Alton Station Timber Footbridge

Structure Summary Report January 2017

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1.0 Introduction

The original footbridge at Alton station (Hampshire) is an interesting timber footbridge which was constructed by the London & South Western Railway in the 1890s. The bridge was originally an open frame truss structure with open parapets and no roof; however, it was added to early in its life and is now a fully enclosed bridge. The bridge condition has deteriorated significantly and now requires extensive repairs in order to make it serviceable. The bridge is currently closed to passengers. Following the construction of a new 'step free access' bridge in 2013, Network Rail (NR) has proposed to remove the old timber bridge.

Local action group Friends of Alton Station (FAS) are keen that something is done to retain this valued Alton landmark and interesting structure.

FAS commissioned structural engineers Integral Engineering Design (Integral) to inspect the footbridge and to produce an independent report.

This report reviews the options for the future of the footbridge and makes recommendations.

2.0 Background and History

Alton station was opened as a terminus in 1852 with only one platform. The station was rebuilt in 1865 as a through station with a second platform initially served by a footpath from the south. Eventually in 1891 an 'open' timber truss footbridge was provided by the London & South Western Railway (LSWR) to give a direct link between the two platforms. Platform 2 was converted to an island platform when the Basingstoke Light Railway (1901) and the Meon Valley line (1903) opened making the footbridge the only means of access to platforms 2 and 3. This timber bridge incorporates timber trestle supports and staircases to each platform. Alton station footbridge is the last remaining London & South Western Railway timber footbridge of which 26 were constructed across the network. It is also the last remaining free standing serviceable timber footbridge over the operational railway on the National Rail network. This much used structure was taken out of service in July 2015 when Network Rail contractors and advisors reported that significant repairs were required which exceeded the budget available at that time.

The 'open' footbridge at Alton station was not popular with ladies; they successfully lobbied the LSWR to have the bridge covered and the open sides boarded over in 1894. Clearly they were not satisfied with this because the bridge was fully enclosed with windows in 1896. Although this is pretty much the form we see today, at some point match-boarding was applied to the outside of the bridge elevations where previously it had only been clad inside the cross-bracing. This former arrangement is seen on the side of the bridge exposed on platform 3 adjacent to the Mid Hants Railway (see figure 4).

Network Rail has archive LSWR drawings of a timber footbridge at Alton. However, it is evident that the structural form of the bridge on site is different from that shown on the drawings. The LSWR drawings suggest a timber footbridge with structural form similar to the bridges installed at West Clandon and Andover Town (see Figures 1 & 3). Intrusive inspection of the bridge has revealed that the Alton structure is an alternative later design that was also installed at Wadebridge station in Cornwall (see Figure 2) and on the nearby Meon valley line (West Meon, Droxford & Wickham). All these bridges were replaced with later designs before the 2nd World War and the lines subsequently closed. There is photographic evidence to support this. The Alton timber footbridge probably survived longer as a consequence of the added cladding and glazing.

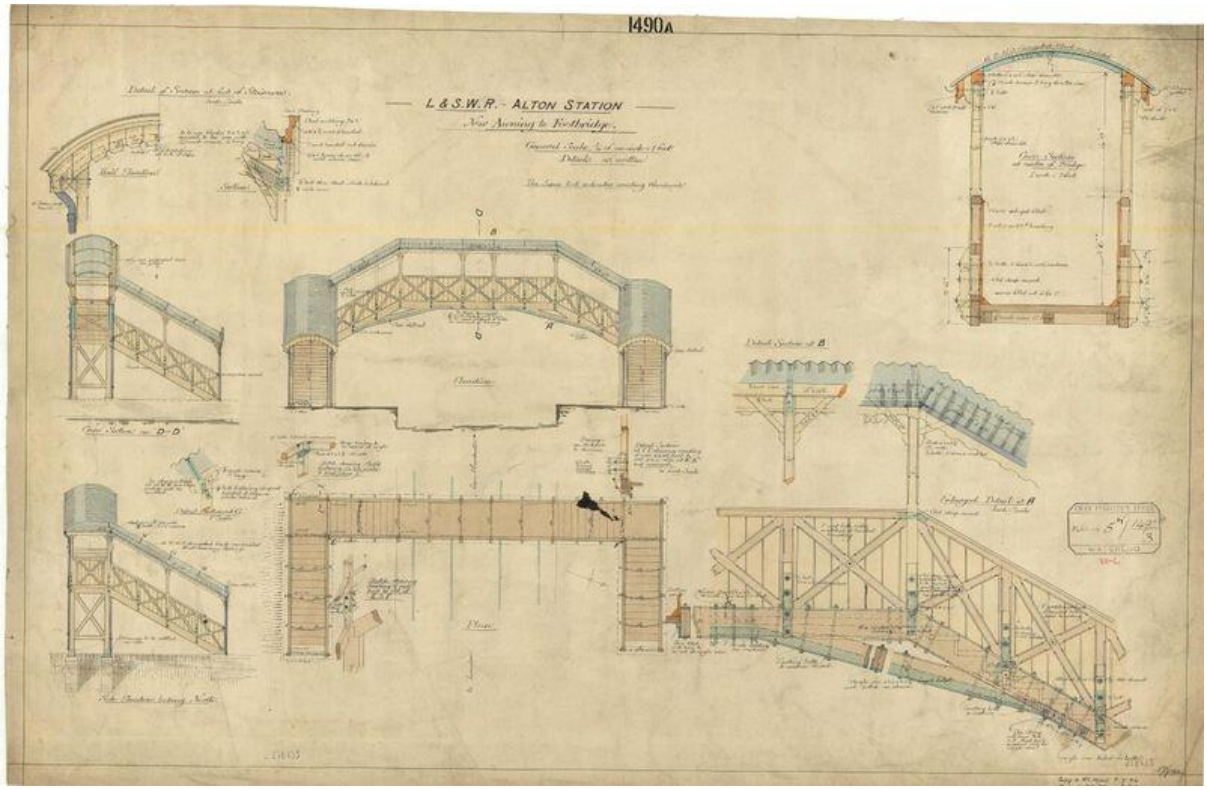

Figure 1 – LSWR drawing of planned cladding and roof at Alton.

Figure 2 - Wadebridge station footbridge circa 1910

Figure 3 - The LSWR timber footbridge at Andover Town station circa 1906

Figure 4 – Alton station footbridge stair elevation on platform 3 showing original bracing.

The corrugated sheet roof covering and associated light metal frame is supported on timber posts integrated with the underlying timber truss. The subsequent glazing was fitted between the posts supporting the roof and additional window mullions (see figure 5).

Figure 5 - Photo of footbridge interior

An 1892 drawing of a Meon valley type footbridge shows great detail about LSWR timber footbridge construction, in particular demonstrating that they were almost entirely bolted together, with very few tenon joints. It also shows that each leg of the supporting timber trestles was bolted into a specially made cast iron 'shoe' that was bolted onto a concrete foundation.

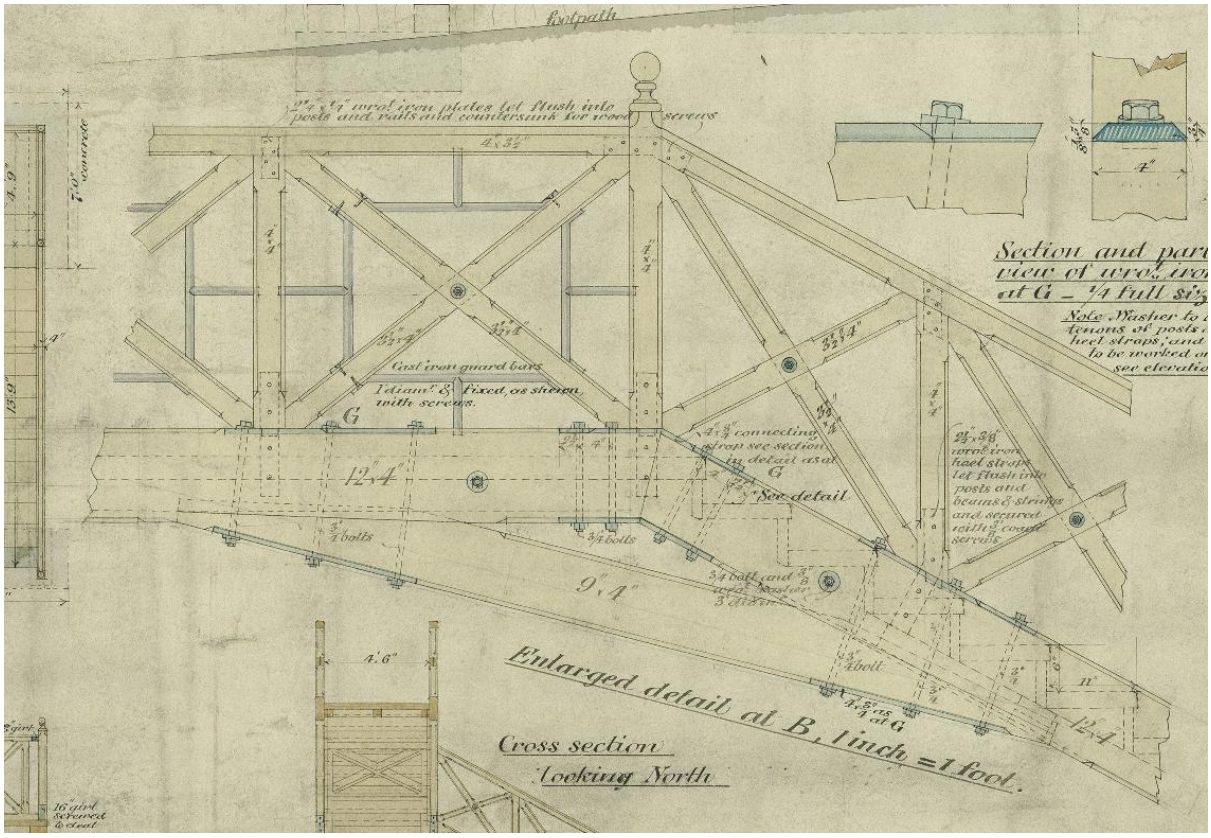

Figure 6 – LSWR 1892 drawing extract

There is much evidence that repairs to the footbridge have been undertaken throughout its life including by the Southern Railway (1923-1947). This included raised concrete bases for the trestle posts on platform 1 and timber section replacement on the trestle supports. Also the main timber lower truss members were strengthened on the soffit with steel 'T' sections at the truss haunches extending from the stair incline timbers to approximately one third the span of the of the main lower truss timbers.

It is evident that the condition of the structure has significantly deteriorated recently with further loss of timber section in trestle members and deterioration of glazing timbers and cladding (see section 3.0 below).

In 2013 Network Rail (NR) determined that the bridge had become uneconomical to repair and needed to be removed. This is now a practical option following construction of an alternative 'Access for All' footbridge (2013).

The concerns with the footbridge were discussed with Alton Town Council members and Planning Committee on 29 Jan 2014. Local councillors have been supportive of activities to retain the footbridge and assisted in establishing contact with Network Rail.

In May 2014 the Friends of Alton Station negotiated with Network Rail to retain the footbridge in the medium-term. The agreement was that NR would, at their own cost, repair the footbridge to the required standards (not a full restoration) to give a further 5 years of serviceable life. This was to give FAS enough time to secure funds to make a full restoration.

In April 2015 consultants Hyder produced a report for NR following a condition survey; this includes a summary of recommended remedial works plus identifies the need for regular 6 month inspections (see appendix 1).

In 2015 NR instructed contractor Osbourne to investigate remedial works. Osbourne used specialist sub-contractor Sumo who carried out the following further survey:

- Examination behind the cladding including use of endoscope
- Removal of one internal panel
- Removing patches of paint on trestles
- Drilling to check the extent of timber rot.

The investigation by Sumo led to the footbridge being closed in July 2015 on safety grounds. NR then contracted Hyder to conduct a second survey and their report was issued in September 2015. This highlighted a greater extent of timber rot than previously anticipated and they recommend further works and a structural assessment (see appendix 2).

In October 2015 some temporary works (steel sections and scaffold elements) were erected by Osbourne around the trestle on platform one to ensure the stability of this stair and the bridge.

Canadian pine was delivered to site for making the repairs, but when work resumed in January 2016, it was realised that the extent of the deterioration exceeded that identified in the second Hyder report. Work was stopped altogether and at the end of March 2016 the NR engineers issued an internal memo, copied to FAS, stating that they recommended removal of the footbridge. This memo estimated the cost of repairs at £750k as opposed to the projected cost of £250k for removal of the footbridge and making good including extended platform canopies etc.

3.0 Current Condition

In addition to the inspection & surveys carried out by Hyder and Osbourne/Sumo, NR enabled FAS to inspect the structure on 15 November 2016 with structural engineers Integral Engineering Design (Integral) and timber repair specialist Gary Appleton.

The footbridge is currently in poor condition. Poor detailing including at the interface between the glazed units and the footbridge main structure & cladding has undoubtedly contributed to the deterioration of the structure.

The following summarises the existing known concerns from the various inspections and surveys (see appendices for detail and photographs):

- Four post supports / trestles - extensive loss of section to members on both platforms as a result of wet and dry rot – repair / replacement of members required.
- Internal stair corner member and joint at half landing above Platform 2 – section loss plus swelling and joint separation – new member required.
- Damaged / poor condition rainwater goods (gutters & downpipes) - requires overhaul and repair or replacement
- Holes/cracking in roof cladding – requires overhaul and repair or replacement.
- External cladding is loose and has deteriorated in places – remedial works to cladding including replacement and re-fixing.
- Rotten timber window sections and sills – replace and repair; add protective flashings, covers and seals.
- Loss of section from timber rot in main truss members – patch repair.
- Minor spalling of concrete and corrosion of reinforcement at 4 post column/trestle bases on platform 1 – minor concrete repairs.
- Broken window panes – replace.
- Minor woodworm in particular on stairs – treat/repair as appropriate.
- Poor condition paintwork – complete repaint.
- Reinstate internal panelling.

The inspections to date suggests that the main truss members which span the operational railway are in reasonable condition. There is evidence of some timber decay, but this is not considered to be excessive. However, further intrusive examination of these main members is essential to verify this.

Substantial works are necessary to make the existing footbridge serviceable. A high proportion of these works are above or adjacent to the operating railway and would undoubtedly require works to be carried out at night or during day time closures. It should also be noted that further works may emerge during the remedial works, as poor condition timbers may be hidden behind cladding.

4.0 Structural Summary

The principal underlying structural form of the footbridge is two 'A' shape timber 'Howe' trusses (see figure 7) with a braced timber deck/walkway spanning between the two trusses. The main span is approximately 11.5 metres between the two timber trestle supports.

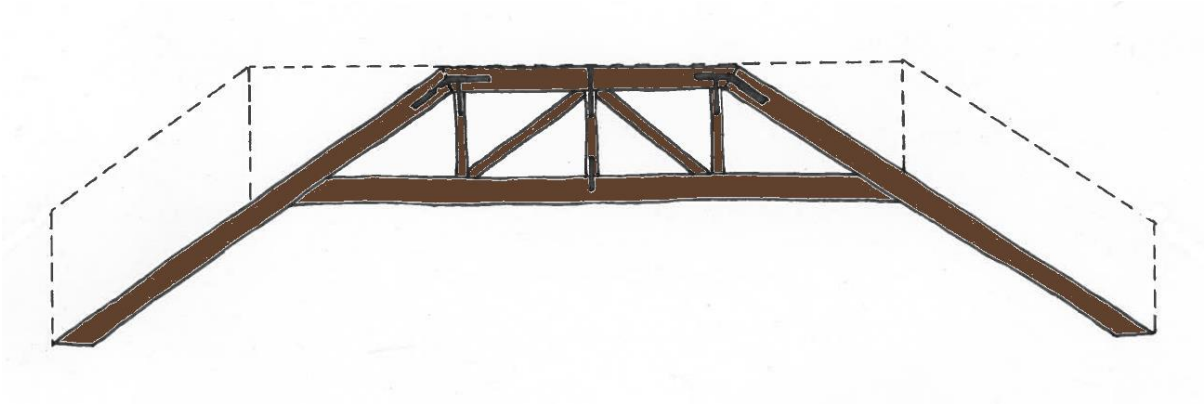

Figure 7 – 'A' shape Howe truss

Independent structural engineers Integral Engineering Design (Integral) produced a simple 2-dimensional assessment / analysis of the trusses to determine the forces on the structure from a worst load case scenario of crowd plus snow loading, i.e. 5KN/m2 (see appendix 3). From this Integral, concluded that with the timbers and connections in perfect condition the trusses would be strong enough to support the bridge's self-weight and imposed loads without significant vertical deflection. Further considerations will need to take into account the actual condition of the main timbers and connections.

It should be noted that there has been no assessment of the timber deck/walkway/stairs or the connections to the main trusses.

The main concern identified by Integral is the evident lack of rigidity/stiffness to resist lateral loading i.e. horizontal wind loading. It is evident by inspection that the connections between the deck/walkway and the trusses, plus the roof corner connections, are inadequate to resist the theoretical forces from wind on the bridge elevations. There is a lack of rigidity which results in excessive lateral movement and potential failure/collapse (see figure 8).

It would appear that a bridge designed and constructed as an 'open' sided structure has had subsequent modifications that has resulted in it being fully clad. As a consequence this has added lateral forces onto the structure for which the original structure has not been designed to resist.

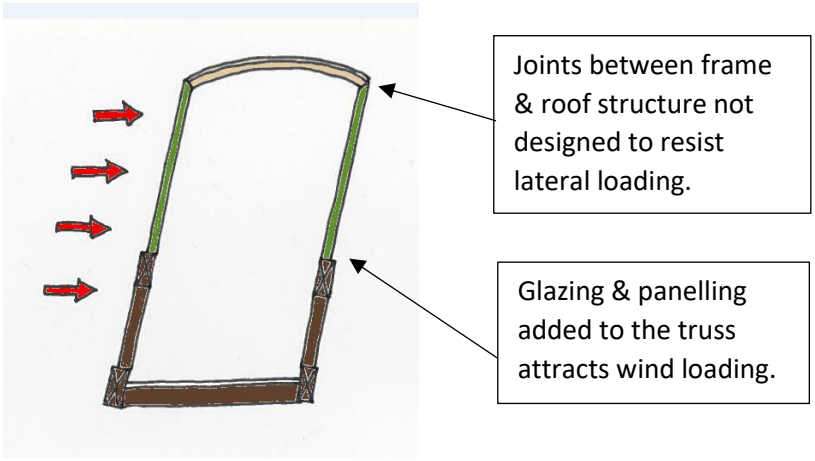

Figure 8 - Diagram from Integral report

This concern will need to be addressed in order to enable the bridge to be returned to service. There are, however, potential options to address this fundamental concern which would enable the bridge to be re-opened.

Integral suggest that it would be practical to strengthen the overall structure to resist lateral forces by the introduction of new rigid steel frames within the footbridge (see figure 9).

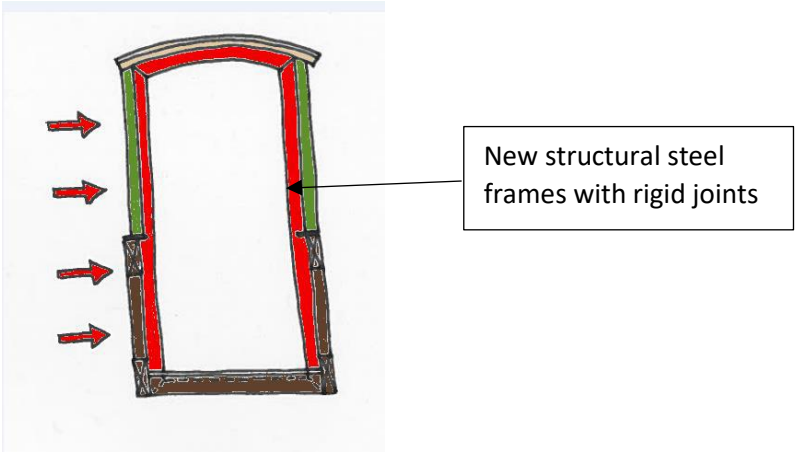

Figure 9 - Diagram of stiffening from the Integral report

Other options include opening up the elevations of the footbridge to allow wind to pass through the bridge and hence significantly reducing lateral loads. This effectively returns the structure to the intermediate form prior to addition of the glazing. This is a common form for footbridges spanning over operational railways.

Additionally it should be noted that the old structure will not have been designed to resist current day design standards i.e. derailment impact on the trestles. NR approval and derogation may be needed if the old bridge is to remain in some form.

5.0 Options

There are a number of options regarding the future of the footbridge. This report will consider the following six options:

1. Remove the old footbridge and make good the adjoining structures.
2. Strengthen and refurbish the old bridge in situ.
3. Strengthen and refurbish bridge off-site, reinstate the bridge in original location, Alton station.
4. Strengthen and refurbish bridge off-site, relocate the old bridge at a new location.
5. Refurbish the bridge in-situ with glazing removed – i.e.an open bridge.
6. Refurbish and make safe as a 'preserved' bridge – remains in situ not for public use.

Option 1 - Remove the old footbridge and make good the adjoining structures

Advantages ● Undoubtedly the cheapest and easiest option for Network Rail (NR) ● No ongoing maintenance liability.
Disadvantages ● Loss of local landmark and facility of value to the local community at Alton. ● Loss of historically important timber bridge. ● Loss of a sympathetic heritage structure as entrance to the heritage steam railway. ● Loss of an interesting heritage feature at Alton station – a key gateway to historic town of Alton. ● Significantly reduces the impact of the arrival at historic Alton. ● Undoubtedly will require at least one weekend closure of the station. ● Adjacent structures and platform will need to be repaired and made good in sympathy with surrounding station.

Option 2 - Strengthen and refurbish the old bridge in situ.

Advantages ● Retains the heritage structure in its current location ● Retains the heritage structure in its current form with some modifications. ● Opportunity to incorporate good practice and detailing to minimise future deterioration and maintenance.
Disadvantages ● Undoubtedly the most expensive option. ● Introduction of steel frames required to provide lateral stability which will impact on width of the walkway over the bridge at frame locations. ● Significant works required on and around the operating railway; will require night working and a number of station closures. ● Retaining old structure may require approval to deviate from current NR standards. ● Ongoing maintenance liability. There is the issue of who pays for this.

Option 3 - Strengthen & refurbish bridge off-site, reinstate the old bridge in original location

Advantages ● Reduces the amount of works on and around the operating railway ● Enables cost effective repairs and strengthening of the main span. ● Retains the heritage structure in its current form with some modifications. ● Opportunity to incorporate good practice and detailing to minimise future deterioration and maintenance. ● On completion the heritage footbridge is reinstated as new in its original location.
Disadvantages ● Requires suitable nearby construction site for at least 6 months. ● Loss of income from construction site. ● Requires use of mobile cranes to remove & reinstate the bridge – including station weekend closures. ● Risk that removal of main span proves not to be practical and the whole structure may fall apart. ● Retaining old structure may require approval to deviate from current NR standards. ● Ongoing maintenance liability and the issue of who pays for this.

Option 4 - Strengthen and refurbish bridge off-site, relocate the old bridge at a new location.

Advantages ● Enables ‘preservation’ of the main span and reconstruction of an interesting historic timber structure. ● Enables cost effective repairs and strengthening of the main span. ● Saves the heritage structure in its current form with some modifications and new elements. ● Opportunity to incorporate good practice and detailing to minimise future deterioration and maintenance.
Disadvantages ● Need to find a suitable alternative location and a willing asset owner. ● Old trestles will be removed and completely new trestles built – reduces amount of the original structure ‘preserved’. ● The footbridge will no longer be at Alton station. ● Loss of a sympathetic heritage structure as entrance to the heritage steam railway. ● Loss of an interesting heritage feature at Alton station – a key gateway to historic town of Alton. ● Significantly reduces the impact of the arrival at historic Alton. ● Adjacent structures and platform will need to be repaired and made good in sympathy with surrounding station.

Option 5 - Refurbish the bridge in-situ with glazing removed.

Advantages ● Eliminating glazing should eliminate the need for lateral strengthening frames (subject to structural assessment & analysis) and should reduce costs. ● Retains the heritage structure in its current location. ● Retains the heritage structure in its current form but with significant modifications. ● Reduced maintenance due to no windows but possible increase in walkway maintenance.
Disadvantages ● Still requires significant works on and around the operating railway; will require night working and a number of station closures. ● Ongoing maintenance liability. Again the issue of who pays for this. ● Walkway and bridge interior will need to have finishes suitable for ‘external’ environment; including appropriate lighting & electrics. ● Retaining old structure may require approval to deviate from current NR standards. ● Does not ‘preserve’ the old bridge in the form that Alton residents are familiar with. ● NR and Office of the Rail Regulator (ORR) may insist on open mesh screens above the operating railway.

Option 6 - Refurbish and make safe as a 'preserved' bridge – remains in situ.

Advantages ● Retains the heritage structure in its current location ● Retains the heritage structure in its current form with some minor modifications. ● Minimises works to the structure, i.e. essential repairs and safety works only. Includes decorative painting. Refurbished for maintenance access loading only.
Disadvantages ● Bridge is not strengthened and not available for use by passengers; purely retained in order to maintain the station ambience. ● Will still require some works on and around the operating railway including night working. ● Retaining old structure may require approval to deviate from current NR standards. ● Significant ongoing maintenance liability. There is the issue of who pays for this. ● May not be acceptable to NR.

6.0 Conclusions

Option 1 is undoubtedly the easiest and cheapest but this does not achieve the main objective of retaining the footbridge at the station. Additionally this option will require the making good of the remaining areas of the station plus sheltered routes to the new footbridge all this to the required aesthetic and practical standards. The Friends of Alton Station cannot support this option.

Option 6 is a 'last resort' that FAS would find tolerable. This is likely to be a cheaper solution but due to the poor condition of the structure it may only prove to be a relatively short term solution and will undoubtedly need significant on-going maintenance the funding of which need to be agreed. This option is unlikely to be acceptable to NR.

FAS consider all other options are practical and should be further investigated and subject to consultation. Retention of the bridge in its current location has the unresolved issue of who pays for ongoing inspection and maintenance. Moving the bridge to another location requires a willing partner to take ownership of the bridge including ongoing maintenance; besides, of course, this means loss of the bridge from Alton station, the whole reason for existence.

Preliminary 'high level' cost estimates for FAS of the options suggest that the NR estimate of £750k for option 2 is excessive and the costs of this option should be investigated further. The cost estimates for options 3 and 5 suggest it may be possible for these options to be delivered at approximately two thirds the cost of option 2 and at a cost not far beyond the NR estimate for footbridge removal. As a consequence these options should be investigated further.

7.0 Recommendations

Investigate further options 2, 3 and 5 including more detailed costings/estimates for the works. This may include further use of consultants as available funds permit.

Consult on whether option 5 is an acceptable strategy for the local community and Network Rail.

Investigate options for relocation of the footbridge and make enquiries in the town for the appetite to support this strategy.

Consider further intrusive survey of the main timber truss elements and seek funding.

Paul Ebbutt
C.Eng FICE, MIStructE, MPWI, MCILT.

21st January 2017

MEMORANDUM

Date	09 April 2015
Reference	UA007705-19-ECV-MEM-HYD-1502 rev A01
From	Toby Skeels
To	Ian Grimes, Daniel Perez
Copies	Richard Shimell, James Buckley, Tom Faith, Geoff Rowan
Subject	Alton Station – Heritage Footbridge Condition Report

To Ian and Daniel,

Hyder Consulting Ltd were commissioned to undertake a visual condition survey of the heritage footbridge structure at Alton Station.

Following the construction of a new DDA station footbridge, Network Rail originally intended to demolish the heritage footbridge structure that is approaching the end of its design life and remove the ongoing associated maintenance costs.

However, the Stakeholder engagement process identified the Watercress Line owners and local community's desire to retain the footbridge as it:-

1. Provides a more direct link to the Watercress Heritage Railway Line from the station entrance and
2. Holds nostalgic value to regular station users and the wider community.

As such, Network Rail instructed a condition survey in order to ascertain the remaining design life of the structure, taking care to ensure the structure would be safe for short-term use while further stakeholder discussions are ongoing. The survey of the structure, remedial works required, conclusions and recommendations have been recorded within.

Kind regards,

Toby Skeels

One Team Wessex – Senior Civil Designer

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Summary

This visual condition survey aims to identify the risk to station users posed by the heritage footbridge structure at Alton Station. The survey was conducted from platform level and through the footbridge using a camera to create photographic records. Defects, where present, were recorded and a course of action noted.

The heritage footbridge structure is a wooden through bridge supported from four post braced columns located on Platforms 1 and 2. The footbridge bottom chords are partially strengthened with steel T-sections from the supports to approximately one third span. The footbridge is fully enclosed with a semi-circular corrugated roof. The footbridge has handrails throughout and the treads and risers are in good condition. It is glazed throughout with only a few broken/missing panes. The survey identified some minor defects, some of which require reactive remedial action in the short-term to extend the structure's life into CP6:-

1. Some woodworm was identified in non-structural timber members.

2. Wet-rot and dry-rot of the large, four post, braced square column supports was identified. Areas where the roof drainage is leaking into the footbridge have also been noted.

At present the current level of section loss at the supports does not present a significant risk to the structure's integrity. It is recommended that specialist advice is sought on all areas of wet and dry rot of the footbridge to ensure appropriate remedial action is taken to agree appropriate surface treatment is performed to prevent further section loss. This intervention should be undertaken within the next 3 months. Minor repairs are required to some gutters, downpipes and window panes to ensure the safety of the footbridge.

The risk in retaining the heritage footbridge until CP6 is considered to be low. If the recommended repair works are carried out then the design life of the footbridge can reasonably be considered to continue for another 4 years. Maintenance recommendations contained herein should be adhered to in order to ensure the safety of the structure is maintained.

The complete list of stations under consideration in the study are shown in the table below.

Station	**ELR**	**Mileage**	**Asset**
Alton	PAA2	49m 13ch	Heritage Footbridge

Below, this memo goes into greater detail on the defects recorded, the remedial works required to ensure the ongoing safety of the structure as well as maintenance recommendations and conclusions.

- *The issue of this memo was delayed in order to incorporate an overview of the most recent structural assessment report against the findings herein. However, as an assessment report has yet to be obtained, Revision A01 of this memo is issued without this evaluation. Should the issue of a structural assessment be forthcoming in the near future, this memo will be revised and verified against the historical assessment data.*

Defects

Photographic records of defects and notes are shown below (see attached Plan):

Photo 1: Wet rot to lower connection of 4 post support column diagonal brace (Platform 1)

Photo 2: Dry rot to underside of 4 post support column diagonal brace (Platform 1)

Photo 3: Dry rot to vertical face of 4 post support column diagonal brace (Platform 1)

Photo 4: Minor spalling and corrosion of reinforcement at southernmost of 4 post column concrete base support (Platform 1)

Photo 5: Split in corrugated roof cladding at stair landing, causing leak into footbridge and water ingress at westernmost corner (Platform 2)

Photo 6: Roof leak above causing swelling and separation of stair corner joint (Platform 2)

Photo 7: Wet rot to top of vertical roof support timber directly below leak (Platform 2)

Photo 8: Wet rot of timber at steel T-section connection at westernmost corner directly below roof leak (Platform 2)

Photo 9: Wet rot of timber at steel T-section connection at westernmost corner directly below roof leak (Platform 2)

Photo 10: leaking gutter allowing water to spill onto country end face of the footbridge causing paint to peel and degrade timbers (Platform 2)

Photo 11: Swelling of timber cladding caused by rainfall. Cladding requires refixing to ensure it does not become dislodged in high winds (Platform 1)

Photo 12: Broken glazing pane in the centre glazing panel above the line. Replacement and repair required

Photo 13: Woodworm affected stair risers (Platform 1)

Remedial Work

The following is to be read in conjunction with Photo Location Plan provided with this memo.

Photo	Defect	Repair	Time frame for action
1	Wet rot causing loss of section	It is recommended that where rot (wet and dry) is present that specialist advice is sought to ensure appropriate remedial action is taken to agree a surface treatment is performed to prevent further section loss	3 Months
2	Dry rot causing loss of section	It is recommended that where rot (wet and dry) is present that specialist advice is sought to ensure appropriate remedial action is taken to agree a surface treatment is performed to prevent further section loss	3 Months
3	Dry rot causing loss of section	It is recommended that where rot (wet and dry) is present that specialist advice is sought to ensure appropriate remedial action is taken to agree a surface treatment is performed to prevent further section loss	3 Months
4	Minor spalling and corrosion of concrete base upstand reinforcement	Small concrete patch repair with associated preparation of area to be repaired.	To be monitored
5	Crack and hole in corrugated roofing causing leak into the footbridge and water ingress at corner location	Repair crack and hole in roof cladding or replace defective corrugated element. Repair timeframe to be aligned with timber repair to ensure the structure is watertight prior to treatment of areas affected by rot.	3 Months
6	Swelling of wood causing separation at corner location	No immediate action Area to be monitored at regular maintenance intervals	N/A
7	Wet rot causing loss of section	It is recommended that where rot (wet and dry) is present that specialist advice is sought to ensure appropriate remedial action is taken to agree a surface treatment is performed to prevent further section loss	3 Months
8 & 9	Wet rot causing loss of section	It is recommended that where rot (wet and dry) is present that specialist advice is sought to ensure appropriate remedial action is taken to agree a surface treatment is performed to prevent further section loss	3 Months

Photo	Defect	Repair	Time frame for action
10	Staining and peeling/loss of paint due to overrunning drainage	Locate source of drainage overrun and take remedial action. Ensure timbers are in good condition, if so re-treat and repaint accordingly.	3 Months
11	Swelling of timber boards due to water ingress	At locations above the platform – repair existing timbers where possible and re-fix to footbridge structure.	6 Months
		At locations above the railway – timber panels are to be monitored during regular inspection – not perceived to be a risk to general public but may cause damage to passing trains.	N/A
12	Broken pane of glass	Replace pane of glass and make good pane mount. All other panes should be checked during future inspections.	3 Months
13	Minor woodworm to stair risers	Treat accordingly to prevent further spread of woodworm	12 Months

Recommendations

Remedial Works:-

Initially it is recommended that the remedial works outlined above are undertaken at the earliest convenience to prevent the spread of the rot and the woodworm.

Maintenance activities:-

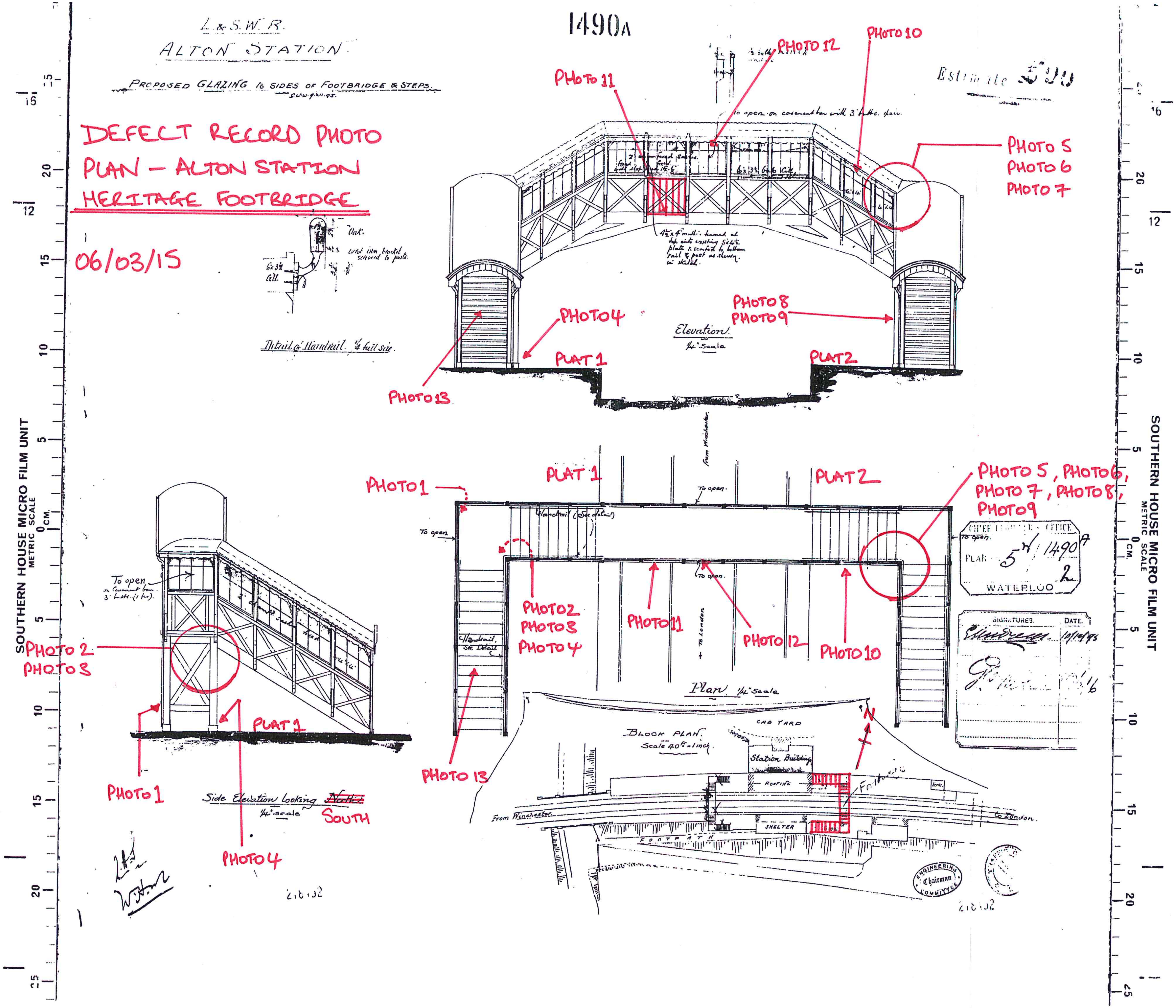
It is recommended that to ensure that the footbridge structure is safe for use until the beginning of the CP6 period that regular maintenance surveys are undertaken. It is proposed that following the remedial works recommended above that the footbridge then be inspected on a 6-monthly basis to confirm that its integrity is ensured.

Should any further drainage leaks be identified during the regular maintenance checks, it is advised that these be dealt with swiftly as the water ingress has the ability to have a grossly detrimental effect on the structure.

Conclusion

Subject to the completion of the remedial works and maintenance advice contained within this memo, it is considered that:-

- The risk presented to the public by the continued use of the heritage footbridge into the CP6 funding period is low,
- The structure retains sufficient design life to support delaying its decommissioning until CP6.


L.&S.W.R.
ALTON STATION
PROPOSED GLAZING to SIDES OF FOOTBRIDGE & STEPS.
1490A
DEFECT RECORD PHOTO
PLAN – ALTON STATION
HERITAGE FOOTBRIDGE
06/03/15
Detail of Handrail. ¼ full size.
Elevation. ¼" Scale
Plan. ¼" Scale
Side Elevation looking North SOUTH
¼" scale
Block Plan. Scale 40ft = 1 inch
CAB YARD
Station Building
SHELTER
FOOTPATH
From Winchester
To London
To open
PLAT 1
PLAT 2
PHOTO 1
PHOTO 2
PHOTO 3
PHOTO 4
PHOTO 5
PHOTO 6
PHOTO 7
PHOTO 8
PHOTO 9
PHOTO 10
PHOTO 11
PHOTO 12
PHOTO 13
SOUTHERN HOUSE MICRO FILM UNIT
METRIC SCALE
WATERLOO
SIGNATURES.
DATE.
Chairman
ENGINEERING COMMITTEE

MEMORANDUM

Date	17 September 2015
Reference	UA007705-19-ECV-MEM-HYD-1503 rev A01
From	Richard Shimell
To	Ian Grimes, Daniel Perez
Copies	Toby Skeels, James Buckley, Tom Faith, Andy Barnes
Subject	Alton Station – Heritage Footbridge Condition Report - Addendum

To Ian and Daniel,

Hyder Consulting Ltd were commissioned to undertake a visual condition survey of the heritage footbridge structure at Alton Station. Hyder produced a memorandum on the bridge condition, UA007705-19-ECV-MEM-HYD-1502 rev A01 dated 09 April 2015, following a daytime visual survey. The document made a number of recommendations and conclusions to identify a scope of works and repairs to allow the bridge to be retained to the start of Network Rail (NR) Control Period 6 (CP6).

The scope of remedial works required to increase the life of the bridge structure was included in Osborne's contract in conjunction with Alton Station Franchised Station renewal works on Platform 2. A specialist timber supplier, Sumo, was commission to undertake the repair works. In preparation to start the works, it is understood that further intrusive inspections of the bridge were undertaken by Sumo. This was done by:

- removing paint on platforms trestle supports and drilling to check for rot extent
- opening one internal panel
- using an endoscope camera through drilled inspection holes

These survey by Sumo identified an increased extent of wood rot in the main trestle legs and also additional wood rot within the main span, including in the single panel opened adjacent to the staircase on Platform 1, where the wooden member beneath the window had significant wet rot. This additional information resulted in an on-site decision to close the footbridge to public throughout the Platform 2 Franchised Station renewals works. Public access was maintained through the modern AfA footbridge situated further towards the London end of the station.

Following this decision, Hyder were asked to provide further advice on whether the original scope of work had grown and if the original conclusions with regards to extending the short-term use of the bridge to CP6 were unchanged. To inform this Hyder re-visited the bridge to inspect the internal panel, obtained feedback from Sumo of the outcome of their surveys and reviewed a video and photographic survey by Osborne undertaken through internal panel inspection holes. This memo presents this additional information and provides conclusions and recommendation on the scope of bridge repairs.

Kind regards,

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Asset Information

The complete list of stations and assets under consideration in the study are shown in the table below.

Station	ELR	Mileage	Asset
Alton	PAA2	49m 13ch	Heritage Footbridge

The heritage footbridge structure is a wooden through bridge supported from four-post braced columns located on Platforms 1 and 2. The footbridge bottom chords are partially strengthened with steel T-sections from the supports to approximately one third span.

The footbridge is fully enclosed with a semi-circular corrugated roof. Archive drawings suggest the footbridge is 1.4m wide. The footbridge has wooden handrails throughout and the treads and risers are generally in good condition (stair woodworm has been previously identified), with yellow nosings to indicate landings and white nosing in-between. It is glazed throughout with only a few broken/missing panes. The bridge is clad with painted tongue and groove boards externally beneath the glazing and has thin painted wooden internal cladding panels.

Additional Survey Information

Following the decision to close the heritage footbridge at Alton Station to the public, more information was needed to allow a review of the bridge condition to judge if original repair recommendations were sufficient to retain the bridge into CP6. The area of focus was the main span of the structure, which was hidden by internal cladding panels on the first survey. Three additional sources of information were obtained:

1. Additional Sumo survey information
2. Day time visual inspection by Hyder on 30 July 2015 to review behind staircase panel
3. Photographic and video camera survey through drilled inspection holes in the panels by Osborne

Sumo Survey Information

It is understood from Osborne that in preparation to undertake contracted repair scope of works on Alton Footbridge, Sumo, a timber specialist subcontractor commissioned to perform the bridge repairs, undertook further inspections in July 2015.

Where repairs had been identified on the platform trestle legs, Sumo removed paint and drilled through members to ascertain the extent and depth of the rot. The rot on diagonal trestle members was more extensive than first identified based on purely visual inspections.

Sumo also drilled round holes approximately 75mm diameter and then used a digital black and white endoscope camera to check if there was rot behind the internal bridge panels. Furthermore Sumo opened a panel on Platform 1 between the intermediate landing and the main span on the country elevation of the bridge (see Figure 1).

A brief report was obtained from Sumo following the surveys which stated that they found “various minor rot behind the panels on the upright posts and stair stringer”. However, it was observed that “without removing the panels, we [Sumo] cannot see the extent of the rot”. The endoscopic camera did not record video and no further data was available to Hyder to review other than these observational comments.

Visual Inspection

Hyder engineers conducted a daytime site visit on 30 July 2015, principally to look behind the panel Sumo opened adjacent to the Platform 1 stairs. The panel had a significantly rotten timber member, spanning between vertical members beneath the window sill. This location is shown in Figure 1.

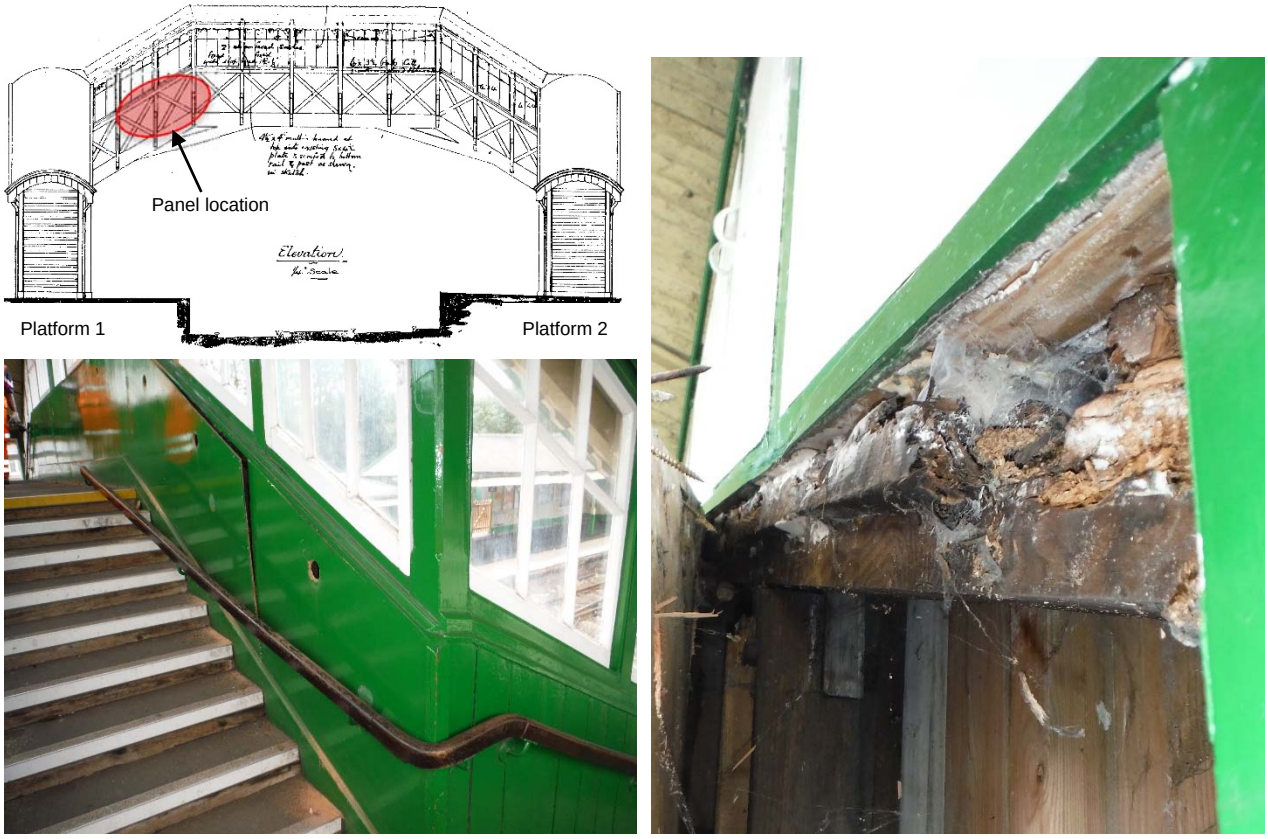


Figure 1: Location and rotten timber behind internal panel

The visual survey continued by looking through the drilled inspection holes on the internal cladding panels to attempt to determine the bridge structure, as initial findings suggested differences to archive information, such as an absence of the cross bracing beneath the windows (as shown in the archive drawing displayed in Figure 1). Whilst the location and size of the holes limited the extent of information to be gained, no cross bracing was observed behind any panel and some structural form could be identified, including perceived main diagonal and horizontal elements, as illustrated in Figure 2 (and shown further in Figure 15).

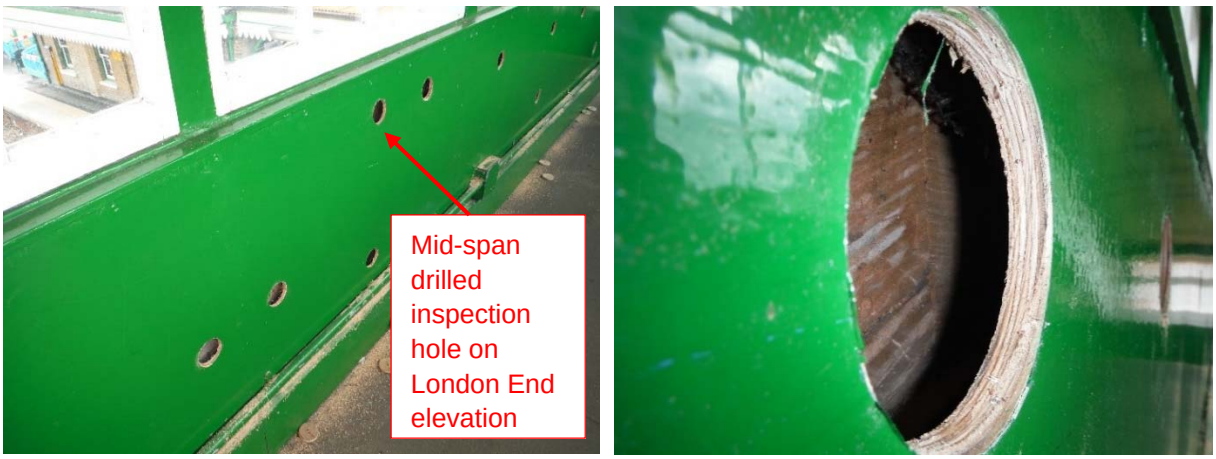


Figure 2: Drilled inspection hole showing diagonal member transition into horizontal member

Further internal cladding panels were not removed at this time due to the risk to operational lines beneath the bridge and potential disturbance to external cladding.

Photographic & Video Survey

To assist with the assessment of the bridge, Osborne performed a video survey behind the panels by drilling larger inspection holes and filming through them to see if rot could be identified on the main span. The survey numbered the panels as shown in Figure 3.

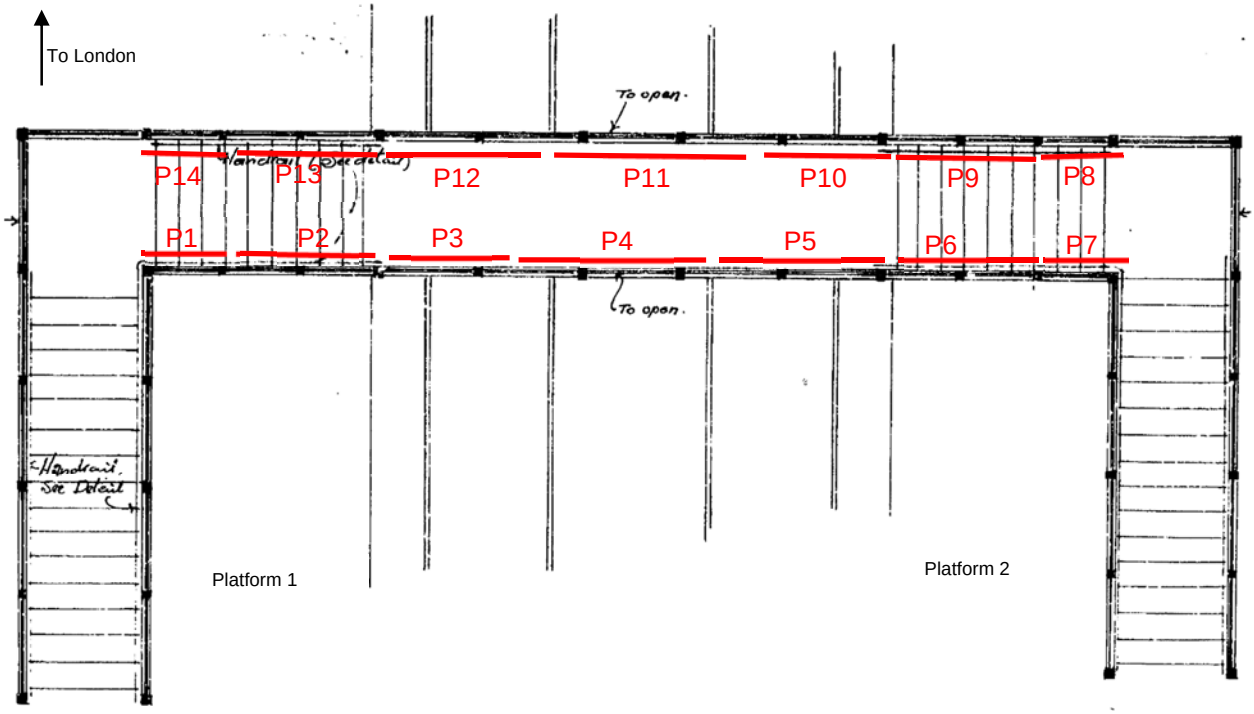


Figure 3: Internal panels numbering for video survey

The video did not provide sufficient lighting levels or image quality to determine any additional rot within the main span. No timbers with section loss were identified and it is unclear if the timbers were wet or dry at the time of filming.

The video was supported by a brief photographic survey with images behind the internal panels. The main observations from these photos are included in Figure 4 to Figure 13.

Figure 4: View down into Panel 1 and view down into Panel 2

Figure 5: View towards Platform 2 and view towards Platform 1 in Panel 3

Figure 6: View towards Platform 1 in Panel 4

Figure 7: View towards Platform 1 and a view looking up to the window sill in Panel 5

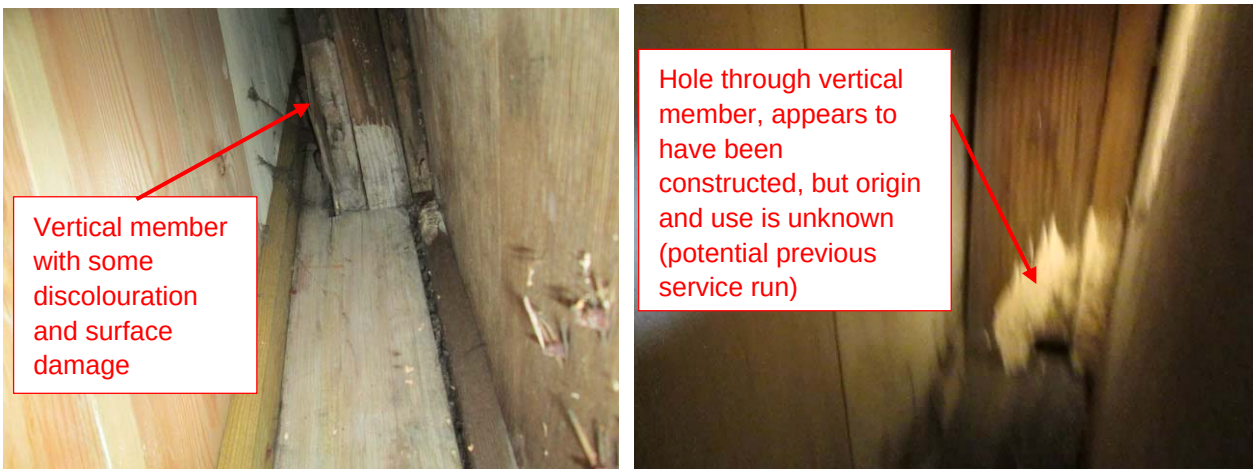


Figure 8: View towards Platform 1 in Panel 6 and a view towards Platform 1 in Panel 7

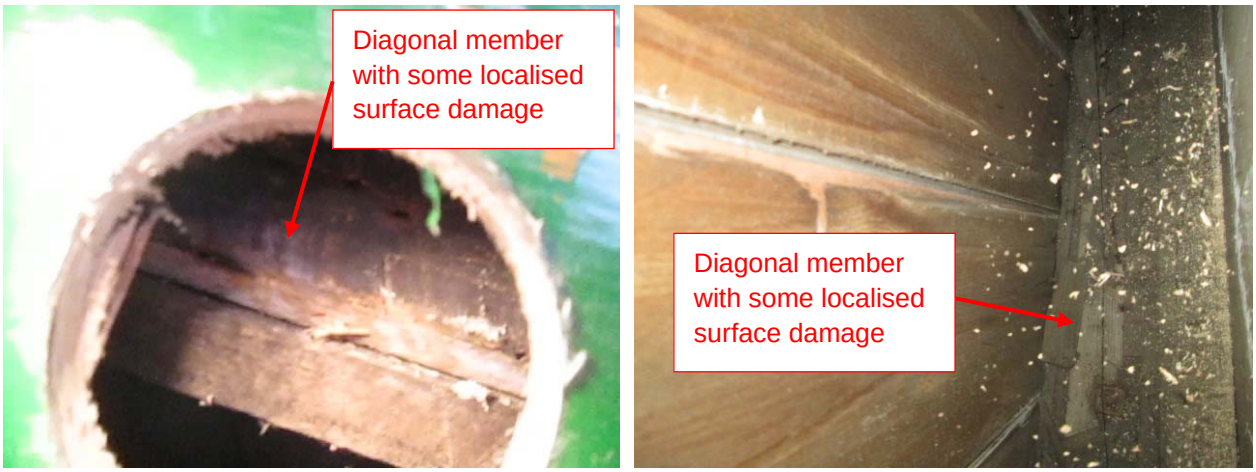


Figure 9: View through inspection hole at top of Panel 8 and a view down into Panel 8

Figure 10: View looking down towards Platform 2 and a view looking up towards Platform 2 in Panel 10

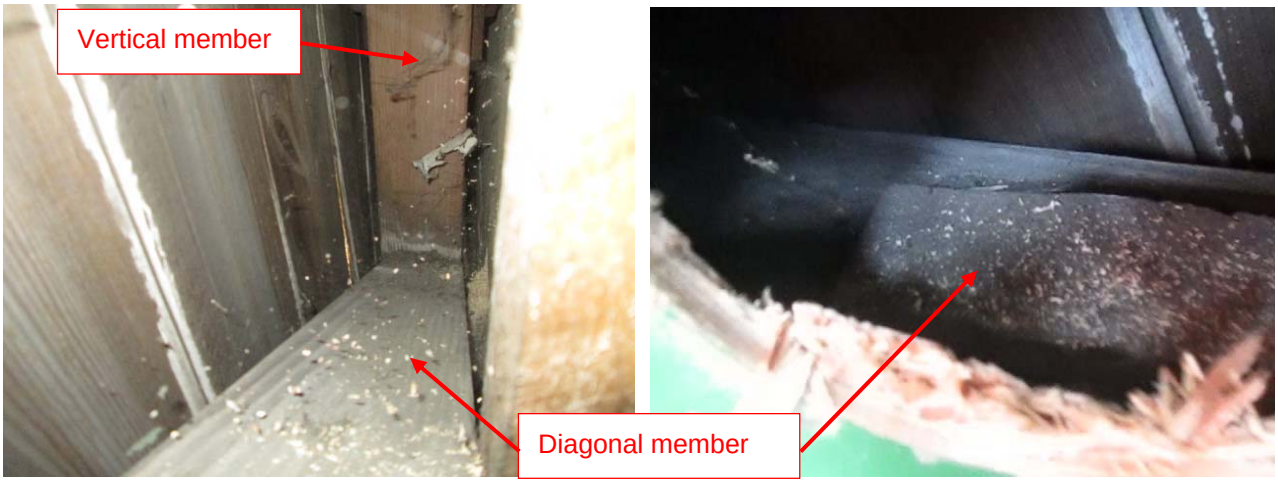


Figure 11: View towards Platform 2 and a view down in Panel 11

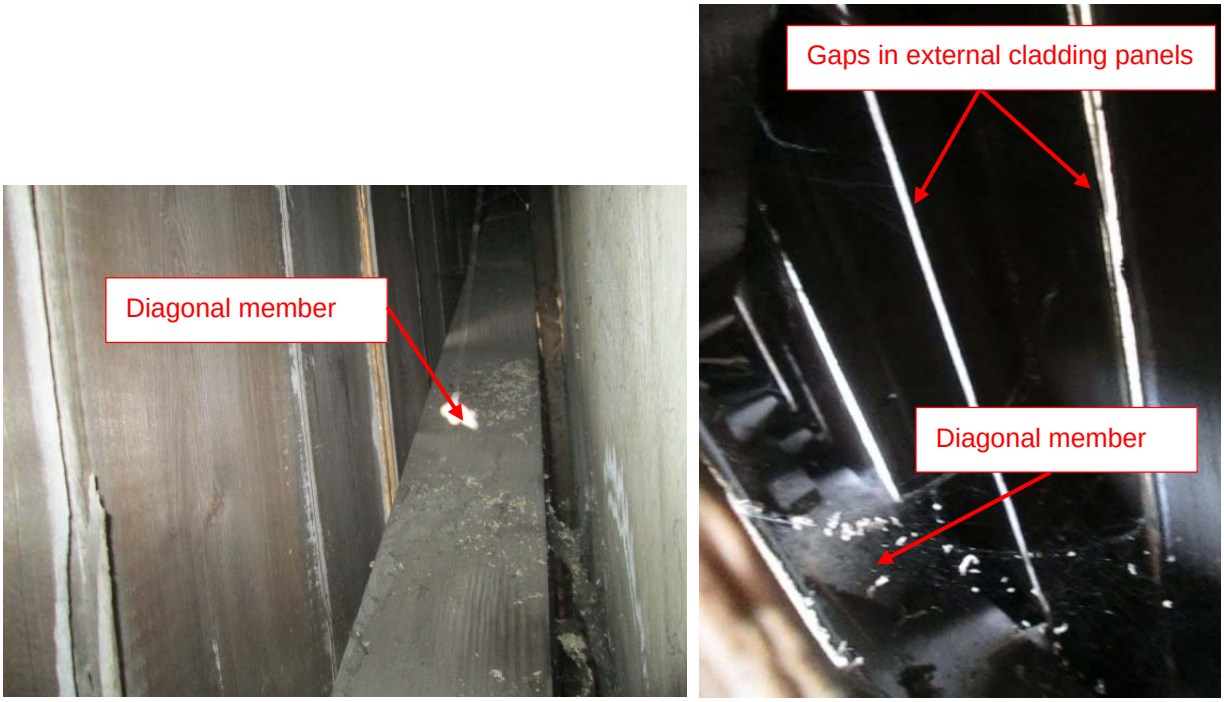


Figure 12: External views of Panel 12

Figure 13: View in Panel 13 & 14 (staircase)

The video and photographic evidence provided shows the diagonal members (transverse stair stringers) spanning from the support trestles do not form the bottom chord of the footbridge. These diagonal members continue up into the structure and another member spans horizontally across the tracks. This supports external observations and suggests metal bracing has been used to provide a link between these two structural members.

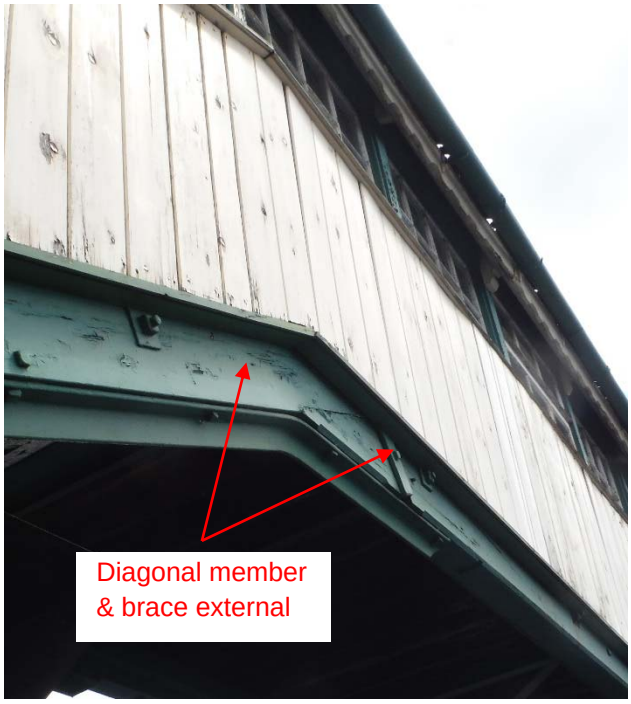


Figure 14: View from Platform 1 of external main span diagonal member which continues under the stairs up between the internal panels and external cladding. A metal brace appears to pass above this diagonal member, as shown in Figure 5 and Figure 10 and fix externally into the main horizontal member

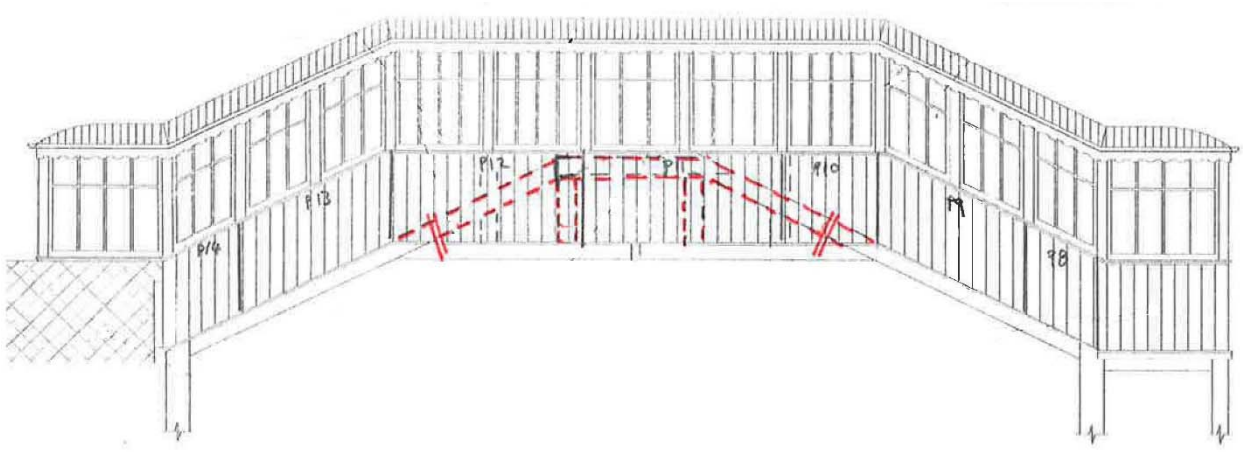


Figure 15: Believed structural form of Alton Footbridge from photos and video evidence

The photos behind the panels illustrated evidence of water ingress, such as discolouration and damage to window sills, and signs of some surface damage to members. From this evidence, these defects are judged to be non-structural and no significant rot within the main span has been identified. However no touching inspection has been performed and unclear if the timbers were wet or dry, soft or hard. Gaps to external cladding panels were previously identified and panels should be re-fixed as required.

Conclusion

It is judged based on this additional information that the original remedial works presented in the Hyder memo UA007705-19-ECV-MEM-HYD-1502 rev A01 dated 09 April 2015, and developed into a scope of works for the Osborne contract at Alton Station are sufficient to extend the bridge design life into CP6. This conclusion is based on engineering judgement of the additional evidence presented, rather than a structural assessment.

The RAM remitted scope of remedial works, developed from the original Hyder inspection and subsequent Osborne supply chain engagement with Sumo, were identified as follows (taken from Alton Stage 2 contract):

- Undertake permanent repairs to existing trestle legs on Platform 1 and 2 where section loss has occurred.
  - Surface decay not exceeding 15mm depth – 2 part filler finished smooth in preparation for decorations
  - Decayed timber not exceeding 40% section loss – chop out defective timber to sound surface and undertake scarf repair using Douglas Fir bolted and plated
  - Section loss exceeding 40% - cut out defective timber to a minimum of 150mm beyond extent of rot, replace section with Douglas Fir to match existing. Slot mortice tennon joints, or doweled tennon jointing between new and existing timber as appropriate
- Patch repair to spalling and corrosion of reinforcement to Platform 1 concrete base
- Patch repair corrugated roofing with code 4 lead dressed to existing sheeting
- Re-fix external vertical TG&V cladding in various location (allow to replace timber studwork behind cladding
- Treat woodworm to stair risers
- Replace broken glass
- Service existing rainwater goods and leave free flowing to eliminate over run
- Chop out rotten sections of window sill and replace with new C24 treated timber
- Fabricate and install new painted steel flashing to cover and protect existing external sill to prevent further water ingress to bridge span
- Reinforce existing joints to timber sashes as required using galvanised steel plates
- Re-seal externally between sashes and frames
- Scrape back areas of loose paint
- Paint all bare timber with ‘Sadolin Superdec’ or similar opaque timber protection pigmented to match existing

These remedial works should be undertaken in conjunction with the identified maintenance activities also recommended in the memo. Access to Platform 2 can be maintained via the AfA footbridge during the works.

The following is recommended based on the additional information available:

1. Previously identified trestle leg repairs should be performed based on extents found in Sumo intrusive survey findings.
2. The rotten timber member beneath the window sill discovered beneath the panel shown in Figure 1 should be replaced.
3. The internal panels which have been drilled for inspection are to be replaced.

Consideration should be given to:

1. Sumo did report the endoscopic survey identified areas of rot and some photos show evidence of surface damage of some timbers. There is evidence of water ingress through the main span (such as discolouration to timbers and damage to window sills) which is consistent which observations in the original remedial repair memo which noted roof and gutter repairs were required. The extent and severity of these defects should be explored and repairs assessed as part of the works, as it is currently unclear if the timbers are dry or damp or exhibit any soft spots.

2. Further inspection behind the internal panels would allow improved understanding of the structural members and loading pathways of the bridge. It is noted that there are discrepancies between archive information and the structural form observed through reviewing photos and video evidence. As such, structural modelling and assessment of the footbridge would benefit the understanding of the existing structure and provide more accurate assessment of its load capacity.

It is noted that if the footbridge needed to be re-opened with a known load capacity then a structural assessment would need to be undertaken.

integral
engineering design

ALTON FOOTBRIDGE INITIAL STRUCTURAL REPORT

Alton Footbridge

Initial Structural Report

1121

December 2016

Revision

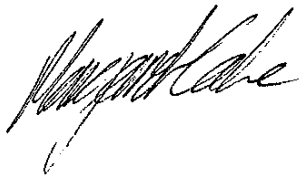
Date	Revision	Comments
02.12.16	/	First issue
19.12.16	A	Revised as indicated

Quality Assurance Review

Prepared by: Kim Collins

Signature 

Reviewed by: Margaret Cooke

Signature 

Date: 02.12.16

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1.0 Introduction

Integral Engineering Design have been asked by the Friends of Alton Station to provide an independent structural assessment of the timber footbridge spanning over the railway at Alton Station.

A visual survey of the bridge was carried out on 15th November 2016. At the time of the inspection the weather was cool but dry. A number of the primary truss timbers on the south side of the bridge were exposed during the visit to allow a visual inspection. Where timber members were hidden by internal and external boarding they were not inspected and the structural condition remains unknown. The stringers and external timbers were viewed only from ground level.

The bridge spans approximately 11.5m over the railway at Alton Station and is constructed from two primary timber trusses, one to each side of the walkway. The primary truss members are connected using iron or steel plates and straps. The walkway is braced on plan and the trusses are supported on timber trestles which sit on the platforms to either side of the line. The primary trusses are built in to the balustrades to either side of the walkway and covered with timber boarding externally and plywood internally. The top of the truss which forms the balustrade to the centre of the span is approximately 950mm above the walkway. The bridge is covered with what appears to be a corrugated iron roof spanning between slender steel or iron 'T' sections which are supported on timber window mullions fixed directly to the top of the balustrade.

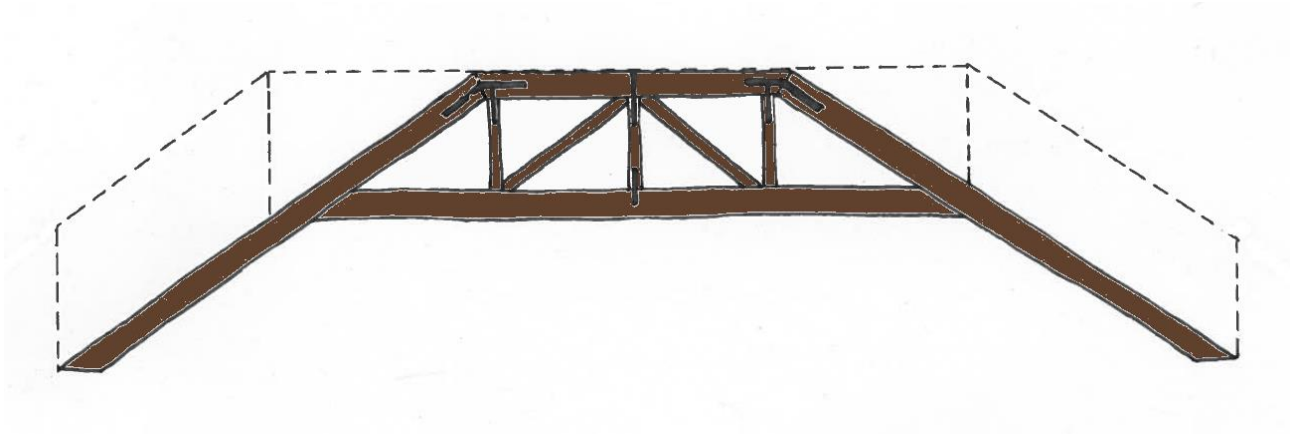

Fig. 1 Bridge truss as built

Historic drawings of the bridge exist but they do not reflect the construction of the existing structure. The drawings show an exposed timber modified Howe truss. The design appears to have been modified prior to construction to allow the primary diagonal timbers to continue to the top chord. The side panelling and iron roof covering was subsequently added followed by the glazing.

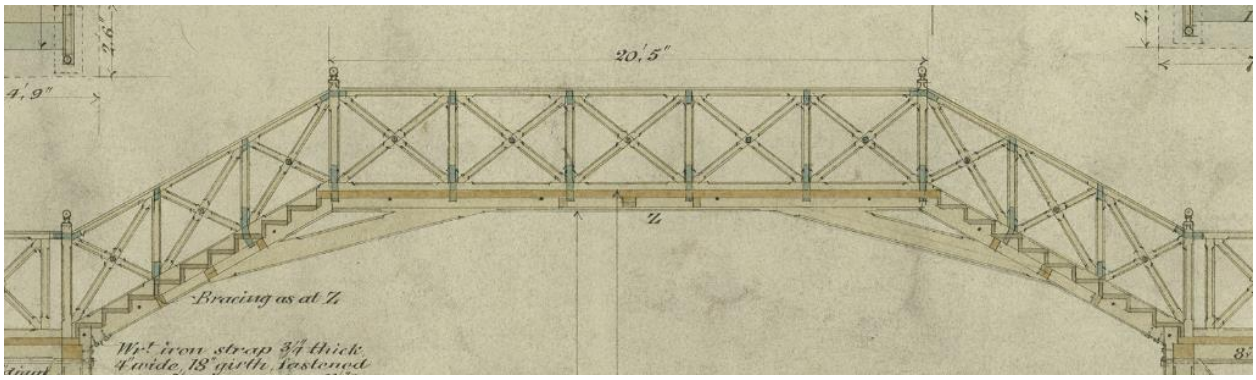

Fig. 2 Bridge truss as shown on historic drawings

2.0 Observations

- The trestle supports have obviously suffered significant decay as a result of water ingress causing loss of section in trestle members on both sides of the bridge. Significant repair or member replacement is required to both trestles.

Fig. 3 Decayed trestle timbers

- The majority of the primary structure remains hidden beneath internal and external timber panelling. There is evidence throughout the structure that the primary structural members have decayed from the inside out leaving a shell of visually intact timber. This is potentially dangerous as without an extensive timber survey involving probing of each individual timber at regular intervals the extent of decay cannot be confirmed. Timbers may appear sound but actually have no structural capacity at all.
- The bridge has limited lateral stability parallel to the railway line and horizontal movement can be felt under very low loads. As the bridge appears to have been designed without panelling it is likely that it was never designed to carry a wind load. The bridge was subsequently covered and then enclosed with glazing and now attracts a significant lateral load parallel to the railway line.

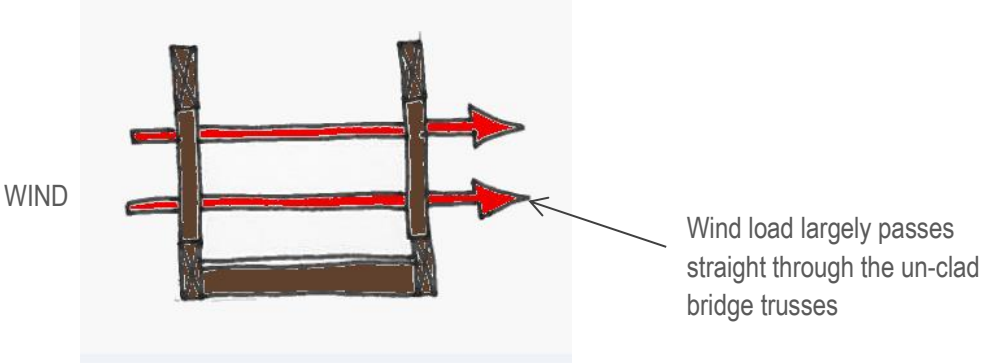

Fig. 4 Original truss design

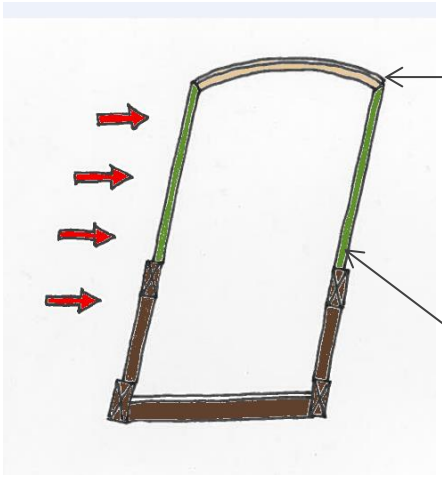

Fig. 5 Truss enclosed with glazing and roof

- The primary timber truss members of the south truss were exposed by removing the internal boarding. The truss appeared damp and signs of wet rot both historic and existing were visible. Some loss of section was observed although the moisture content of all primary timbers was less than 20%. (Moisture contents of greater than 20% are generally required for decay to occur.) Although some decay has obviously taken place the primary timbers appear to be largely sound where exposed.

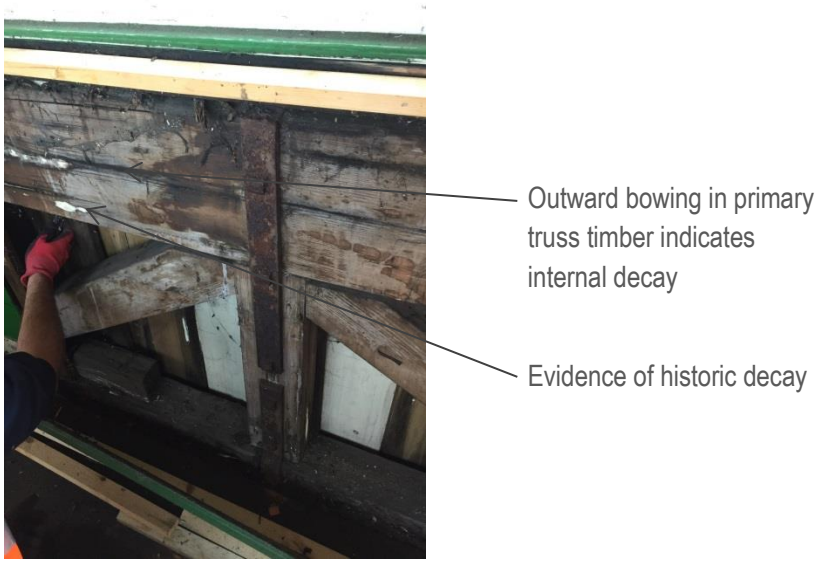

Fig. 6 Primary timber truss exposed

- Poor detailing at the junction between the glazing and the top of the truss/balustrade appears to be responsible for trapping moisture around the truss members and subsequently the top chord of the truss appears to be the worst affected member.
- Cracking and separation within and between the truss members appears to be shrinkage cracking due to the truss being constructed with green timber and it is not thought that these present a concern.

3.0 Load Assessment

A preliminary assessment of the vertical load carrying capacity of the bridge has been made. A single primary truss has been analysed considering the self-weight of the structure and a live load of 5kN/m² (500kg/m²) which is thought to be in excess of any live load which the structure may be subject to under normal conditions. (A live load is any movable load which the structure may be subject to during its life time; in this case the live load is made up of people and snow.)

The analysis assumes that the truss timbers and all connections are in perfect condition and that the truss is prevented from spreading by the trestle legs. In reality this is unlikely to be the case.

The analysis shows that if in perfect condition the primary truss members would be strong enough to resist the self-weight and live load applied without significant vertical deflection.

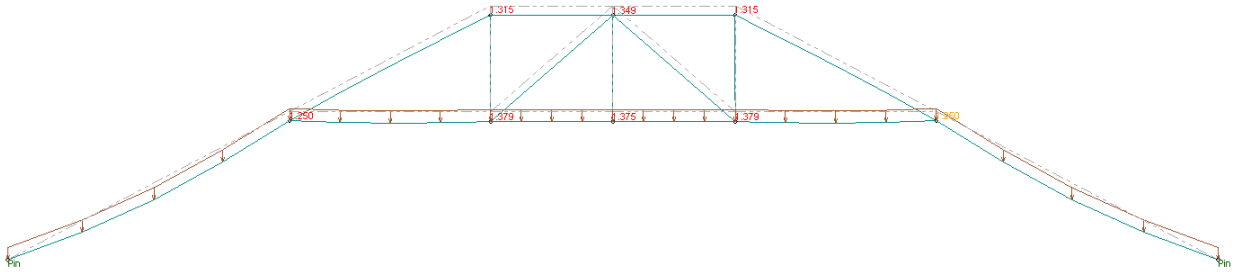

Fig. 7 Deflected shape of fully loaded bridge showing vertical deflections of less than 2mm

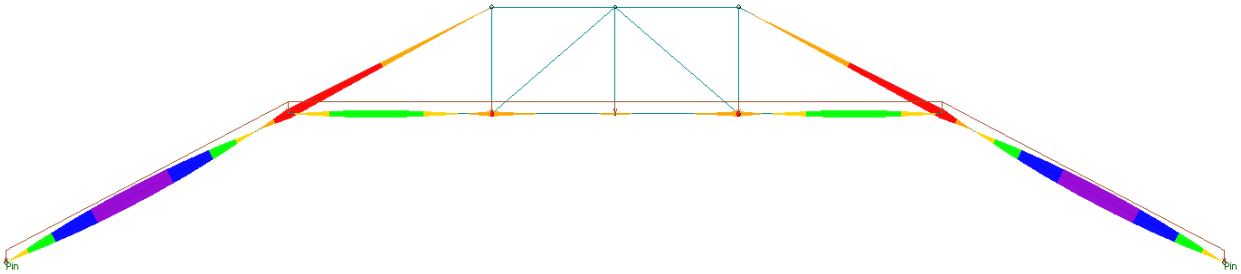

Fig. 8 Fully loaded model showing locations of maximum bending moments

It should be stressed that this analysis takes in to account vertical load only and no complex three dimensional of dynamic effects have been considered. In this situation it is likely that wind loading will be the critical load case and the slender trusses have very limited capacity to resist this load. Significant strengthening in the form of additional structural members is likely to be required to resist lateral loads.

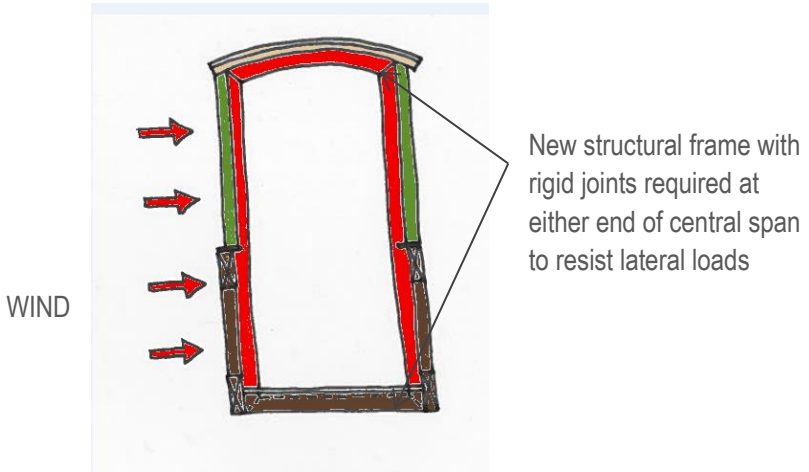

Fig.9 Strengthening required to resist lateral loads

Option	Advantages	Disadvantages
Leave the bridge in its current location and repair	• Allows the bridge to be retained in its current location. • The aesthetic of the bridge is what is important in this case and this solution retains the bridge largely in its current form.	• It is likely that the bridge will need to be strengthened to meet current Network Rail standards to allow it to remain in position over a live railway line- Network Rail would need to confirm the load which the bridge would be required to resist, this load could be higher than the bridge could support without significant intervention and there is unlikely to be any flexibility in this load. • This is likely to involve significant repair and replacement of timber members- does this affect the character of the bridge? Is it the same bridge if much of the bridge is new material? • The repaired bridge will require regular maintenance to prevent future decay - who will this cost fall too?
Let Network Rail demolish the bridge	• The bridge has suffered from lack of maintenance and extensive and costly repair will be required to make the bridge serviceable again. • Ongoing future maintenance problem removed.	• Historically important bridge is lost. • The bridge currently leads to the steam railway which is an important local tourist attraction. • The bridge is part of Alton's heritage and is valued locally and nationally. • Cost associated with demolition and making good platform.
Move the bridge to the steam railway or an alternative location and repair	• The bridge would not necessarily be required to resist Network Rail loads. • The glazing and roof structure which have caused many of the water ingress problems could be removed to prevent the need for expensive strengthening to allow the bridge to resist lateral loading.	• Repair of the bridge would still be required at significant cost and large amounts of historic fabric would still be lost. • Regular maintenance would still need to be funded (though cheaper as those carrying out work would not need to comply with Network Rail safety standards)

4.0 Conclusion

Significant repair and strengthening of structural members is required to bring the bridge back in to use. The trestles are particularly badly decayed. Due to the restricted nature of these spaces repairs are likely to be challenging however, member replacement or localised traditional repair are both possible options.

The structural analysis shows that it is theoretically possible for the bridge in perfect condition to resist a vertical live load of 5kN/m² however; significant strengthening is likely to be required for the bridge to resist the applied wind loading as this does not appear to have formed part of the original design. Further structural analysis would be required to confirm how this could be achieved. Network Rail should also be consulted on the suitability of the 5kN/m² live load and confirmation should be requested that the bridge does not need to meet any other accidental or other loading criteria.

To confirm the extent of timber decay and enable repairs to be detailed a timber survey involving micro drilling of all the primary structural timbers should be carried out by a timber specialist.

A number of options have been outlined above but the decision is not wholly a structural one. Before proceeding further it needs to be decided what it is about the bridge that makes it so important- is it the historic fabric? In which case due to the amount of intervention required to retain the structure would a repaired and strengthened bridge be as significant? Or is it the aesthetics and social aspect as part of Alton's heritage? In this case it may be worth the cost of repairing the bridge to enable it to remain in its current location fulfilling the purpose for which it was originally designed.