signed

Date 17-04-09

Approved by:

Name



Title Regional Director

Signed

Date 17/04/2009

Accepted by M

Signed

Date 26/05/09

Accepted by B

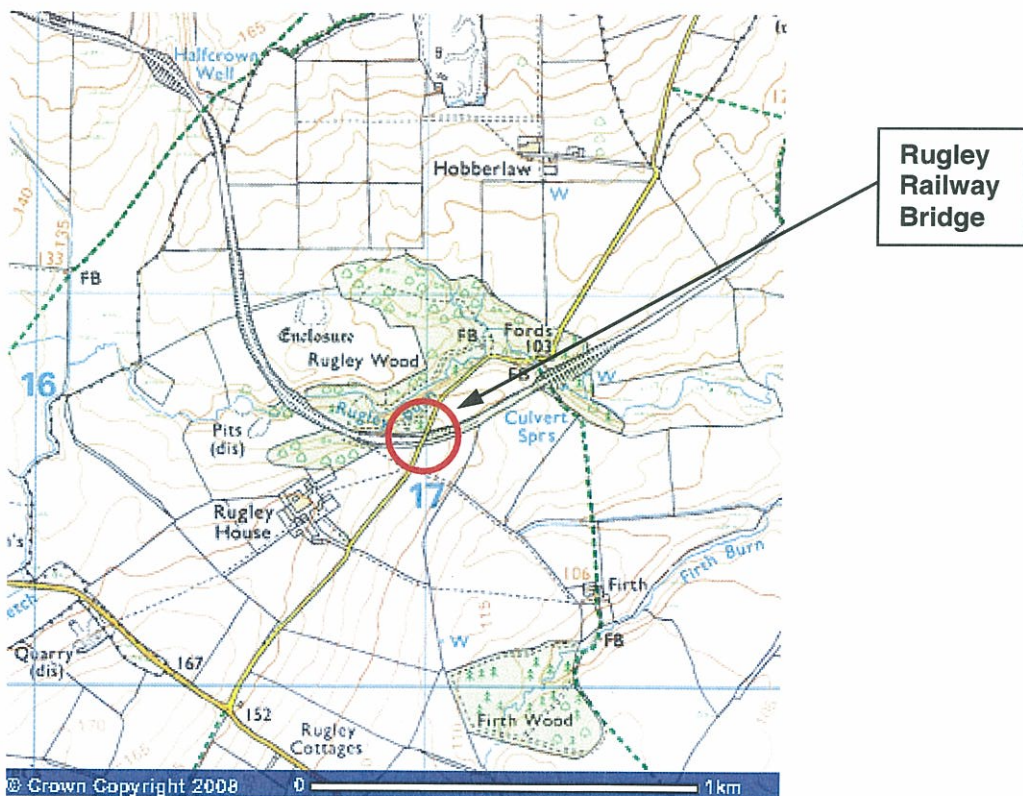
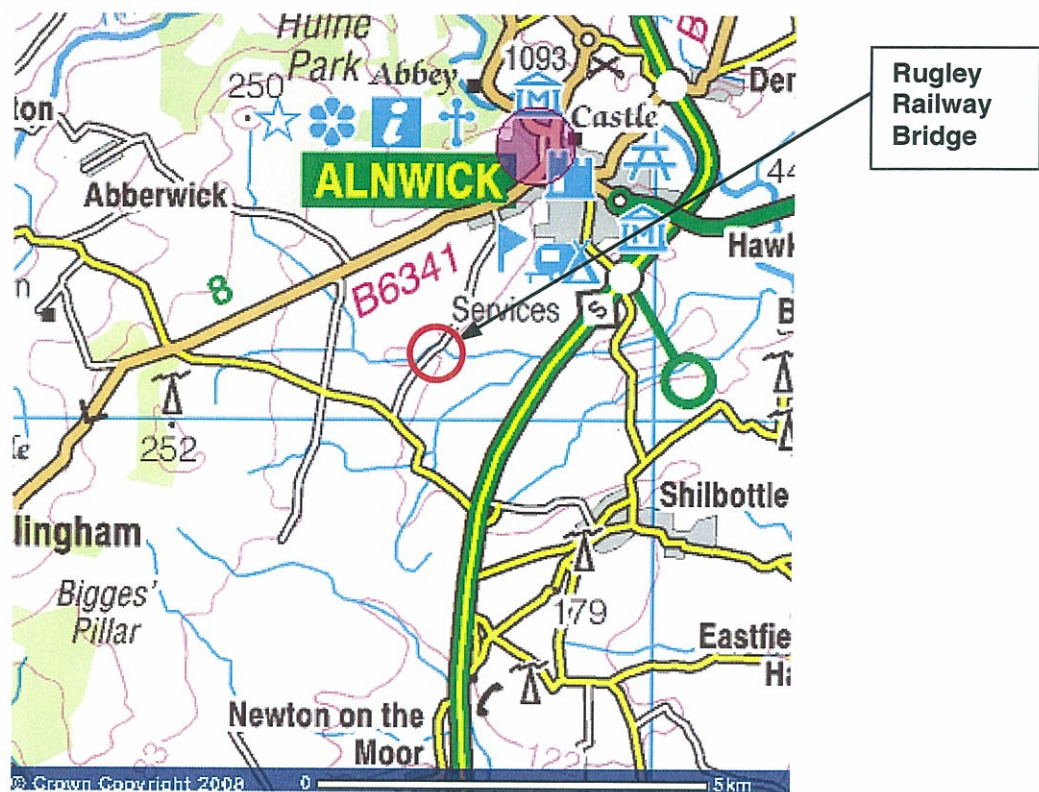
Signed

Date 4/8/09

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## Location Plans



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# Assessment Report

# 1 Details of Structure

## 1.1 General Description

Rugley Railway Bridge is a single span masonry arch bridge. The bridge carries the U3053, single track road, over a dismantled railway at OS Grid Reference: NU 170 106, between the C92 and the A697 to the Southwest of Alnwick in Northumberland. The orientation of the bridge is such that it runs in a Northeast Southwest direction.

The date of construction of the bridge is unknown. The highway carried over the structure is a two-way single track road 2.7m wide with verges either side, being 2.0m wide (South) and 2.9m wide (North), with a total width of 7.6m between parapets.

The bridge has a skew span of 11.05m at a skew angle of 11°. There is a square span of 10.8m between the abutments.

## 1.2 Deck Description

The arch has a circular profile and is constructed from bricks in a coursed helicoidal pattern. The arch barrel has irregular shaped stone voussoirs to the elevations.

A rise of the arch is 2.782m at mid-span and 2.203m at the quarter points. Archive data suggests that the arch barrel is 457mm (4 bricks) in thickness with mortar joints typically 10mm wide.

A level survey found the depth of fill above the arch at crown level to be 156mm (based on 457mm barrel).

The spandrel walls are constructed from random sized stone blocks brought to course.

The type of fill material is not known, but is assumed to be a well compacted fill.

## 1.3 End Supports

The abutments and wing walls are constructed from random sized rock faced stone brought to course. The wing walls run parallel to the bridge elevation.

## 1.4 Bearings and Articulation

The arch spans from stone imposts at springing level of the abutments.

## 1.5 Deck Ancillaries

### 1.5.1 Waterproofing Membrane

It is not known if a waterproof membrane exists over the structure, however there was very little evidence of water seepage to the arch barrel.

### 1.5.2 Parapets

The parapets are constructed from medium sized coursed stone blocks with a hammer dressed finish. The parapet height is approximately 1.1m above road level.

### 1.5.3 Surfacing

The road surfacing is of bituminous construction, the thickness of which is not known.

## 1.6 Drainage System

There is no drainage system in place for the bridge and no weep holes were observed to the abutments.

## 1.7 Services

The west verge appears to have a service duct encased with concrete installed at the surface. The type of services carried is unknown.



## 2 Archive Information

### 2.1

#### **Archive Information**

Bridge file including

- 1994 Assessment
- 2 Photos (date unknown)
- Bridge Information Sheet
- 2 Original Microfilm Drawings

## 3 Summary of Previous Assessment

### 3.1 Summary of Previous Assessment

Rugley Railway Bridge was assessed by Northumberland County Council in June 1994. The assessment was carried out using the modified MEXE method. The assessment found the arch barrel of the bridge to have a capacity of 40 tonnes. No calculations were carried out to determine the HB rating of the bridge. The bridge geometry used in this assessment differed to that used with the present assessment bringing into question the reliability of the archive assessment. The fill depth used was 600mm compared to the actual measured depth of 156mm.



## 4 Inspection for Assessment

### 4.1 Inspection Team and Equipment

The inspection for assessment was undertaken on foot on the 28<sup>th</sup> November 2000 by Northumberland County Council staff. The weather was wet.

A subsequent inspection was undertaken by Faber Maunsell staff on the 15<sup>th</sup> May 2008. The weather was dry and bright.

Access to the underside of the structure was obtained on foot via the embankments.

### 4.2 Results of the Inspection

#### 4.2.1 *Masonry Arch*

The inspection found the arch barrel to be in good shape with the mortar in the joints intact and in good condition. The arch barrel was found to be soot stained with evidence of water seepage and salt deposits.

#### 4.2.2 *Abutments and Wing Walls*

The abutments and wing walls were found to be largely in good condition with joints and stones intact and in good shape. The abutments showed signs of water seepage and a small amount of moss growth along with soot staining and some local surface deterioration only.

#### 4.2.3 *Foundations*

The foundations of the bridge are not visible and were not inspected. There are trees adjacent to the wing walls but there were no signs of undermining by roots.

The arch shape was found to be good and a level survey found the springing levels to be consistent, suggesting no major signs of differential settlement or movement of the foundations.

#### 4.2.4 *Parapet and Spandrel Walls*

The parapets and spandrel walls were generally found to be in good condition. The spandrel walls showed no signs of tilting or bulging.

#### 4.2.5 *Carriageway*

The road surface was in generally good condition with only minor surface break up to the edge of the carriageway.

# 5 Assumptions for Assessment

## 5.1 Loading

The structure will be assessed in accordance with clauses 6.15 and 6.16 of BD21/01 and for loading from Table 3/6 of BA16/97 for Load Capacity and Gross Vehicle Weight Restrictions for Masonry Arches.

An HB rating is not normally determined for arch structures; however, Network Rail Current Information Sheet 27 calculates an HB rating. This will be adopted for the assessment should the arch achieve 40t / 44t Assessment Live Loading.

## 5.2 Superstructure

For assessment the measured span of 11.05m will be used with the arch profile taken as circular. The 2000 assessment undertaken by Northumberland County Council used a rise at the crown of 2.641m and a rise at the quarter points of 2.250m, however, the 2008 inspection found the rise at the crown to be 2.760m and the rise at the quarter points to be 2.189m. The latter values will be used for the assessment.

The arch barrel thickness is 457mm throughout the structure (see section 1.2).

The arch barrel is in fair condition therefore a condition factor of 0.85 will be applied when assessing the arch in accordance with the AIP.

The depth of fill above the arch barrel at the crown was found to be 156mm and this value will be used for the assessment in accordance with clause 6.17 of BD21/01.

The type of brick used in the arch barrel is unknown and will therefore be conservatively assumed to be constructed from coursed building bricks with a barrel factor of 1.0.

The fill will be assumed to be a well compacted material with a fill factor of 0.7.

Joints were found to be typically 6-12.5mm in width therefore a width factor of 0.9 will be used.

The joints of the stonework are in good condition therefore depth factor of 0.9 will be used. It is assumed that the remaining mortar is in good condition hence a mortar factor of 1.0 will be used.

Axle lift and centrifugal effects are considered to be not appropriate.

## 5.3 Spandrel Walls and Parapets

Parapets and spandrel walls will be assessed qualitatively based on the results of the inspection.

## 5.4 Substructure

The foundations, abutments and wing walls will be assessed qualitatively based on the results of the inspection.



## 6 Assessment Methods & Results

### 6.1 Superstructure

The Arch Barrel has been assessed using the modified MEXE method and the factors determined in section 5.

The arch barrel was found to be able to accommodate vehicles with Max Gross Vehicle Weight of 12.5t ALL and 9 units of HB loading, with a weight restriction of 13t required.

As the bridge failed to achieve a 40 tonne rating using the MEXE analysis a more accurate analysis was carried out using the ARCHIE-M software. As the masonry strength and mortar type is unknown a sensitivity analysis will be carried out considering the masonry to be class B engineering bricks, class A engineering bricks and Wire cut bricks with both 1:2:9 mortar and 1:3 lime mortar.

The ARCHIE-M analysis found the bridge to have a rating of **3 Tonnes** and the ability to accommodate **5 HB Units**.

As the ARCHIE-M analysis is deemed as more accurate it is this analysis rating which will be recommended to be applied.

### 6.2 Spandrel Walls and Parapets

The spandrel walls and parapets have been assessed qualitatively as adequate in accordance with BA16/97 as there are no defects to suggest any ill effects.

### 6.3 Substructure

The spandrel walls and parapets have been assessed qualitatively as adequate in accordance with BA16/97 as there are no defects to suggest any ill effects.

# 7 Conclusions

## 7.1

### Conclusions

The structure has an overall assessed capacity **3 Tonnes** Assessment Live Loading and is able to accommodate only **5 units** of HB loading. This was assuming the arch barrel thickness to be 457mm and the minimum fill above the arch barrel to be 156mm.

The ARCHIE-M sensitivity analysis analysed different arch barrel strengths ranging from 3.2MPa to 11MPa and received a rating of group 1 fire engine for an 11MPa and 9.0MPa barrel but for all strengths below the previously stated values, a rating of 3 tonne was achieved therefore a rating of **3 tonnes** was used as the type of brick and mortar is unknown. This low rating is a direct result of the flat arch profile. The only way to achieve a higher rating is to apply a higher level of backing to the arch or to saddle the arch.

The spandrel walls, parapets and substructure have been assessed qualitatively as adequate



## 8 Recommendations

### 8.1

#### **Recommendations**

The structure has been assessed to **3 Tonnes**; hence a weight restriction of **3 Tonnes** should be put in place.

Extensive strengthening works would be required in order to increase the capacity of the bridge up to 40 tonnes.

## Appendix A: Calculation Summary Sheet

**Structural Assessment Summary of Results**

**Analysis Results: Rugley Railway Masonry Arch**

Span Reference	Span 1	Span 1	
Method Used (e.g. MEXE)	MEXE	ARCHIE-M	

**Single Span Analysis**

Allowable Axle Loads	Single Axle Load	10.02 T	-	
	Double axle Load	6.11 T	-	
	Triple Axle Load	4.82 T	-	

**Multi Span Analysis**

Overall Global Capacity			
Maximum Gross Vehicle Weight	12.5 T	3 T	
Assessment Live Load Rating	13 T	3 T	
HB Rating	9 Units	5 Units	

**Comments**

ARCHIE-M Analysis is deemed most accurate.



## Appendix B: Calculations

# CALCULATION SHEET

FABER MAUNSELL | AECOM

<b>Project:</b> NCC BRB Assessments - Rugby Railway Bridge	<b>Ref:</b>	10
<b>Section:</b> MEXE Assessment	<b>Job No:</b>	60045644
	<b>Date:</b>	11/07/2008
<b>Made By:</b> ACL	<b>Checked By:</b> ABW	<b>Sheet No:</b> 1 of 1

## ASSESSMENT OF MASONRY ARCH BRIDGES BY THE MODIFIED MEXE METHOD IN ACCORDANCE WITH SECTION 3 OF BA16/97

Span	L	11.050	m	<u>Comments</u>
Rise at Crown	$r_c$	2.760	m	Skew Span
Rise at Quarter points	$r_q$	2.189	m	From level survey
				Based on constant radius
Thickness of Arch Barrel (Reduced if applicable)	d	0.457	m	
Actual Depth of Fill at Crown	$h'$	0.156	m	From level survey
Fill Depth to be used ( $\leq d$ ) (cl. 6.17 BD21/01)	h	0.156	m	
Provisional Axle Load (cl. 3.10)	$PAL = \frac{740(d + h)^2}{L^{1.3}}$	PAL	12.24	t
Span/Rise Ratio ( $L/r_c$ )		4.00		
Span/Rise Factor (cl. 3.11 & Fig 3/3)	$F_{sr}$	1.00		
Profile Ratio ( $r_q/r_c$ )		0.79		If 0.75 or less then $F_p = 1.0$
Profile Factor (cl. 3.12 & Fig 3/4)	$F_p = 2.3 \left[ \frac{(r_c - r_q)}{r_c} \right]^{0.6}$	$F_p$	0.89	
Barrel Factor (Table 3/1)	$F_b$	1.0		Bricks of unknown strength
Fill Factor (Table 3/2)	$F_f$	0.7		Assumed well compacted materials
Material Factor (cl. 3.13)	$F_m = \frac{(F_m \cdot d) + (F_f \cdot h)}{d + h}$	$F_m$	0.92	
Width Factor (Table 3/3)	$F_w$	0.9		Joints 6-12.5mm
Mortar Factor (Table 3/4)	$F_{mo}$	1.0		Mortar in good condition
Depth Factor (Table 3/5)	$F_d$	0.9		Good condition
Joint Factor (cl. 3.16)	$F_j = F_w \cdot F_d \cdot F_{mo}$	$F_j$	0.81	
Condition Factor (cl 3.17 & Annex D)	$F_{cM}$	0.80		0.1 deducted for age & condition 0.1 for salt & water ingress
Modified Axle Load (cl. 3.24)	$MAL = F_{sr} \cdot F_p \cdot F_m \cdot F_j \cdot F_{cM} \cdot PAL$	MAL	6.55	t
Axle lift off is considered not to be appropriate. Hence use Fig 3/5a for axle factors				
Axle Factor (Single - Fig 3/5a)	$A_{r1}$	1.64		
Axle Factor (Double - Fig 3/5a)	$A_{r2}$	1.00		
Axle Factor (Triple - Fig 3/5a)	$A_{r3}$	0.79		
Centrifugal Factor (Effects are minimal)		1.00		
Allowable Axle Load (Single - MAL x $A_{r1}$ )	AAL1	10.74	t	
Allowable Axle Load (Double - MAL x $A_{r2}$ )	AAL2	6.55	t	
Allowable Axle Load (Triple - MAL x $A_{r3}$ )	AAL3	5.17	t	
Max Gross Vehicle Weight (Table 3/6)	gvw	12.5	t	
Weight Restriction (Table 3/6)		13		
HB Rating (no. of units = MAL x $A_{r2}$ x 1.6)		10.5	units	
(In accordance with Network Rail Current info sheet 27)				

### Notes





## Appendix C: ARCHIE-M Assessment



# Calculation Sheet

FABER MAUNSELL | AECOM

Project: **NCC BRB ASSESSMENT**

Job No: 60045644

Section: ARCHIE-M ASSESMENT

Date: **23 February 2009**

Made by: ACL

Checked by: MAH

Sheet No: 1 of 2

## **ARCHIE-M input**

### Material

Effective Masonry Strength: varies see section 6.1

Unit weight: 21kN/m<sup>3</sup>

### Arch

LHS: X: 0

LHS: Y: 3257

Span: 11050mm

Rise: 2760mm

Q-rise: 2189mm

d-ctr: 457mm

d-spr: 457mm

### Abutment

Thickness at top (left): 1000mm

Thickness at top (right): 1000mm

Masonry strength: 6N/mm<sup>2</sup>

Masonry unit weight: 21kN/m<sup>3</sup>

### Fill

Unit weight: 19kN/m<sup>3</sup>

Phi value: 30 degrees

### Road Level

Point	X	y
1	-1500	6732
2	0	6732
3	2763	6680
4	5525	6627
5	8288	6551
6	11050	6475
7	12550	6475

Depth of surfacing: 100mm

Depth of Overlay: 0mm

Surfacing unit weight: 24kN/m<sup>3</sup>

Overlay unit weight: 15kN/m<sup>3</sup>

Lane Width: 2500mm



Project: **NCC BRB ASSESSMENT**

Job No: 60045644

Section: ARCHIE-M ASSESMENT

Date: **23 February 2009**

Made by: ACL

Checked by: MAH

Sheet No: 2 of 2

**Summary of ARCHIE-M sensitivity analysis**

Brick Type	Mortar Type	Characteristic Strength (MPa)	Passing Vehicle Load	Passing HB Vehicle
Wire Cut	1:2:9 Mortar	6.5	3 tonne	5 units
Class B Engineering	1:2:9 Mortar	9.0	Group 1 FE	5 units
Class A Engineering	1:2:9 Mortar	11.0	Group 1 FE	5 units
Wire Cut	1:3 Lime Mortar	3.2	3 tonne	5 units
Class B Engineering	1:3 Lime Mortar	4.6	3 tonne	5 units
Class A Engineering	1:3 Lime Mortar	5.0	3 tonne	5 units

**Summary of ARCHIE-M analysis**

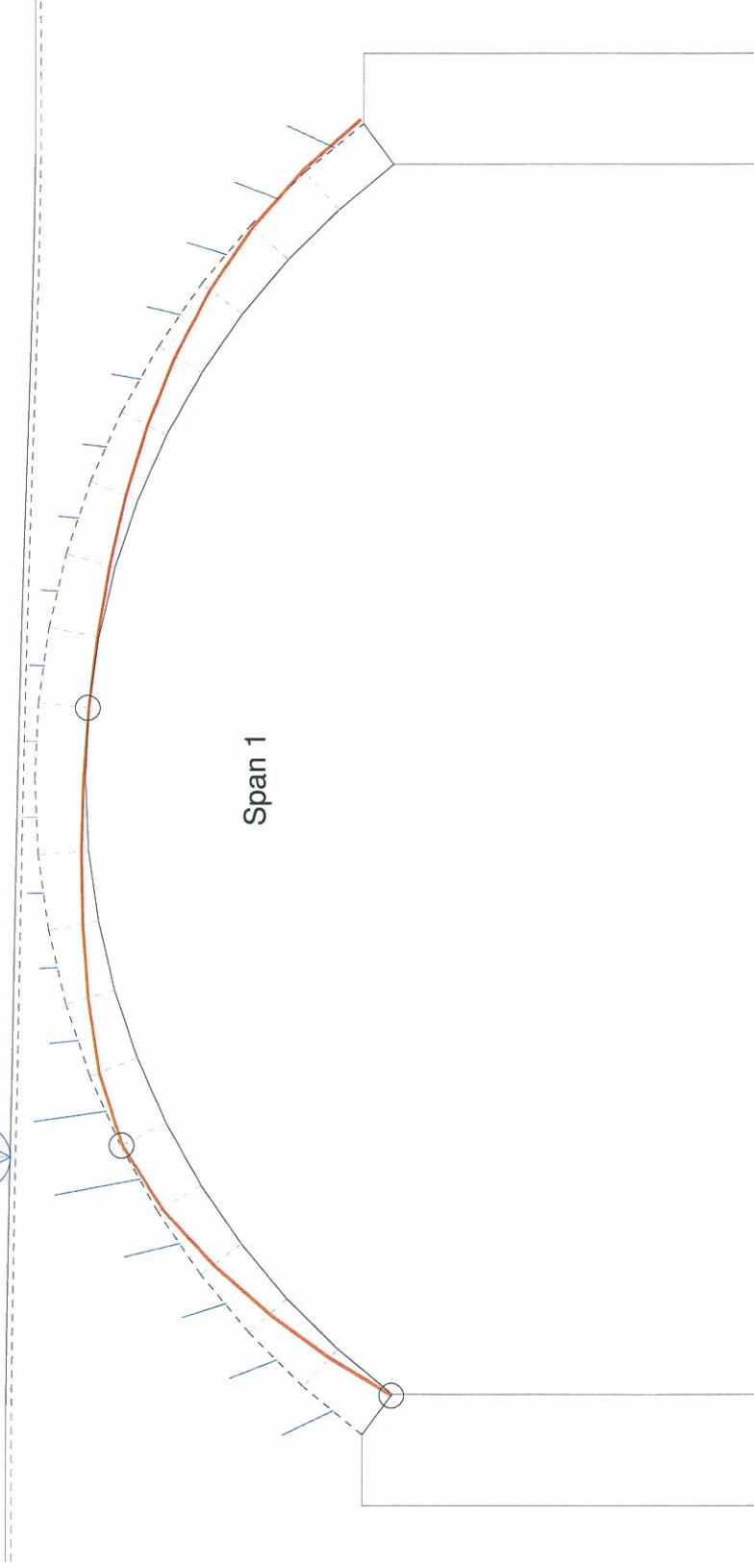
The results of the sensitivity analysis for various types of bricks and mortar are shown above.

The ARCHIE-M sensitivity analysis analysed different arch barrel strengths ranging from 3.2MPa to 11MPa and received a rating of group 1 fire engine for an 11MPa and 9.0MPa barrel but for all strengths below the previously stated values, a rating of 3 tonne was achieved therefore a rating of **3 tonnes** was used as the type of brick and mortar is unknown. This low rating is a direct result of the flat arch profile. The only way to achieve a higher rating is to apply a higher level of backing to the arch or to saddle the arch.

# Rugley

7.5t Single Axle with Impact at 2135 mm

18.81



gammaFI dead load: 1.00 7.5t Single Axle with Impact @ 2135 [mm]

gammaFI superimposed: 1.00

gammaFI live load: 1.90

gammaF3 load effect: 1.00

gammaM material: 1.00

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NAME: Rugley

LOCATION:

NUMBER:

Faber Maunsell

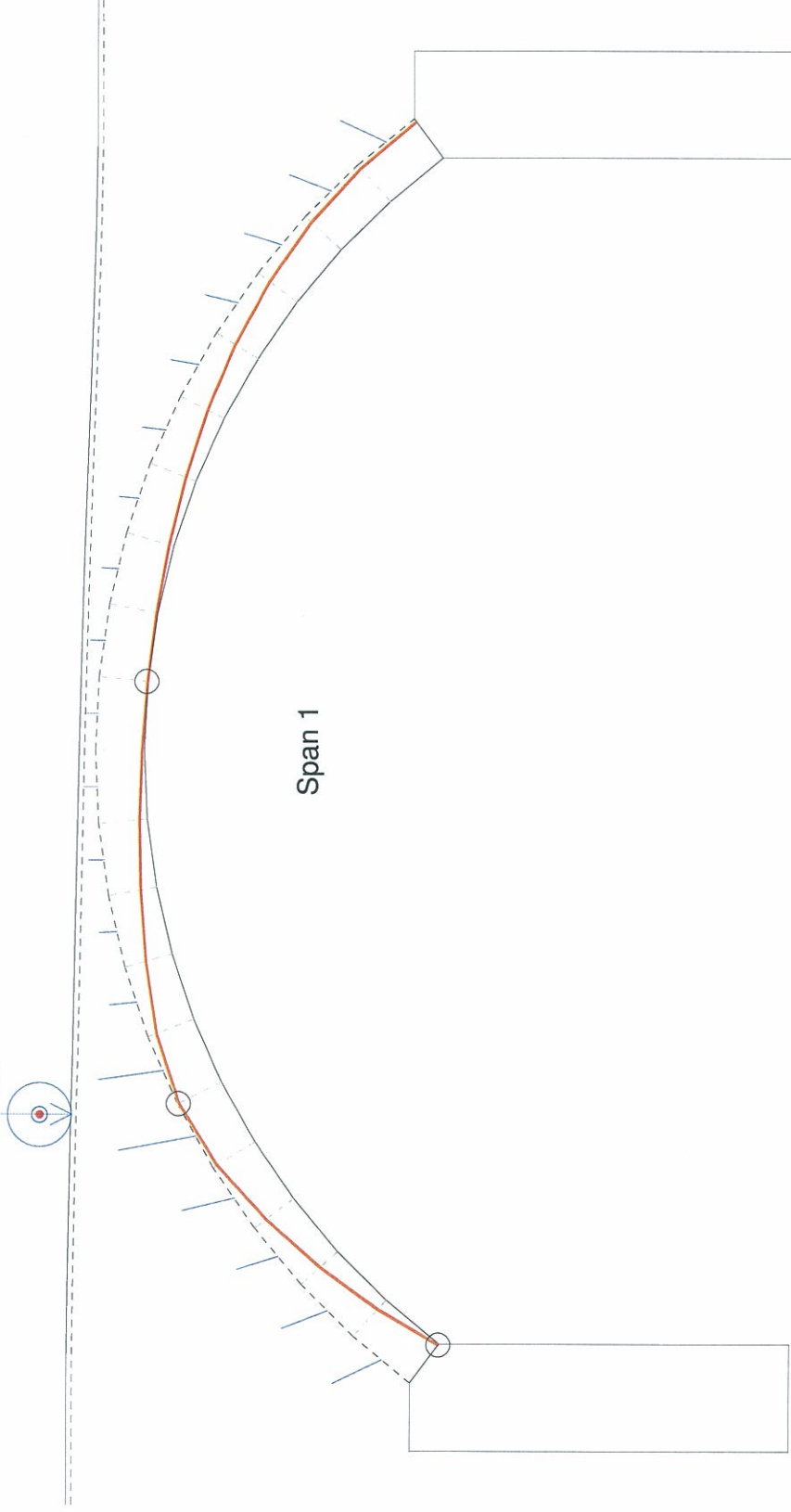
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Printed on: Friday, February 13, 2009 11:37:05

# Rugley

FE 2 Single Axle with Impact at 2135 mm

17.10



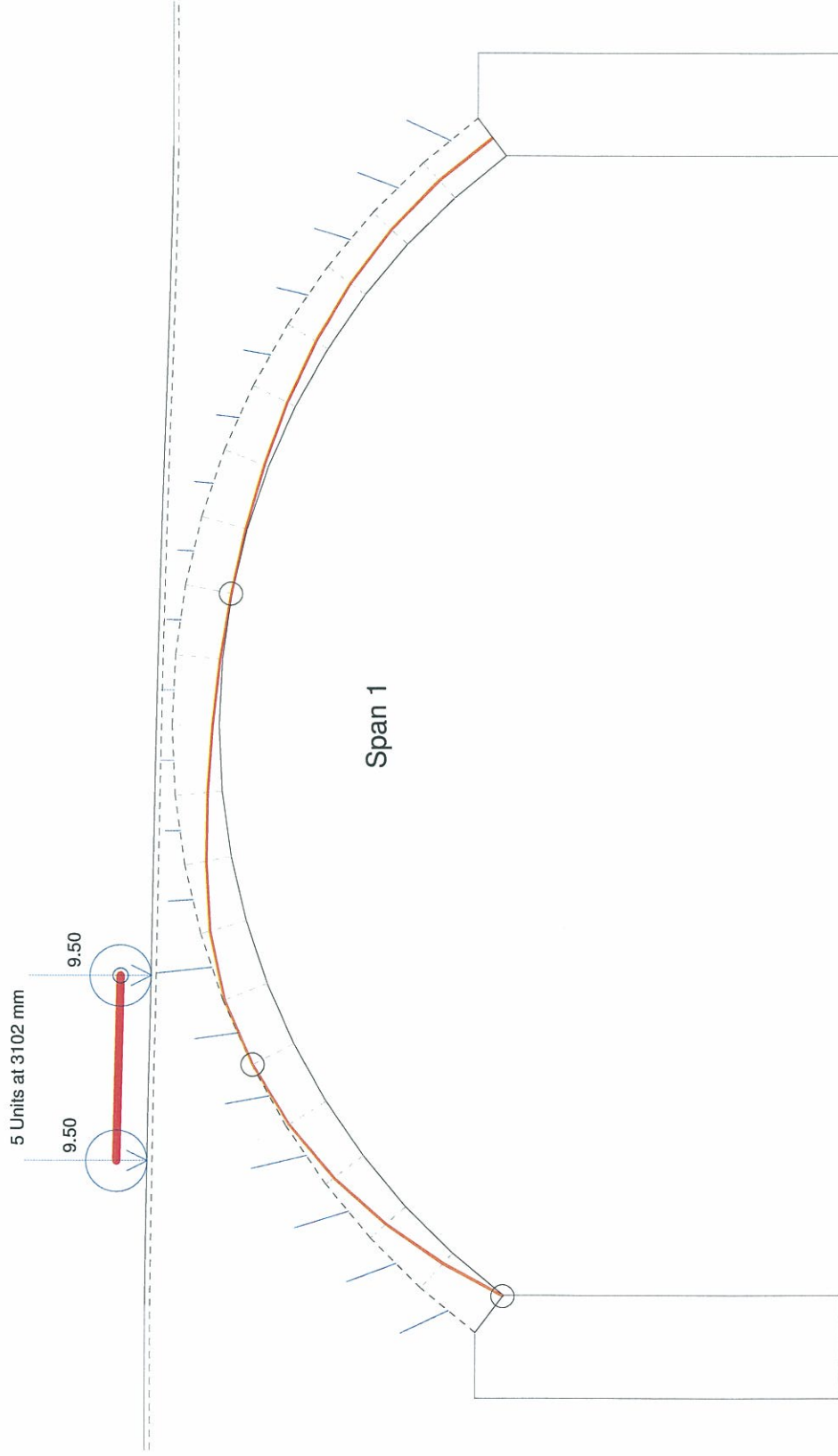
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 LOCATION:  
 NUMBER:  
 Faber Maunsell  
 DATE: 09 February 2009  
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# Rugley



gammaFI dead load: 1.00 5 Units @ 3102 [mm]  
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gammaFI live load: 1.90  
gammaF3 load effect: 1.00  
gammaM material: 1.00

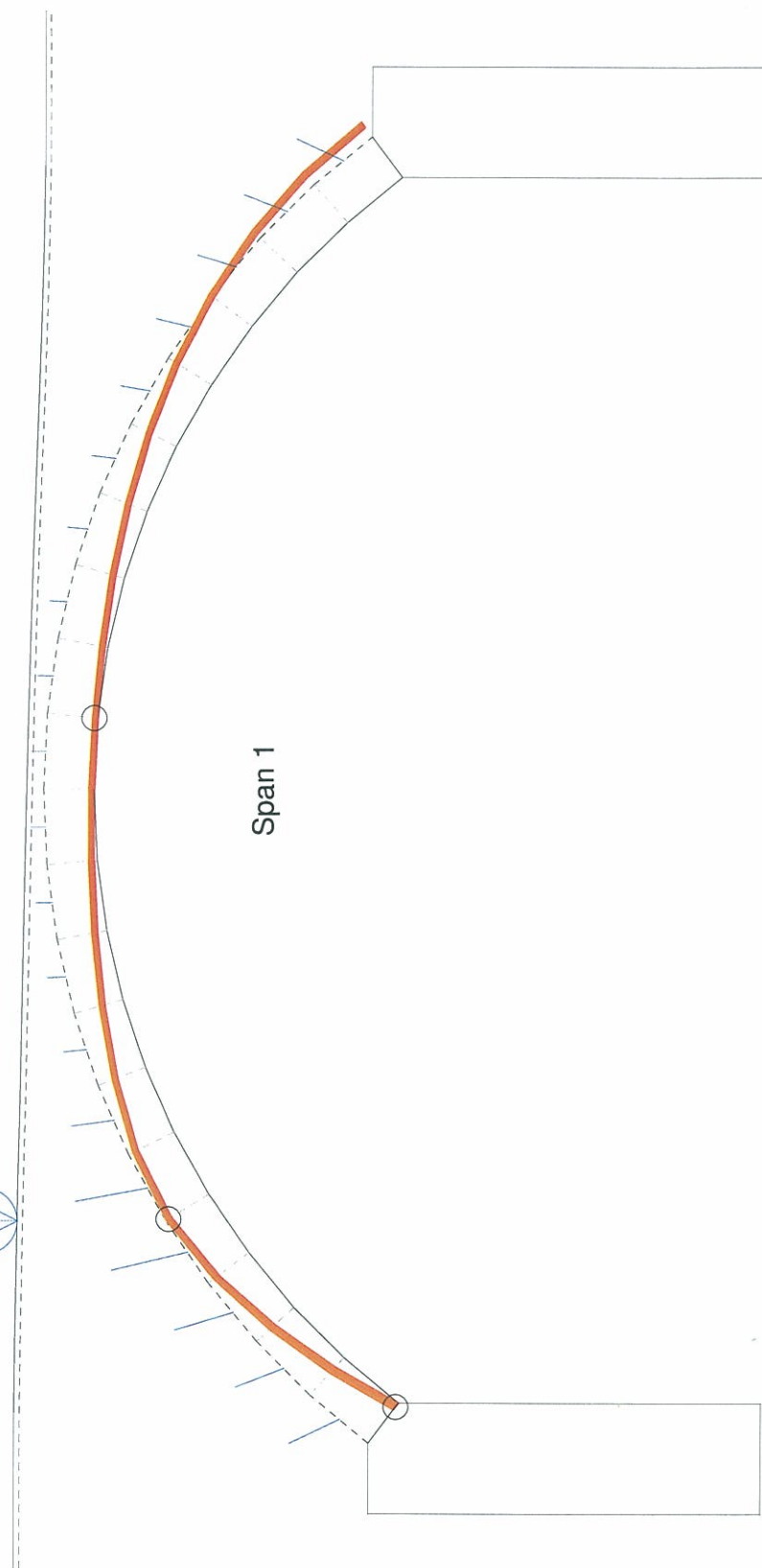
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NUMBER:  
Faber Maunsell  
DATE: 09 February 2009  
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# Rugley

FE 2 Single Axle with Impact at 1635 mm

17.10



gammaFI dead load: 1.00  
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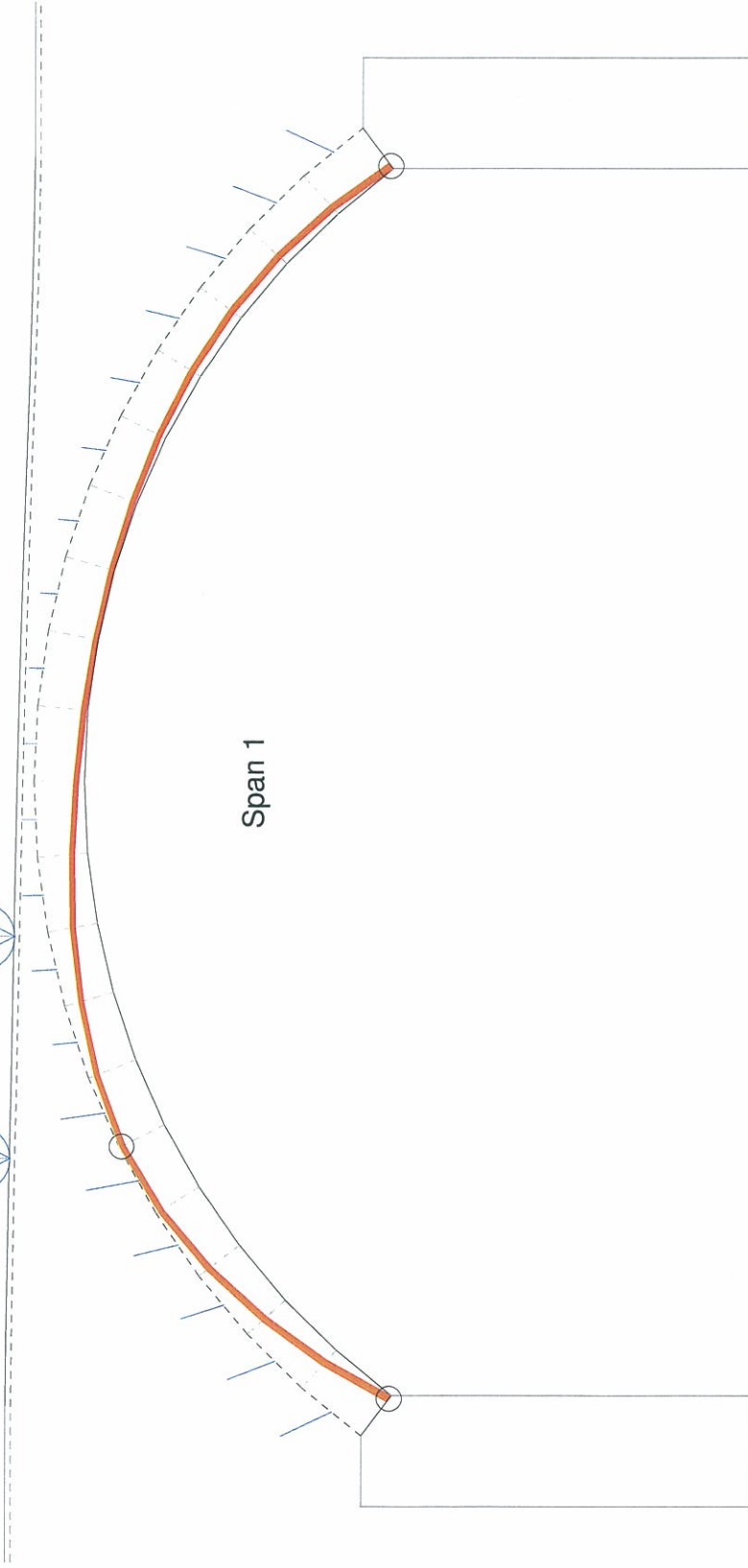
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 NUMBER:  
 Faber Maunsell  
 DATE: 09 February 2009  
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# Rugley

RG (3-t 2-axle R) impact axle 2 at 4135 mm

7.18

1.71



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 gammaFI live load: 1.90  
 gammaF3 load effect: 1.00  
 gammaM material: 1.00

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LOCATION:

NUMBER:

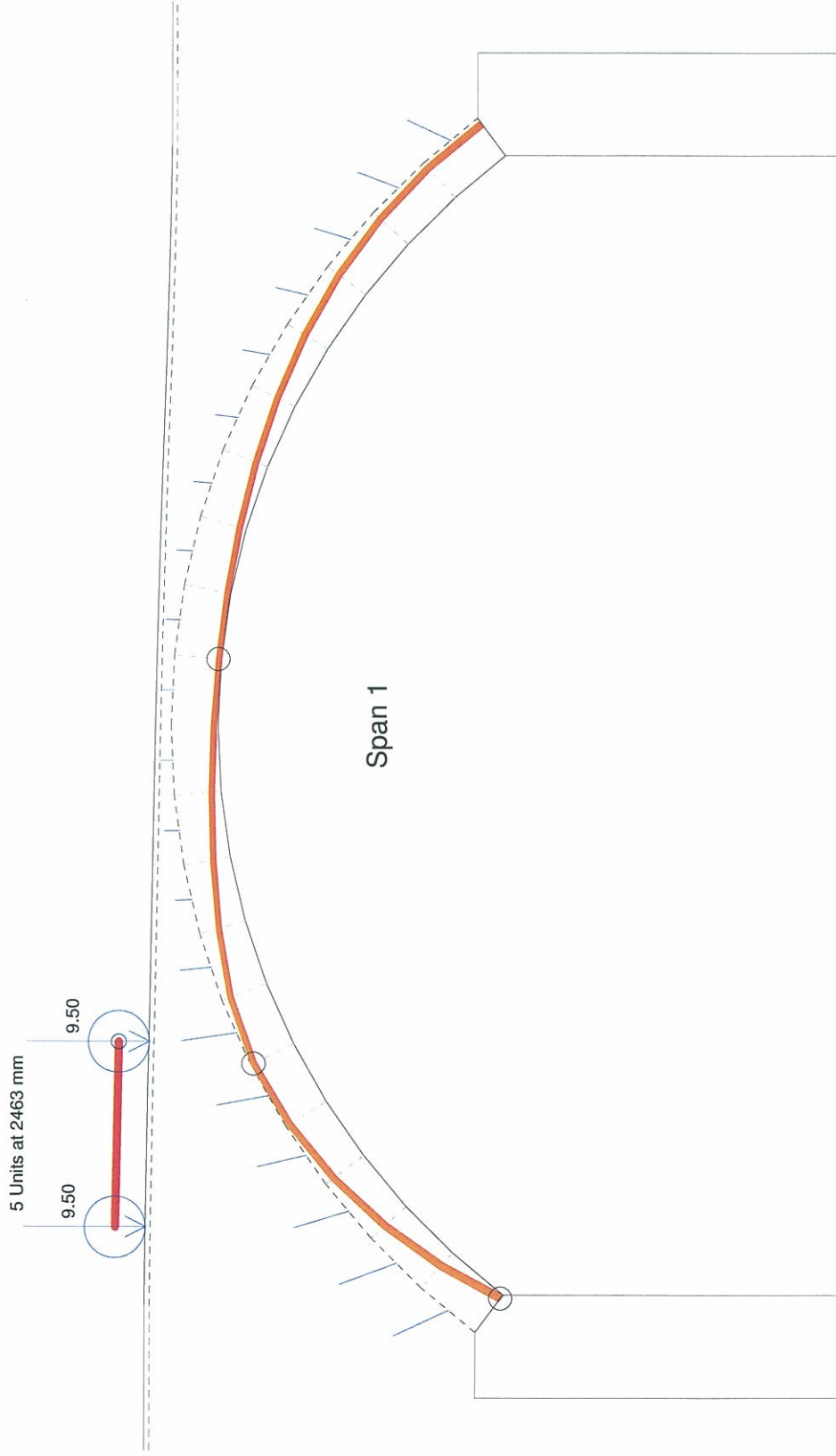
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# Rugley



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gammaM material: 1.00

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NAME: Rugley  
LOCATION:  
NUMBER:  
Faber Maunsell  
DATE: 09 February 2009  
Printed on: Friday, February 13, 2009 12:15:05

## Appendix D: Inspection Photographs





Photo 1. South Elevation



Photo 2. North Elevation





Photo 3. East Abutment



Photo 4. West Abutment





Photo 5. Soffit Typical



Photo 6. Moss Growth on West Abutment





Photo 7. Bridge deck surface looking West



Photo 8. North West corner of bridge





## FORM 'BA' (BRIDGES)

GC/TP0356

ELR/ Bridge No <sup>AKC</sup> ACK/99

Appendix: 4

Issue: 1

Revision: A (Feb 1993)

**CERTIFICATION FOR ASSESSMENT CHECK**

**Assessment Group: -** Faber Maunsell (on behalf of Northumberland CC)  
First Floor  
One Trinity Gardens  
Quayside  
Newcastle upon Tyne  
NE1 2HF

**Bridge/Line Name: -** Rugley Bridge. U3053/01RY  
Grid Ref: NU 170 106

**Category Of Check: -** 1

**ELR/Bridge No.: -** ACK/99

I certify that reasonable professional skill and care have been used in the assessment of the above structure with a view to securing that:

- (1) It has been assessed in accordance with the Approval in Principle (where appropriate) as recorded on Form AA approved on 15-12-2003
- (2) It has been checked for compliance with the following principal British Standards, Codes of Practice, BRB (Residuary) Limited Technical notes and Assessment standards.

List any departures from the above, and additional methods or criteria adopted, with reference and justification for their acceptance (commenting on the results if appropriate).

None

**STATEMENT OF CAPACITY**

The bridge deck is capable of accommodating **3 tonnes** assessment live loading and **5 units** of HB loading.

The substructures and foundations have been assessed qualitatively as adequate.

**Recommended Loading Restrictions**

3 Tonnes

**Description of Structural Deficiencies and Recommended Strengthening**

Strengthening works to increase capacity to 40 tonnes

## FORM 'BA' (BRIDGES)

GC/TP0356

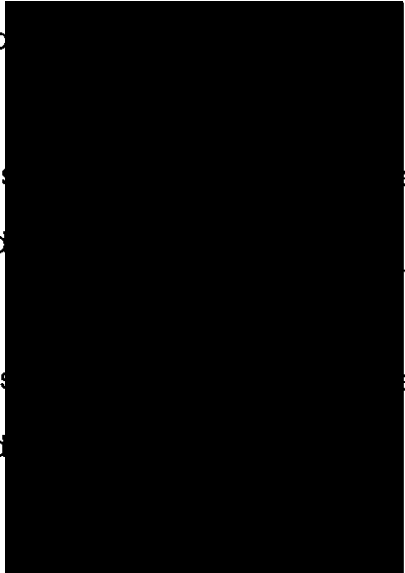
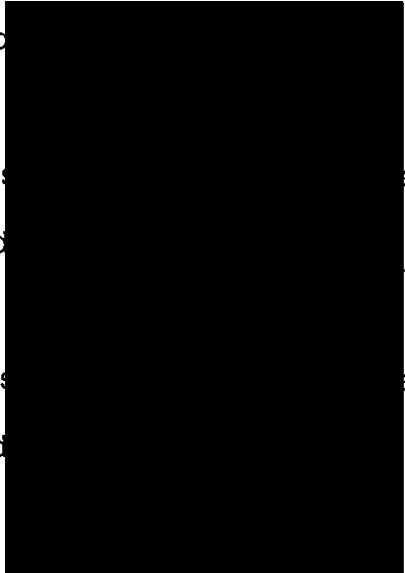
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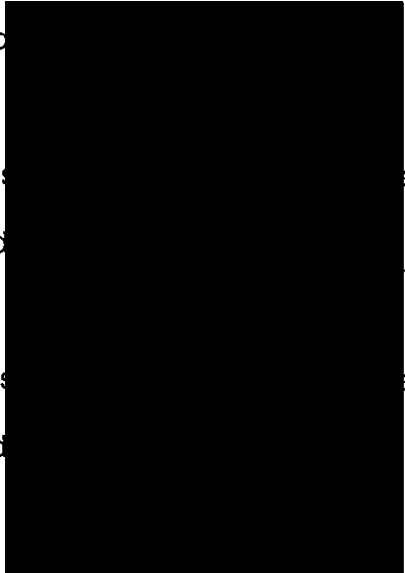
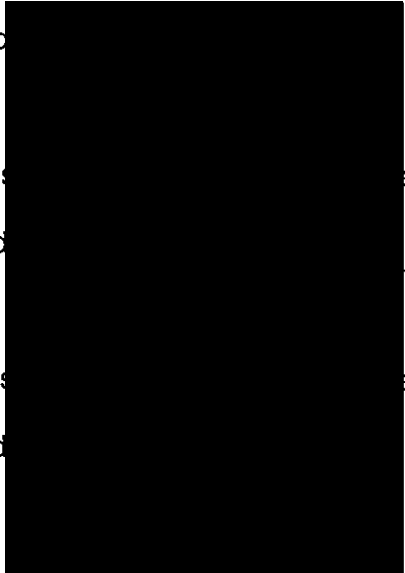
ELR/ Bridge No ACK/99

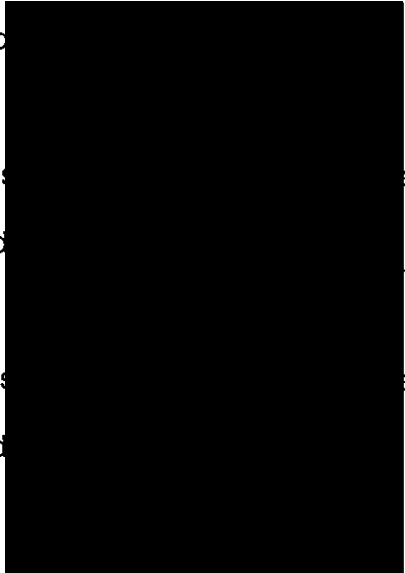
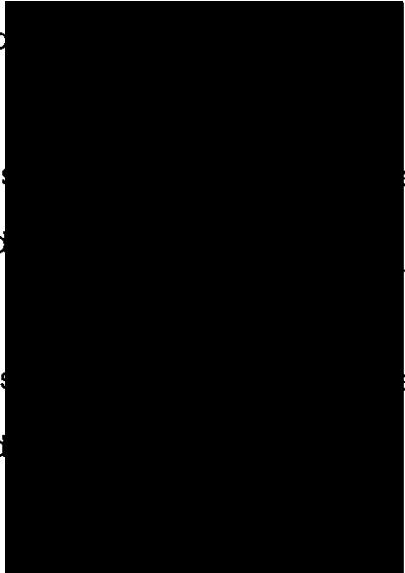
Issue: 1

Revision: A (Feb 1993)

**CERTIFICATION FOR ASSESSMENT CHECK**Category 1

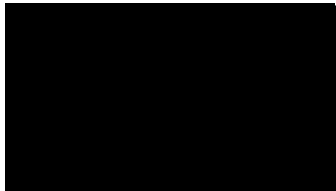
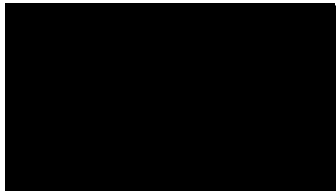
Signed  Title Engineer  
Name  Date 17-06-2009  
To be signed by the leader carrying out the assessment

Signed  Title Senior Engineer  
Name  Date 17-04-2009  
To be signed by the leader carrying out the check

Signed  Title Regional Director  
Name  Date 17/04/2009  
To be signed by a Director in the organisation responsible for the staff carrying out the assessment and check

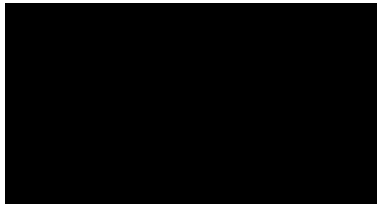
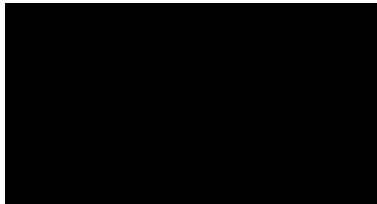
Acceptance by Reviewer

I accept this certificate as a record that the assessment and checking of the structure identified above have been carried out in accordance with the criteria given.

Signed  Title Structures Team Manager  
Northumberland County Council  
Name  Date 26/05/09

Acceptance by the Director Structure's

I accept this certificate as a record that the assessment and checking of the structure identified above have been carried out in accordance with the criteria given.

Signed  Title Director Structures  
Name  Date 4/8/2009



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

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**APPROVAL IN PRINCIPLE FOR ASSESSMENT**

STRUCTURE/LINE NAME      Rugley Railway Bridge, U3053/01RY  
 Grid Ref: 416998E 610630N, see location plan in  
 Appendix B

ELR/STRUCTURE NO.      ACK /99

**BRIEF DESCRIPTION OF EXISTING BRIDGE:****(a) Span Arrangement**

Single skew arch of span 11.05 metres between abutments. The square span is 10.8m with a skew angle of 11 degrees.

**(b) Superstructure Type**

The arch barrel was constructed of bricks in a coursed helicoidal pattern. The spandrel walls were of random sized stone brought to course.

**(c) Substructure Type**

Construction of foundations is not known.

Abutment walls : random sized rock faced stone brought to course.

Wingwalls : walls run parallel to the arch elevation and comprised random sized rock faced stone brought to course.

The parapets were constructed of medium to large sized coursed rock faced stone.

**(d) Details of any Special Features**

None

**ASSESSMENT CRITERIA****(a) Loadings and Speed**

Traffic speed to be used shall be 60 mph.

HA Loading shall be 40 tonnes assessment live load as detailed in BD 21/01

Footway Live Loading shall be Accidental wheel loading as given in BD 21/01 clause 5.35. The footway loading will be applied in accordance with BD 21/01 clause 5.36.

If bridge passes the 40 tonnes assessment, the number of sustainable HB units will be determined. HB loading shall be applied in accordance with BD37/01 but using associated live loads as specified in BD21/01.



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**APPROVAL IN PRINCIPLE FOR ASSESSMENT****(b) Codes to be used**

See Appendix A

In addition the following Railtrack Current Information Sheets will be referred to

19 Rigorous Arch Analysis – Application of Condition Factors

20 Assessment of Skew Arches

21 Single Span Arches  $h > d$ 

27 HB capacity from MEXE

**(c) Proposed Method of Structural Analysis**

Substructure and foundations

Qualitative assessment in accordance with BD21/01 and BA16/97.

Superstructure

The assessment will be carried out using the Modified MEXE method on the skew span dimensions.

**(d) Details of any Special Requirements**

Axle lift off effects will not be considered.

Centrifugal effects will not affect the assessment of the structure.

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**APPROVAL IN PRINCIPLE FOR ASSESSMENT****STRUCTURAL ASSESSMENT ENGINEER'S COMMENTS**

The bridge carries the U3053 between the C92 and the B6341. The road is two lane single carriageway approximately 4m wide.

The bridge was inspected on the 28 November 2000 in wet weather. The scope of the survey was to inspect the visible and accessible parts of the bridge fabric access only available on foot and did not include for the removal of finishes, exposure of foundations or structural testing of materials.

The bridge was generally in a poor condition. The arch barrel was 457mm (18") deep at the crown with stone faced voussoirs at the elevation. Previous assessment calculations by British Rail Eastern Region have used 1' 6" for the arch barrel.

The voussoirs were laid with joints 6 to 12.5mm wide. The overall shape of the arch barrel was good. Mortar condition was good. There was extensive water and calcareous deposits under the verges, however the soffit under the carriageway was dry and unmarked. The arch barrel had extensive soot deposits.

The spandrel walls showed no evidence of tilting or bulging.

**Factors for Modified MEXE Assessment**

Condition factor	$F_{CM} = 0.8$	0.1 deducted for age and condition 0.1 salt and water ingress
Arch barrel factor	$F_b = 1.0$	Barrel comprised of brick .
Fill factor	$F_f = 0.7$	Fill material is unknown but the carriageway is in good condition with little rutting or depressions, therefore the fill shall be assumed to be well compacted.
Width factor	$F_w = 0.9$	Joints were between 6 and 12.5mm.
Mortar factor	$F_{mo} = 1.0$	The mortar in the arch barrel was in a good condition.
Depth factor	$F_d = 0.9$	There was slight mortar loss.

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APPROVAL IN PRINCIPLE FOR ASSESSMENTCIVIL ENGINEER'S COMMENTS

None

BRB WORKS GROUP COMMENTS - IF APPLICABLE

2

## PROPOSED CATEGORY FOR INDEPENDENT CHECK:

SUPERSRUCTURE .....Category I.....

SUBSTRUCTURE ..... Not Applicable.....

NAME OF CHECKER SUGGESTED IF CAT 2 OR 3 .....N/A.....

CATEGORY 1

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

SIGNED

TITLE

DATE

CATEGORY 2 AND 3

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

SIGNED .....

TITLE .....

DATE .....

SIGNED .....

TITLE .....

DATE .....



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**APPROVAL IN PRINCIPLE FOR ASSESSMENT****APPENDIX A - List of relevant documents****SCHEDULE OF DESIGN AND ASSESSMENT DOCUMENTS RELATING TO  
BRITISH RAILWAYS BOARD BRIDGES AND STRUCTURES CARRYING  
HIGHWAYS**

(All documents are taken to include revisions current at date of this TAS).

**1. Department of Transport - Departmental Standards**

BD 02/02 Technical Approval of DTp Highway Structures on Motorways and Other Trunk Roads.

~~BD 12/95 Corrugated Steel Buried Structures.~~

BD 21/01 The Assessment of Highway Bridges and Structures.

~~BD 31/87 Buried Concrete Box Type Structures.~~

BD 37/01 Loads for Highway Bridges.

~~BD 44/95 The Assessment of Concrete Highway Bridges and Structures.~~~~BD 52/93 The Design of Highway Bridge Parapets.~~~~BD 56/96 The Assessment of Steel Highway Bridges and Structures.~~~~BD 61/96 The Assessment of Composite Highway Bridges and Structures.~~**2. Department of Transport - Department Advice Notes**

BA 16/97 The Assessment of Highway Bridges and Structures.

~~BA 37/92 Priority ranking of existing parapets.~~~~BA 39/93 Assessment of Reinforced Concrete Half joints.~~~~BA 44/96 Assessment of Concrete Highway Bridges and Structures.~~~~BA 51/95 The Assessment of Concrete Structures Affected by Steel Corrosion~~~~BA 52/94 The Assessment of Concrete Structures Affected by Alkali Silica-  
Reaction~~~~BA 56/96 The Assessment of Steel Highway Bridges and Structures.~~~~BA 61/96 The Assessment of Composite Highway Bridges~~**3. Department of Transport - Technical Memoranda (Bridges)**~~BE 3/78 Reinforced Earth and Anchored Earth Retaining Walls and Bridges-  
Abutments for Embankments.~~~~BE 5/75 Rules for the Design and Use of Freyssinet Concrete Hinges in-  
Highway Structures.~~~~BE 23 Shear Key Decks.~~**4. Miscellaneous**~~Guidance Note for the Assessment and Design of Unreinforced  
Masonry Vehicle Parapets produced by the County Surveyor's Society-  
Vol. 1 (First Edition 1995).~~



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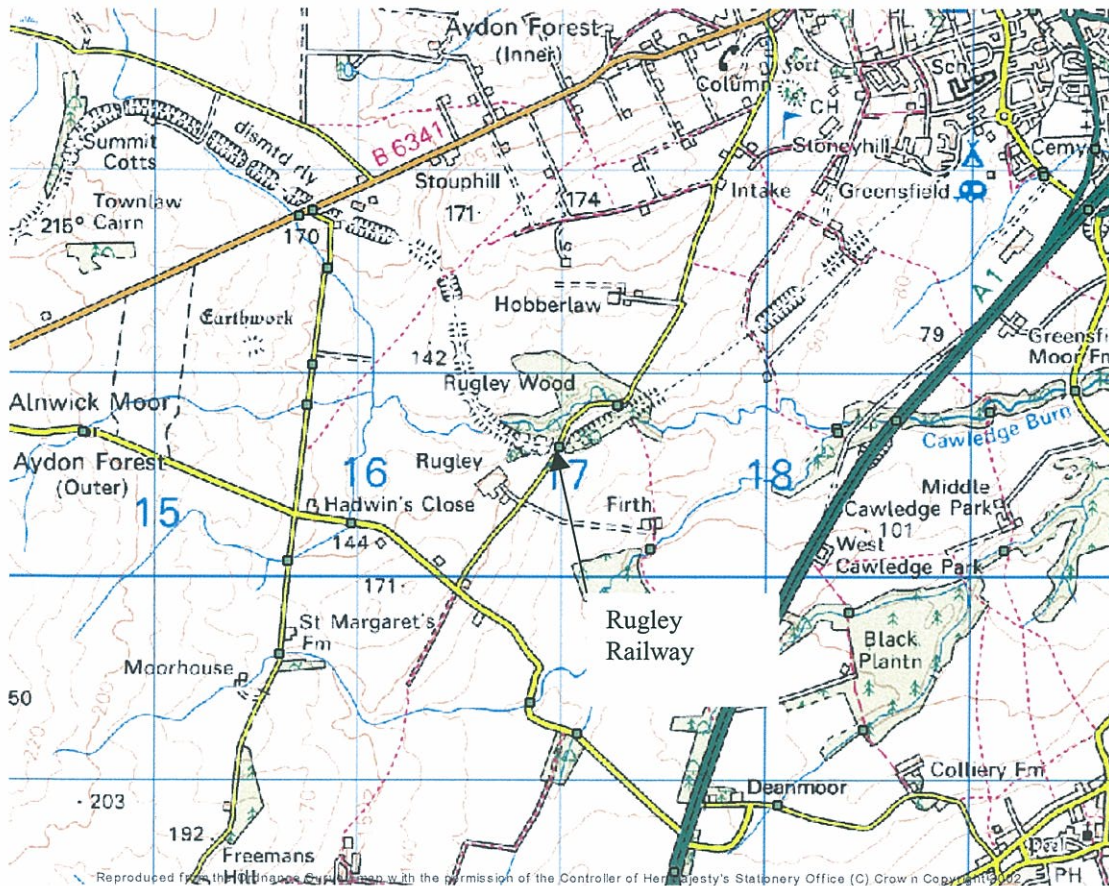
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**APPENDIX B – LOCATION PLAN**



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**APPENDIX C – PHOTOGRAPHS**



**Approach Looking Northeast**



**East Elevation**

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**Typical Arch Barrel**