



Aston Hall Barns, Shropshire

Schedule of Structural Repairs

Project Number: 10854

Date: September 2021



Content/Quality Assurance

1.0 Introduction

2.0 Drawings

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Version Number	Issue Date	Issue Status	Distribution
01	08.09.2021	Preliminary, Issued for Planning	Client & Design Team
Prepared	Checked	Approved	Date
HP			

1.0 Introduction

Purpose

- 1.1 Mann Williams have been appointed by David and Rosalind Cleevely to provide civil and structural engineering services relating to proposed conservation, limited alteration, and extension of the outbuildings at Aston Hall, in Aston Munslow, Shropshire. We are working as part of a design team led by Giles Quarre Architects.
- 1.2 The barns form part of the curtilage of Aston Hall which is a Grade II* listed property.
- 1.3 This document describes the structural repairs which are necessary to secure the long-term stability of the barns and which are proposed to be included in the planned construction and conservation works.
- 1.4 The repair requirements range from global matters such as the introduction of floor and roof diaphragms to enhance lateral stiffness throughout the buildings, to the specific repair of individual elements and connections.
- 1.5 This document is intended to be used to provide detail of the proposals in support of the planning application, as well as for initial cost planning.

Organisation

- 1.6 The repairs are presented in the following section via a series of drawings with key-plans for each area of the building and tabulated visual schedules of the requirements / proposals. The drawings deal with repairs only, not the proposed alterations or additions. They should be read in conjunction with the architect's proposals.
- 1.7 For simplicity the connected group of outbuildings has been described as 4 barn structures, referenced as follows:



Conservation approach

- 1.8 Our approach to conservation generally is to carefully consider the way in which structural elements have withstood the loads that have been applied in the past, rather than purely using calculations to assess the theoretical strength of structural elements. This sensitive approach is based on the SPAB principle of minimum intervention. It is rarely appropriate to compare historical structures against modern standards of performance, or to design repair details to the letter of modern codes of practice.
- 1.9 Where repairs have been deemed necessary the general approach has been to favour methods which: preserve as much original fabric as possible; are reversible if possible; and are visually “honest” in distinguishing between new and original fabric, yet if possible subtle, or at least sensitive to the aesthetics of the building.

Structural condition overview

- 1.10 The overall condition of the buildings is a mixed picture. Much of the timberwork is in very good condition *considering its age and the nature* of the buildings, but none-the-less there are a number of isolated structural defects (as one would expect) some of which are relatively serious and require substantial structural repair.
- 1.11 Similarly the masonry elements are, on the whole, in fair condition *considering their age and nature*, but there are significant issues which require careful structural attention. The most obvious of these is the substantial eastward lean of the west range, which is unusually pronounced. In the areas of maximum lean, both front and rear walls are well beyond their natural "tipping point"; they want to topple forward and the current steel frames are actively holding them up, not merely providing a "stabilising hand". The severity of this issue should not be under-estimated. It is notable that an area of the rear rubble wall appears to have collapsed (or perhaps been taken down) and rebuilt in the relatively recent past - more recently than the steel frame installation. Evidently although the existing steel frames themselves appear to be adequately sturdy, the walls as a whole remain insufficiently restrained. It appears they are listing to such a degree, relative to their thickness, that a section of wall *between two of the steel frames* was caused to come down. It is not inconceivable that other areas of wall, between or beyond the steel frames, remain similarly at risk.
- 1.12 It should be noted that calculating the strength and predicting the stability of historic masonry walls, in particular rubble stone, is a far from precise science. The leaning elevations of the west barn must therefore be treated with utmost caution during both the design and execution of stabilisation works.
- 1.13 There has also been significant historical movement of the south-east gable end, which appears to be progressive and is requiring substantial structural intervention. Elsewhere more localised masonry repair works are required.

Basis and limitations

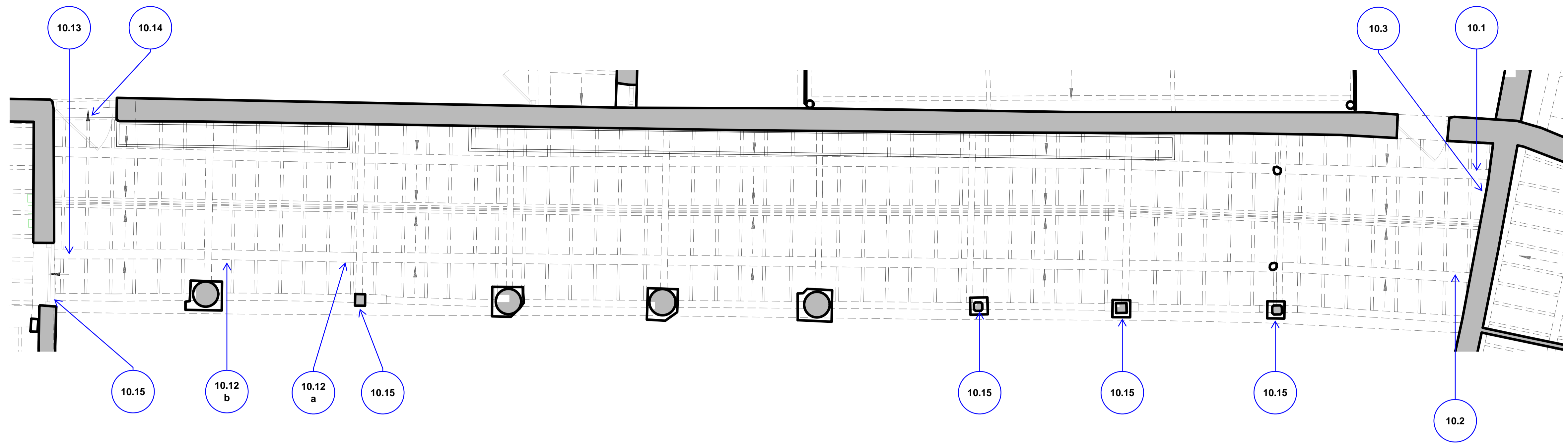
- 1.14 The proposals are based on thorough visual inspections by Mann Williams, together with detailed specialist Investigation of Structural Timber Elements reports prepared by Hutton + Rostron Environmental Investigations Limited (H+R) in March 2021. The specialist investigations included widespread moisture measurements, localised timber sampling for species identification, and micro-drill resistance measurements, in addition to detailed visual observation.
- 1.15 None-the-less both Mann Williams' and H+R's surveys were limited by various constraints, including hidden aspects of the structure (e.g. beneath roof coverings, tops of beams etc.) and areas of the buildings which were unsafe to access (in particular some of the first floor areas and the south-west attic space). Mann Williams' observations were made from ground level or safe areas of first floor only (i.e. no ladder or scaffold access was employed for close observation of elements at high level).

- 1.16 As such, it should be anticipated that additional repair requirements are likely to come to light during the course of the work when the structure is fully stripped back, and also that in some instances the initial proposals may need to be adapted to suit the conditions encountered. The following drawings are therefore best considered as 'outline' schedules, although they are as comprehensive as can reasonably be achieved at this stage of the process.
- 1.17 The key repair requirements have been identified and the anticipated solutions described and illustrated. In most cases further design detailing and precise specification of the repairs will be required in preparation for or during the execution of the works. Often the final /refined details will be dependent on further discovery / investigation and survey work.

2.0 Drawings

Appended

<u>Ref</u>	<u>Rev</u>	<u>Title</u>	<u>Subject</u>
SK10	P1	Outline Structural Repair Proposals – Sheet 1	North Barn
SK11-1	P1	Outline Structural Repair Proposals – Sheet 2	West Barn – Up to 1 st Floor – Page 1/3
SK11-2	P1	Outline Structural Repair Proposals – Sheet 3	West Barn – Up to 1 st Floor – Page 2/3
SK11-3	P1	Outline Structural Repair Proposals – Sheet 4	West Barn – Up to 1 st Floor – Page 3/3
SK12-1	P1	Outline Structural Repair Proposals – Sheet 5	West Barn – Above 1 st Floor – Page 1/2
SK12-2	P1	Outline Structural Repair Proposals – Sheet 6	West Barn – Above 1 st Floor – Page 2/2
SK13	P1	Outline Structural Repair Proposals – Sheet 7	South-West Barn – Roof
SK14-1	P1	Outline Structural Repair Proposals – Sheet 8	South-East Barn – Up to 1 st Floor – Page 1/3
SK14-2	P1	Outline Structural Repair Proposals – Sheet 9	South-East Barn – Up to 1 st Floor – Page 2/3
SK14-3	P1	Outline Structural Repair Proposals – Sheet 10	South-East Barn – Up to 1 st Floor – Page 3/3
SK15-1	P1	Outline Structural Repair Proposals – Sheet 11	South-East Barn – Above 1 st Floor – Page 1/2
SK15-2	P1	Outline Structural Repair Proposals – Sheet 12	South-East Barn – Above 1 st Floor – Page 2/2



Reference	Defect Description	Photo	Repair Description	Indicative Sketch	Notes
10.1	Decayed embedded purlin bearing end		Splice on new end using seasoned oak (preferably reclaimed) of matching section size. Tabled scarf joint with s/s coach screws.		New bearing to be fully isolated from masonry using continuous DPM sock.
10.2	Decayed embedded purlin bearing end		Splice on new end using seasoned (preferably reclaimed) oak, of matching section size. Tabled scarf joint with s/s coach screws.		New bearing to be fully isolated from masonry using continuous DPM sock.
10.3	Decayed rafter		Remove and replace using seasoned oak (preferably reclaimed) of matching section size.		<ul style="list-style-type: none"> Assuming corrugated metal roof is retained, only severely decayed rafters require renewal. If roof finishes are changed to tiles, more moderately decayed rafters will also require strengthening, by partnering – say up to 20no.
10.12a	Purlin connection compromised by local splits &/or superficial decay		Reinforce splits using s/s woodscrews		
10.12b	Purlin connection compromised by local splits &/or superficial decay		Reinforce splits using s/s woodscrews		
10.13	Decayed embedded purlin bearing end		Splice on new end using seasoned oak (preferably reclaimed) of matching section size, using tabled scarf joint with s/s coach screws.		

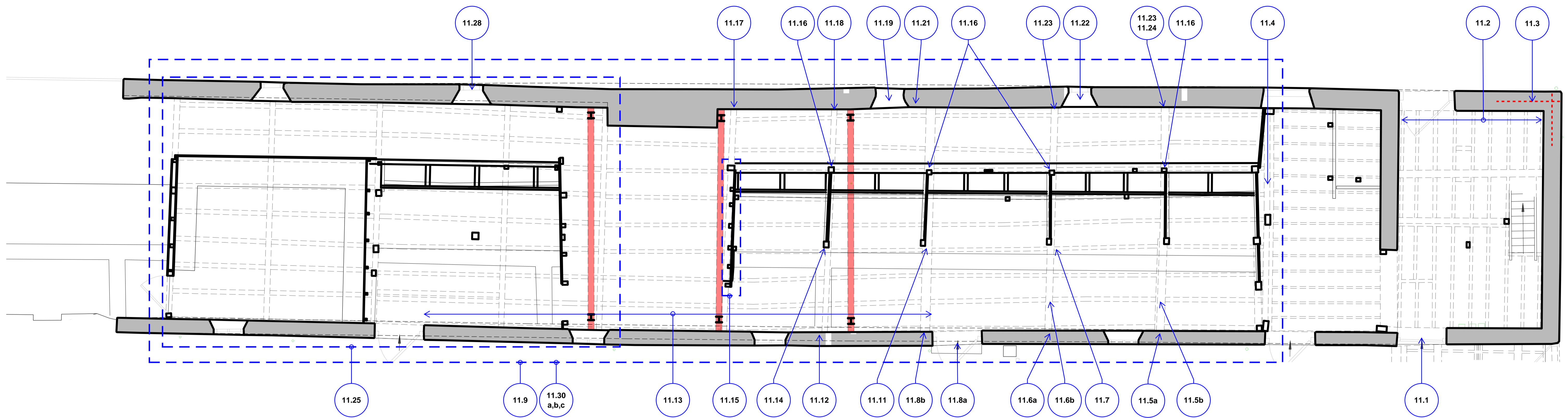
Reference	Defect Description	Photo	Repair Description	Indicative Sketch	Notes
10.14	Excessive historic notch weakening wall plate where it spans over doorway		Relieve load on plate by packing rafter feet off extg outer/lower lintel, using oak blocks		
10.15	Brickwork in poor condition over doorway and at south jamb, including corbelled head of pier on inside face.		<ul style="list-style-type: none"> Carefully take down defective masonry and rebuild using reclaimed brick/stone with lime mortar. Over doorway allow for area 1.0m wide x 5 courses tall. For corbel allow for 0.5m thk (full thickness of jamb) x 0.6m h x 0.3m wide. 		<ul style="list-style-type: none"> Temp propping required to 2no. adjacent doorways / openings. Rebuild to include s/s joint bed reinforcement (detailed spec to be developed).
10.16	Decayed timber posts		Replace with circular brick piers based on original detail.		<ul style="list-style-type: none"> 4no. replacement piers required. Allow for oak bearing plates under purlins as original detail. 4no. surviving piers require isolated brick repairs.

NOTES

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NOTES CONTINUED

REV P1	DESCRIPTION Issued for planning	BY HP	DATE 31.08.21	PROJECT ASTON HALL BARN	MANN WILLIAMS CONSULTING CIVIL AND STRUCTURAL ENGINEERS 7 OLD KING STREET QUEEN SQUARE BATH BA1 2JW T 01225 464419 F 01225 468551 E bath@mannwilliams.co.uk
DRAWN HP	CHKD -	SIZE A1	SCALE 1:200	DATE AUG '21	
PROJECT 10854				DRAWING SK10	
STATUS PRELIMINARY				REV P1	



Reference	Defect Description	Photo	Repair Description	Indicative Sketch	Notes
11.1	Sagging lintels – inner section excessively notched, outer section notched & decayed		Replace both inner and outer lintels using reclaimed heartwood oak of similar cross sections (approx. 225x100 & 175x100 respectively, TBC)	-	
11.2	Floor joists ends decayed where embedded in external west wall.		Splice replacement ends onto extg joists, using same bearing holes in masonry. Replacement to be seasoned oak, section sizes to match extg (approx. 100x75).		<ul style="list-style-type: none"> Current joists in this area probably late C19th. Bolted splice connections using s/s. New bearings to be fully isolated from masonry using continuous DPM sock. Allow for 9no. joists.
11.3	Masonry fractures at corner due to lack of effective bonding and tying to rubble walls.	-	Cintec anchors installed from outside face in pairs to cross-bond corner.	-	<ul style="list-style-type: none"> Number and spec of anchors tbc. Anchor heads recessed. Alternative approach could be to use RC elbow ties. Result is less subtle, but allows work to be done from inside face.
11.4	Primary floor beam badly split, + bearing ends compromised by pull-out & large notches in supporting lintels.	-	Beam already re-supported by 3no. remedial timber posts. No further action required at this time assuming posts are retained.	-	Observations recorded for info only.
11.5a	Brickwork fractured & damaged, caused by local area around beam bearing and lintel being restrained while surrounding masonry has leaned outwards.		<ul style="list-style-type: none"> Improved tie through wall to beam end, with large external pattress. Void in wall locally opened up and lime grouted. Remedial walls ties (inc. @ adjacent window reveal) and helibar crack stitching installed locally. 		<ul style="list-style-type: none"> Expressed pattress detail to be developed, probably cruciform arrangement similar to extg ones. Steelwork galv'd and painted.
11.5b	Main floor beam badly split at 0.8m & 2.2m from E bearing	-	Beam already "informally" supported by 2no. timber posts. No further action required at this time assuming posts are retained.	-	Observations recorded for info only
11.6a	Brickwork fractured & damaged, caused by local area around beam bearing and lintel being restrained while surrounding masonry has leaned outwards.		<ul style="list-style-type: none"> Improved tie through wall to beam end, with large external pattress. Local re-set area of brickwork on inside face (approx. 0.3m x 0.3m). 	As 11.5a	<ul style="list-style-type: none"> Similar to 11.5a but damage less severe. Expressed pattress detail to be developed, probably cruciform arrangement similar to extg ones. Steelwork galv'd and painted.
11.6b	Concerning split or shake in main beam, approx. 2.5m long.		Strengthen beam using vertical screws or through-bolts at regular centres along length of split, to prevent further development of split.		<ul style="list-style-type: none"> Detailed spec for fixings TBC. Eastern stalls post is loose (i.e. not load-bearing) in this bay.

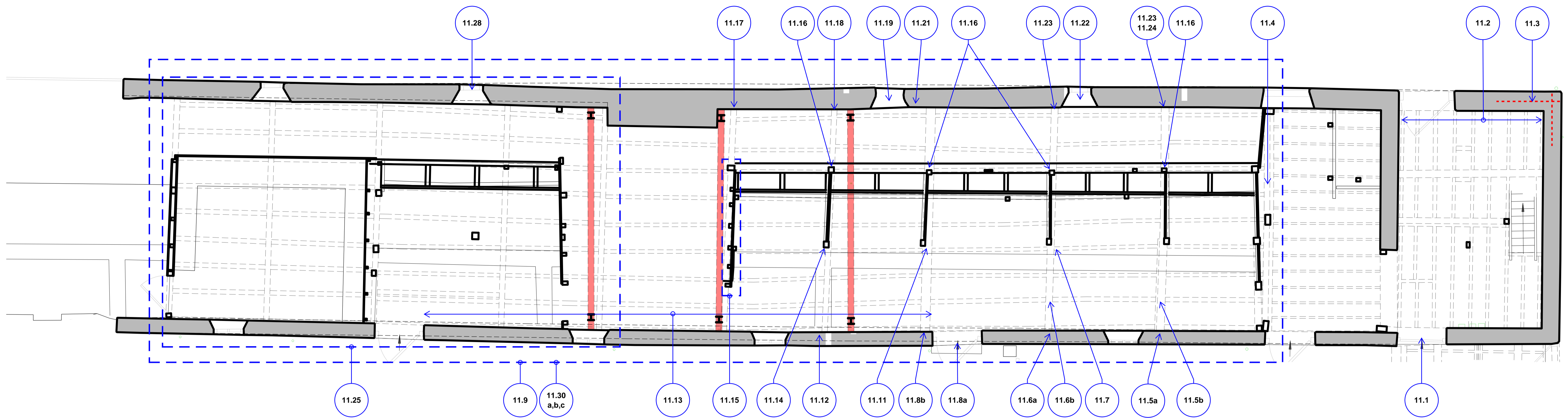
Reference	Defect Description	Photo	Repair Description	Indicative Sketch	Notes
11.7	Floor joist tenon split at interface with beam		Re-support using coach-screwed oak bearer face-fixed to beam.		S/S fixings
11.8a	Outer timber lintel split beyond repair and partially decayed		Replace with matching lintel using reclaimed oak, approx. 100x200 section size.	-	Also allow for rebuilding upper parts of brickwork reveals to enable installation of new timber.
11.8b	Brickwork damaged by relative movement around beam bearing (similar to 11.6a).		<ul style="list-style-type: none"> Improved tie through wall to beam end, with large external pattress. Fractured bricks at adjacent door reveal replaced. 	-	Pattress as 11.5a & 11.6a-
11.9	Many floor joists are undersized in this area	-	Allow for supplementing 50% of joists using additional 150dp x 70wd seasoned grade TH1 oak joists, placed between existing ones and supported using concealed proprietary joist hangers e.g. Simpson Strongtie ETB90-B or equiv. approved.	-	<ul style="list-style-type: none"> Specific positions to be confirmed. Spans vary 2.3m – 3.1m clear. Extg sizes vary considerably: Around 25% are circa 80x80, which is too small. Around 50% are circa 120x70, which is adequate only up to 2.5m span. Around 25% are circa 150x70, which is adequate. Recommendations assume that 1st floor loading requirements will be no greater than / equiv. to domestic type loading (i.e. not heavy storage or equipment). Perimeter of joists hangers potentially require protection with intumescent mastic – TBC.
11.11	Major fracture of floor beam, with former iron bar repairs plus supporting timber post	-	Appears long-standing / non-progressive. No further action required at this time assuming post is retained.	-	Observations recorded for info only

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TITLE OUTLINE STRUCTURAL REPAIR PROPOSALS - SHEET 2	DRAWN HP	CHKD -	SIZE A1	SCALE 1:50		DATE AUG '21
PROJECT WEST BARN - UP TO 1st FLOOR - PAGE 1/3	STATUS PRELIMINARY		PROJECT 10854	DRAWING SK11-1		REV P1
P-PRELIMINARY		T-TENDER		CONSTRUCTION		



Reference	Defect Description	Photo	Repair Description	Indicative Sketch	Notes
11.12	Historic mortice in embedded timber pad directly beneath beam end		Piece in timber accurately cut to fit slot, using very dry oak. Screw in place.		Requires skilled conservation carpenter.
11.13	Bottom 3-5 brick courses of wall on inside face are in poor condition in this area.		Localised rebuilding or repointing as appropriate, all in lime mortar & by conservation mason.		<ul style="list-style-type: none"> Applies to 13m run of wall. Assume 50% requires rebuild of inside face (3 - 5 courses high x 1/2 - 1 brick deep) and remainder requires deep-pack repointing (3 - 5 courses high). Where rebuilding assume 50% of bricks salvageable, 50% to be matching new. Rebuild to be undertaken in short sequential sections to avoid undermining.
11.14	Extg stalls post is "informally" helping to support floor beam over.		No further action required at this time assuming post is retained.		Observations recorded for info only
11.15	Extg wall studs are "informally" helping to support floor beam over.		No further action required at this time assuming post is retained.		Observations recorded for info only
11.16	Extg stalls posts are "informally" propping floor beams over (although they are also substantially leaning due to the overall distortion of the building).		No further action required at this time assuming stalls / posts are retained in this part of the barns.		Observations recorded for info only. Applies x 4no. bays.
11.17	Substantial diagonal fracture in masonry beneath beam bearing approx. 0.7m from edge of formerly rebuilt area.		TBC. Provisionally a combination of localised rebuilding to the ground floor portion (effectively extending the "buttress" by approx. 1m) and helibar stitching at first floor.		Requires further site review.

Reference	Defect Description	Photo	Repair Description	Indicative Sketch	Notes
11.18	Historic mortice in embedded timber pad directly beneath beam end		Piece in timber accurately cut to fit slot, using very dry oak. Screw in place.		Requires skilled conservation carpenter.
11.19	Timber lintels decayed beyond repair		<ul style="list-style-type: none"> Replace using 100mm dp precast concrete lintels to core of wall, with 100sq reclaimed oak facing lintel on inside face. Rubble stone reveals to be made good. Also remove decayed timber cill and make good. 		<ul style="list-style-type: none"> Outside face of wall has brick arch facing (1/2 brick thick) - to be carefully preserved / repaired as necessary. Lintel bearings to match extg. All work to use lime mortar. Temporary propping/needling required.
11.21	Embedded timber beam pad partially decayed.		Cut out / remove decayed portion (south end up to & including mortice). Infill scar using matching rubble stone masonry.		For costing assuming 250mm deep.
11.22	<ul style="list-style-type: none"> Timber lintels excessively decayed. Opening reveals fractured on both sides near mid-line due to poor bonding & wall movements; possibly indicative of more widespread delamination of wall faces due to weak core. 		<ul style="list-style-type: none"> Replace using 100mm dp precast concrete lintels to core of wall, with 100sq reclaimed oak facing lintel on inside face. Reveals to be stitched using helibar at each course & fractures repointed good. More widespread use of consolidation ties may be considered. 		<ul style="list-style-type: none"> Outside face of wall assumed to have brick arch facing (1/2 brick thick) - to be carefully preserved / repaired as necessary. Lintel bearings to match extg. All work to use lime mortar. Temporary propping/needling required. Helibar detailed spec tbc.
11.23	Floor beams very deeply notched and partially decayed at west bearings.		Although beam capacities are compromised, while support from stall posts is retained no action is required.		Observations recorded for info only. Applies x 2no. beams.
11.24	Structurally significant crack in main beam end, with former bolted repair		While support from stall post is retained no action is required.		Observation recorded for info only.

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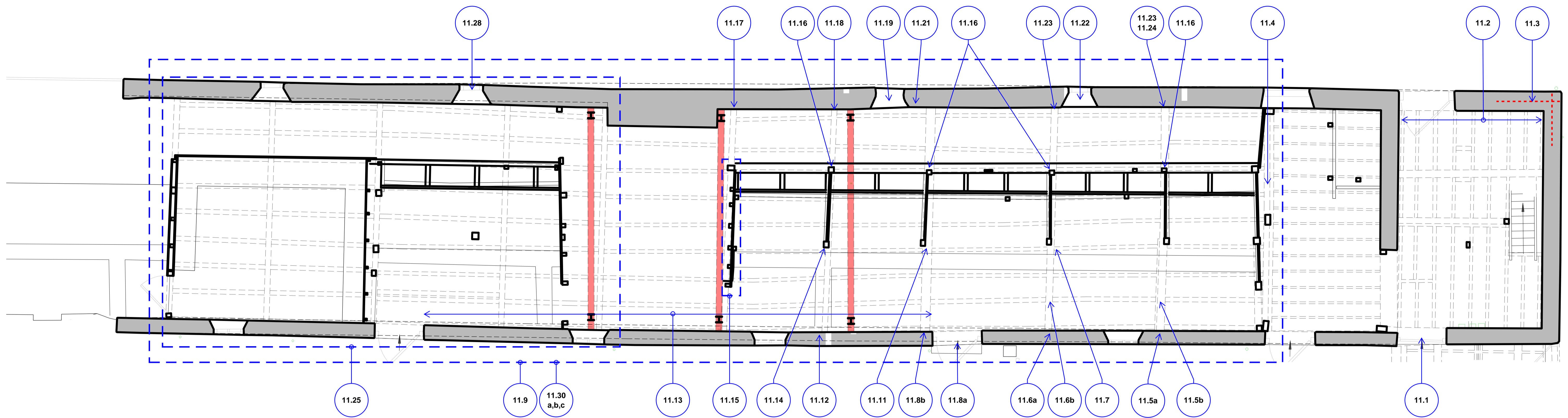
NOTES CONTINUED

REV	DESCRIPTION	BY	DATE
HP	Issued for planning	HP	31.08.21

PROJECT		ASTON HALL BARNs	
TITLE		OUTLINE STRUCTURAL REPAIR PROPOSALS - SHEET 3	
PROJECT		WEST BARN - UP TO 1st FLOOR - PAGE 2/3	

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DRAWN	CHKD	SIZE	SCALE	DATE
HP	-	A1	1:50	AUG '21
STATUS				
PRELIMINARY				
PROJECT	DRAWING	REV		
10854	SK11-2	P1		



Reference	Defect Description	Photo	Repair Description	Indicative Sketch	Notes
11.25	Main floor beams typically reliant on existing posts / studs for support, due to inherent under-sizing, plus various splits and localised instances of decay.		<ul style="list-style-type: none"> Beams to be strengthened using supplementary steelwork, where extg props are to be removed. Typically allow for bolting fabricated profiled angle sections either side, 150x150x20. End beam could have a single 200x20 profile flat plate coach screwed to outside face. Bespoke details to be confirmed for each beam. Alternative internal "fitch plate" detail may be considered. Advantage is end result is hidden. Disadvantage is that the timber beam is irreversibly damaged in the process, and installation is difficult for relatively narrow beams (130mm wide typ.) esp. where they are heavily notched / morticed or split. 		<ul style="list-style-type: none"> Further detailed surveying required in this area following removal of modern insertions. Assume 5-6no. beams strengthened similarly to create open-plan zone at southern end of barn. Provisional sizing assumes that 1st floor loading requirements will be no greater than / equiv. to domestic type loading (i.e. not heavy storage or equipment). Steelwork to have intumescent paint or other fire protection. All steels fabricated suit deflected profile of timber beams, using templates. Steelwork may stop at wall face, or be built in the strengthen bearing, depending on detailed inspection of each extg timber bearing condition. Where steelwork is built in to masonry locally bitumen paint and concrete encase for corrosion protection.
11.27	Historic mortice in embedded timber pad directly beneath beam end		Piece in timber accurately cut to fit slot, using very dry oak. Screw in place.		Requires skilled conservation carpenter.
11.28	<ul style="list-style-type: none"> Outer timber lintel excessively decayed. Opening reveals fractured on both sides. 		<ul style="list-style-type: none"> Replace using matching oak heartwood section (approx. 100mm sq TBC). Reveals to be stitched using helibar at each course & fractures repointed good. Also remove decayed timber cill and make good. 		<ul style="list-style-type: none"> Temporary local opening up of reveals necessary to facilitate installation. Outside face of wall assumed to have brick arch facing (1/2 brick thick) - to be carefully preserved / repaired as necessary. Lintel bearings to match extg. All work to use lime mortar. Temporary propping/heeling required.

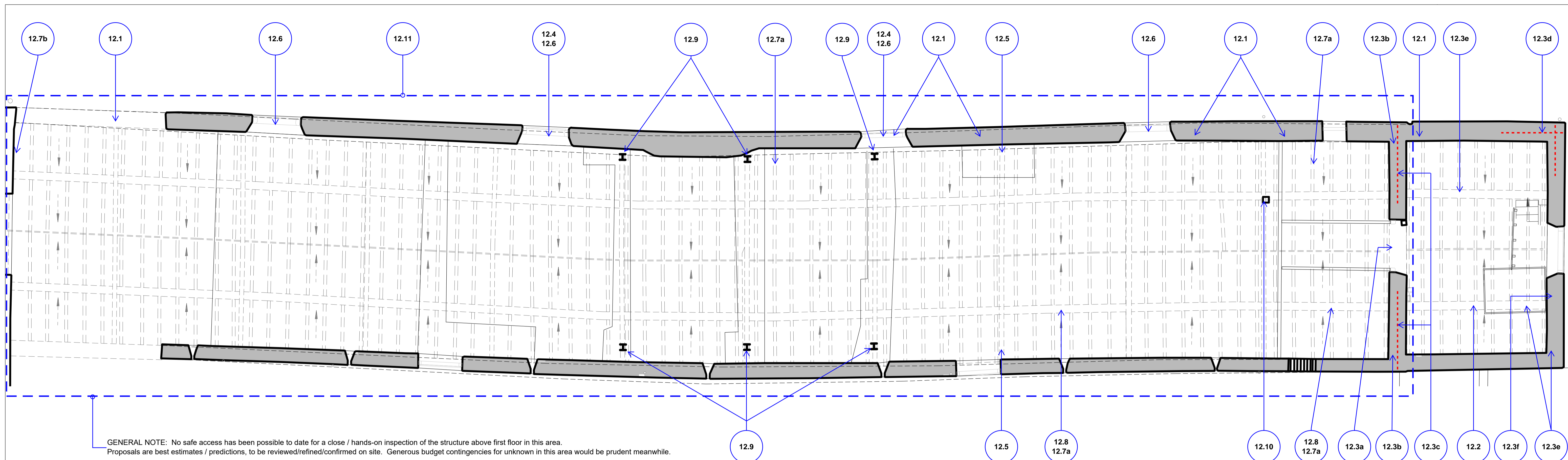
Reference	Defect Description	Photo	Repair Description	Indicative Sketch	Notes
11.30a	<p>Walls leaning very substantially to the east, by up to 470mm (-H/10).</p> <p>Underlying cause is thought to be an inherent lack of cross-walls & excessive slenderness of unbraced external walls, combined with a tendency for the footings to rotate in the direction of dip of the underlying rockhead bedding planes.</p>		<p>The existing steel frames appear to have been reasonably effective at slowing or halting further distortion of the walls (although this is difficult to establish for certain without long term monitoring), however the bracing arrangements inhibit the use of the spaces and are unsightly.</p> <p>It is proposed to improve the stability arrangements using a combination of methods:</p> <p>a)</p> <ul style="list-style-type: none"> At least 1 and possibly all 3 of the braced steel frames to be replaced with engineered 2-storey 'moment frames' providing a similar function in a more discrete manner. Frames to comprise 152UC columns and 203UC beams at 3 levels including concrete encased 'ground beam'. 		<ul style="list-style-type: none"> Detailed designs to be developed, including direct fixing of new frames to floors / roofs / front & rear walls. New stability frames most likely to be installed near to existing ones but not in exactly the same positions, to facilitate sequencing (new frames installed and pre-loaded prior to carefully removing extg ones while monitoring deflections). New stability frames to have large cruciform pattress plates on external elevations similar/same as extg ones.
11.30b			<p>b)</p> <ul style="list-style-type: none"> Repaired first floor deck to incorporate a 2-layer plywood diaphragm, screwed to all joists and beams. Pitched roof also to incorporate an equivalent plywood diaphragm screwed to all rafters. The purpose of these lateral diaphragms is to enable the whole length of the 2 elevations to benefit from the stability provided locally by the 3 steel cross frames and the end walls. 		Detailed specs to be developed.
11.30c			<p>c)</p> <p>Fixings between the timber elements and the masonry walls to be improved generally, so that the floor and roof diaphragms are effectively able to restrain the walls and localised stress concentrations are minimised. This will include:</p> <ul style="list-style-type: none"> Fixing perimeter first floor joists into the walls on each elevation - provisionally using M12 Cintec s/s stud anchors at 0.9m cntrs. Fixings wall plates at eaves level down into the wall head, provisionally using M12 s/s threaded bar resin anchors @ 0.9m cntrs. Ensuring rafters are well secured to wall plates, e.g. using Expamet HD9090 brackets. 		<ul style="list-style-type: none"> Detailed specs to be developed. Recommend trial of wall head anchors to ensure wall head not excessively voided, especially on rubble side.

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SCALE 1:50	DATE AUG '21	TITLE OUTLINE STRUCTURAL REPAIR PROPOSALS - SHEET 4 WEST BARN - UP TO 1st FLOOR - PAGE 3/3		DRAWN 10854	
STATUS PRELIMINARY		PROJECT 10854	DRAWING SK11-3	REV P1	

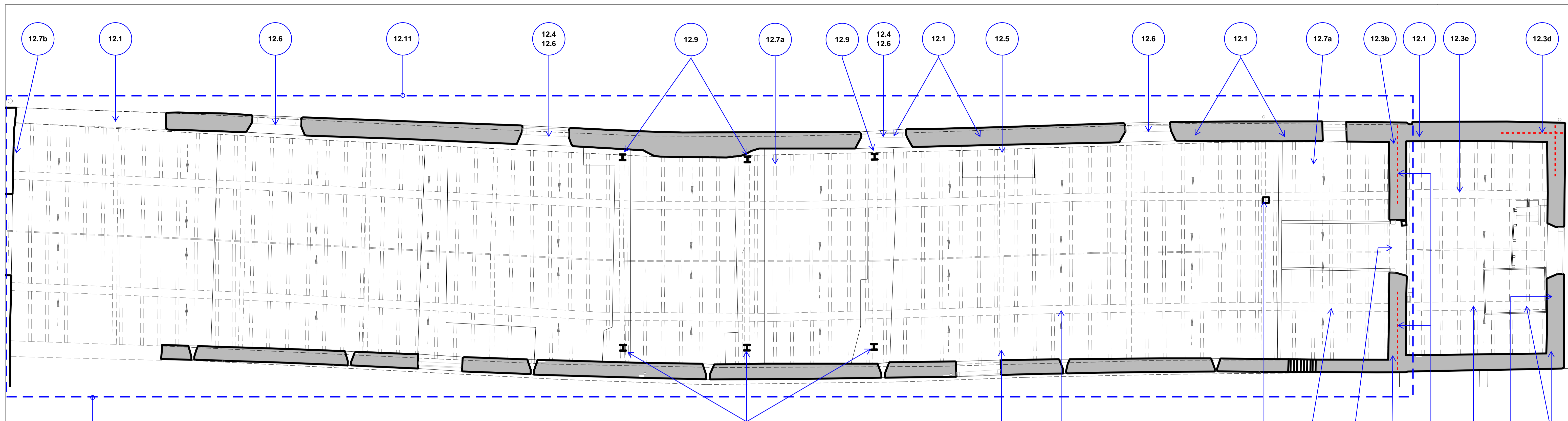


GENERAL NOTE: No safe access has been possible to date for a close / hands-on inspection of the structure above first floor in this area. Proposals are best estimates / predictions, to be reviewed/refined/confirmed on site. Generous budget contingencies for unknown in this area would be prudent meanwhile.

Reference	Defect Description	Photo	Repair Description	Indicative Sketch	Notes
12.1	Length of wall plate locally decayed		Locally replace with equivalent oak section, typically circa 190x100 TBC. Fix new to extg using half-lap scarf joints either end, with s/s coach screws.		Provisionally allow for 8no. instances, average length 1.5m + laps. Actual requirements TBC on site.
12.2	Purlin locally severely decayed		Partner with new oak purlin alongside, provisionally 150x200, grade THA.		<ul style="list-style-type: none"> Provisional size assumes roof finishes in this area to remain as corrugated metal.
12.3a	Rubble masonry bulging and cracking over doorway		Carefully take-down and rebuild local area over doorway x ~0.8m high (full thickness).	-	<ul style="list-style-type: none"> All work to use lime mortar. Temporary propping & needling required.
12.3b	Holes and loose areas of masonry.		Carefully take-down and rebuild local areas as required.	-	<ul style="list-style-type: none"> Allow for areas approx. 0.5m sq at wall junction with east elevation, & approx. 0.3m sq just above junction with west elevation, both x full wall thickness.

Reference	Defect Description	Photo	Repair Description	Indicative Sketch	Notes
12.3c	Fractures at original gable end junctions with front and rear walls, indicative of spreading & lack of bonding.		Cintec anchor wall junctions at both elevations and make good associated cracks by deep raking out and repointing.	-	<ul style="list-style-type: none"> Number and spec of anchors tbc. Anchor heads recessed. Repairs will also assist with general enhancement of building's sway stability.
12.3d	Masonry fractures at corner (formerly filled) due to lack of effective bonding and tying to rubble walls.	-	Cintec anchors installed from outside face in pairs to cross-bond corner.	-	<ul style="list-style-type: none"> As per ground floor. Number and spec of anchors tbc. Anchor heads recessed. Alternative approach could be to use RC elbow ties. Result is less subtle, but allows work to be done from inside face.
12.3e	Locally deficient rubble masonry e.g. holes and loose stones	Examples 	Local rebuild to infill holes and make good / consolidate as required.	-	<ul style="list-style-type: none"> All work to use lime mortar. Areas include: <ul style="list-style-type: none"> Around both ends of both purlins Around north-east corner, just above and below eaves level (inside & outside faces)
12.3f	Raking fracture in masonry		Stitch crack using Helibar in coursed rubble joints and make good crack by repointing.	-	<ul style="list-style-type: none"> Helibar detailed spec tbc. Provisionally allow for installing 3no. 8mm dia bars x 1.2m long each, in both inner and outer wall faces.

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		PROJECT WEST BARN - ABOVE 1st FLOOR - PAGE 1/2						STATUS PRELIMINARY					
		PROJECT 10854	DRAWING SK12-1	REV P1									
		F:PRELIMINARY		T:TENDER		CONSTRUCTION							
		PROJECT: ASTON HALL BARN											

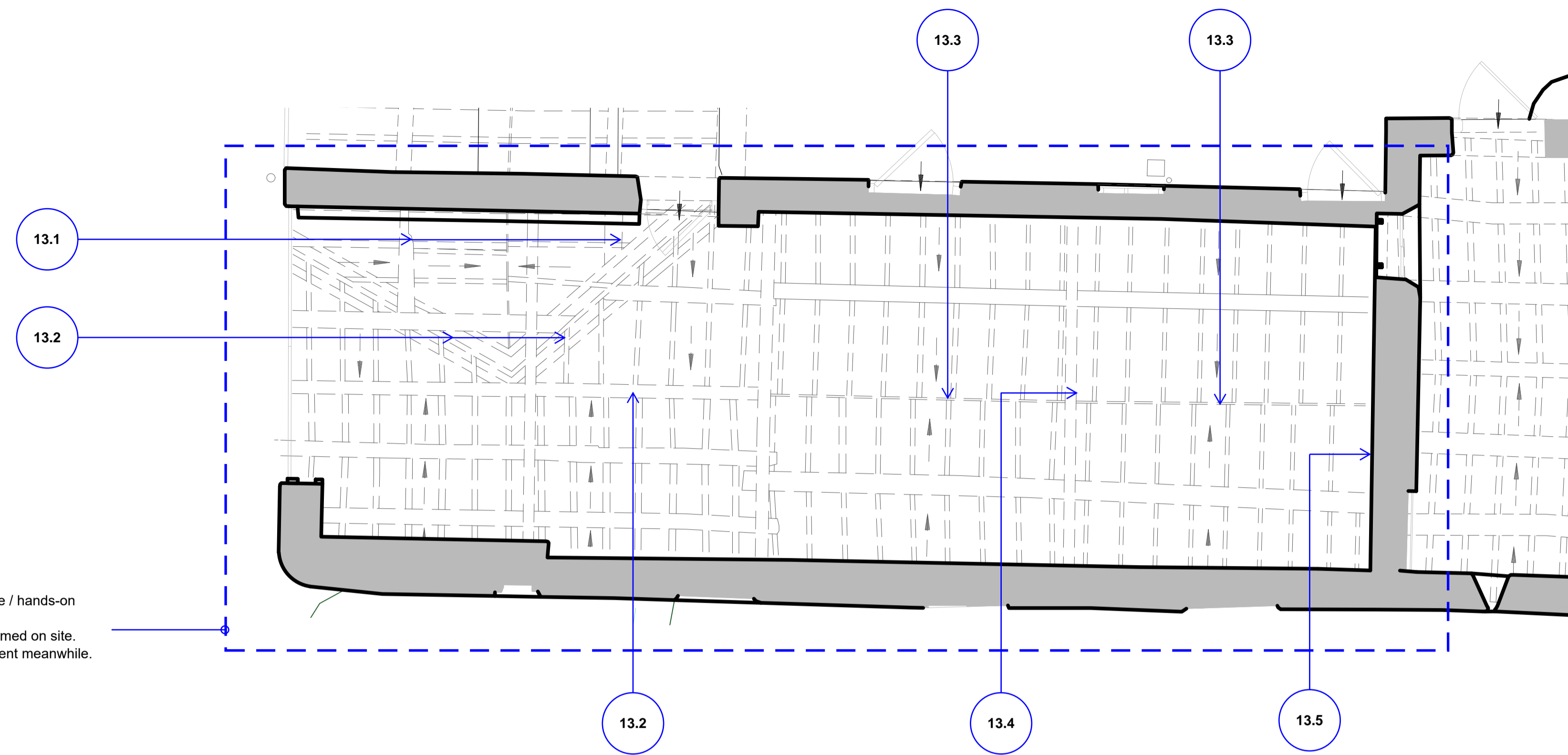


GENERAL NOTE: No safe access has been possible to date for a close / hands-on inspection of the structure above first floor in this area. Proposals are best estimates / predictions, to be reviewed/refined/confirmed on site. Generous budget contingencies for unknown in this area would be prudent meanwhile.

Reference	Defect Description	Photo	Repair Description	Indicative Sketch	Notes
12.4	Decayed lintels		Renew lintels using reclaimed oak of matching size (estimated circa 150x300). Also remove decayed cills and make good masonry by stoning up scars at base of reveals.	-	<ul style="list-style-type: none"> Applies to 2no. windows. Lintel bearings to match extg. All work to use lime mortar. Temporary propping likely required.
12.5	Possible decay of truss bearing ends		If necessary, install steel shoe	 ELEVATION SECTION	<ul style="list-style-type: none"> Requires closer hands-on inspection to confirm requirement and if necessary detail design. Provisionally allow for 2no. (TBC)
12.6	Fractures to rubble window reveals		<ul style="list-style-type: none"> Reveals to be stitched using helibar at each rubble course & fractures repointed / made good. 	-	<ul style="list-style-type: none"> Appears to mainly affect the flared windows on the west elevation. Provisionally allow for 4no. window openings x 2 reveals each. Helibar detailed spec tbc.
12.7a	Locally decayed common rafters	-	Partner with new oak rafter alongside extg. matching size (approx. 90x80)	-	<ul style="list-style-type: none"> Allow for say 20no. (TBC on site). Typically only necessary to partner a single span (e.g. wall plate to purlin, depending position of decay).
12.7b	Failed / split common rafters	-	Replace with new oak equivalent (approx. 90x80)	-	Only 1no. identified so far, but provisionally allow for up to, say, 5no.

Reference	Defect Description	Photo	Repair Description	Indicative Sketch	Notes
12.8	Decayed purlins		Provisionally 2no. required. Unable to access to carry out sufficiently detailed design in each case. Allow for 1no. like-for-like full replacement (full length of extg purlin, say approx. 3m) in THA green oak of matching section size (assume approx. 200mm sq) using replicated traditional joints. Allow for 1no. locally strengthen using 150x12 steel RSA x say 2m long, with through-bolted connections.		All subject to closer inspection on site.
12.9	Role of existing steel frames		TBC. Possible requirement for steel "truss shoes".	-	The posts of the 3 existing braced steel frames have connections to 3no. roof trusses. While it is likely that this was done only for the purposes of lateral stability, it has not been possible to carry out close inspections to confirm that the connections do not also have a role in helping to support the truss ends (e.g. due to decay at the original bearings on the wall heads). This check is necessary prior to removal of the steel frames, and it may be necessary to strengthen the truss bearing ends (up to 6no.) if defects are identified.
12.10	Post with active wood-boring beetle infestation		Possible renewal	-	The purpose of (/ continuing need for) this existing remedial timber prop needs to be investigated via closer inspection than has been possible to date. The truss end has an existing steel show / repair. If the prop pre-dates this it may no longer be structurally relevant. If on the other hand it is still required then it may need to be renewed.
12.11	Walls leaning very substantially to the east, by up to 470mm (-H/10).	-	Plywood roof diaphragm – see 11.30b. Enhanced fixings at wall heads – see 11.30c.	-	As 11.30b & 11.30c

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		PROJECT WEST BARN - ABOVE 1st FLOOR - PAGE 2/2	DRAWING SK12-2	REV P1	STATUS PRELIMINARY								



GENERAL NOTE: No safe access has been possible to date for a close / hands-on inspection of the structure above first floor in this area. Proposals are best estimates / predictions, to be reviewed/refined/confirmed on site. Generous budget contingencies for unknown in this area would be prudent meanwhile.

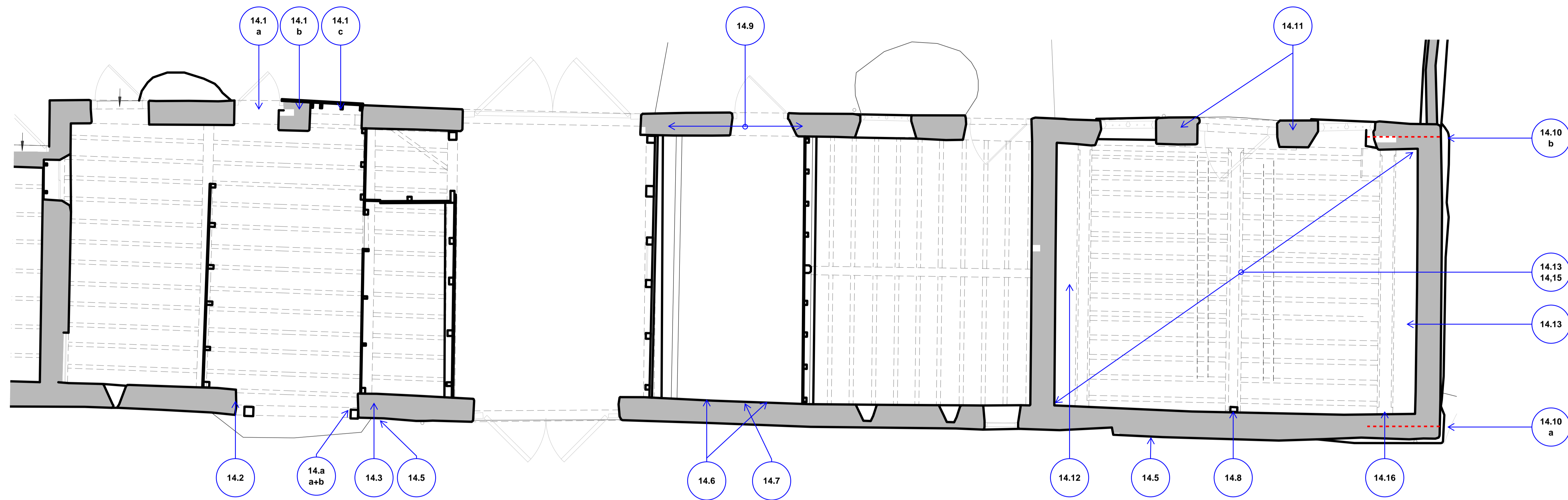
Reference	Defect Description	Photo	Repair Description	Indicative Sketch	Notes
13.1	2x purlins have poor connection to supporting valley beams		Build-up adjacent rubble wall "gable" to provide improved support to purlins where they pass through	-	Rubble masonry to match extg
13.2	Risk items – visual indications of possible decay, close inspection & testing required. In particular: <ul style="list-style-type: none"> 1 x ridge beam 2 x valley beams 		TBC during site phase once safe access is possible for detailed assessment	-	Additional local defects also likely to become apparent during site works, due to restricted nature of inspection.
13.3	Ridge beams absent		Reinstate using reclaimed oak sections matching other bays (est. approx. 150mm sq). Install using traditional pegged connections.	-	
13.4	Repaired truss tie requires closer inspection		TBC during site phase once safe access is possible for detailed assessment	-	Original tie beam fully failed with multiple fractures across the span. Has been strengthened by partnering with softwood timbers either side (approx. 225dp x 100 & 75 wd). Strengthening detail appears to be functioning adequately with no indications of ongoing distress, but should be checked closely after the modern ceiling & wall linings have been removed, especially at the bearings (which are currently hidden)
13.5	Decayed common rafters		Depending on extents of decay, either replace new oak equivalent, or partner with new oak rafter alongside extg, matching size (est. approx. 90x80)	-	Only 1no. definite identified so far, but provisionally allow for up to, say, 10no.

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TITLE OUTLINE STRUCTURAL REPAIR PROPOSALS - SHEET 7	DRAWN HP	CHKD -	SIZE A1	SCALE 1:50	
PROJECT SOUTH-WEST BARN - ROOF				STATUS PRELIMINARY	
PROJECT 10854		DRAWING SK13		REV P1	
P-PRELIMINARY		T-TENDER		CONSTRUCTION	



Reference	Defect Description	Photo	Repair Description	Indicative Sketch	Notes
14.1a	Decayed and failed wall plate / lintel. Modern steel beam alongside supported prop to failed truss bearing above.		Failed/decayed section of wall plate / spanning lintel to be removed locally and replaced with new section from reclaimed oak, with pegged tenon connection to truss post above (and any other posts along the section replaced) and spliced to adjoining sections of wall plate using half-lap scarf joints with s/s coach screws.	-	<ul style="list-style-type: none"> Section size of new timber circa 230mm sq TBC following detailed design (greater than original which was inadequate to carry the principal truss). Temporary propping required and work must be undertaken in conjunction with the repairs to the truss bearing above (item 15.4) Modern steel beam will become redundant and can be removed once the repairs to the truss bearing above have been completed.
14.1b	Blockwork pier (former repair) is functional but detrimental to character of the building.		Remove pier and rebuild section of wall in rubble stone matching existing.	-	
14.1c	Unsupported cill plate, inadequate for the span		Fully re-support cill plate on masonry as intended.	-	
14.2	Masonry fracture in upper parts of reveal		Stitch using helibar turned around reveal, in rubble bed joints, and make good crack by repointing in lime mortar	-	<ul style="list-style-type: none"> Helibar detailed spec tbc. Provisionally allow for installing 3no. 8mm dia bars x 2m long each
14.3	Straight joint / fracture in rubble wall, evident on both faces		Stitch crack using Helibar in coursed rubble joints and make good crack by repointing in lime mortar	-	<ul style="list-style-type: none"> Helibar detailed spec tbc. Provisionally allow for installing 3no. 8mm dia bars x 1.5m long each, in both inner and outer wall faces.

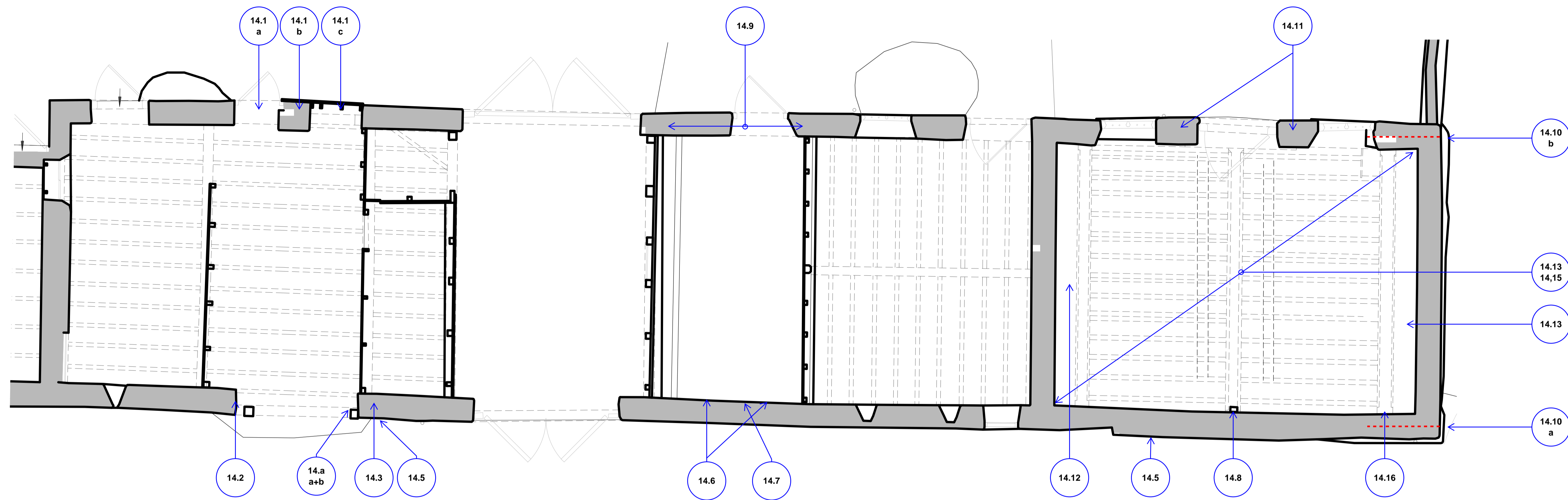
Reference	Defect Description	Photo	Repair Description	Indicative Sketch	Notes
14.4a	Possible decay at bottom of post		Locally replace decayed section using new or reclaimed oak, scarfed in with a halving joint, coach screwed and plugged.	-	<ul style="list-style-type: none"> Requires closer inspection to confirm necessity. Consideration should be given to raising post ends off ground for durability e.g. using stone plinths or s/s shoes.
14.4b	Masonry heavily weathered at base of reveal.		Locally rebuild, or piece in replacement stone where possible.	-	
14.5	Various former repairs to rear wall in concrete and/or blockwork are functional but detrimental to character of the building.		Remove and rebuild areas in rubble masonry matching etc	-	<ul style="list-style-type: none"> Will require both temporary works and a sequential approach, taking down and rebuilding small areas at a time. All masonry in lime mortar
14.6	2no. locally collapsed areas of rubble masonry at base of wall on inside face		Rebuild affected areas	-	<ul style="list-style-type: none"> Allow for approx.. 1m x 0.5m x 2no.

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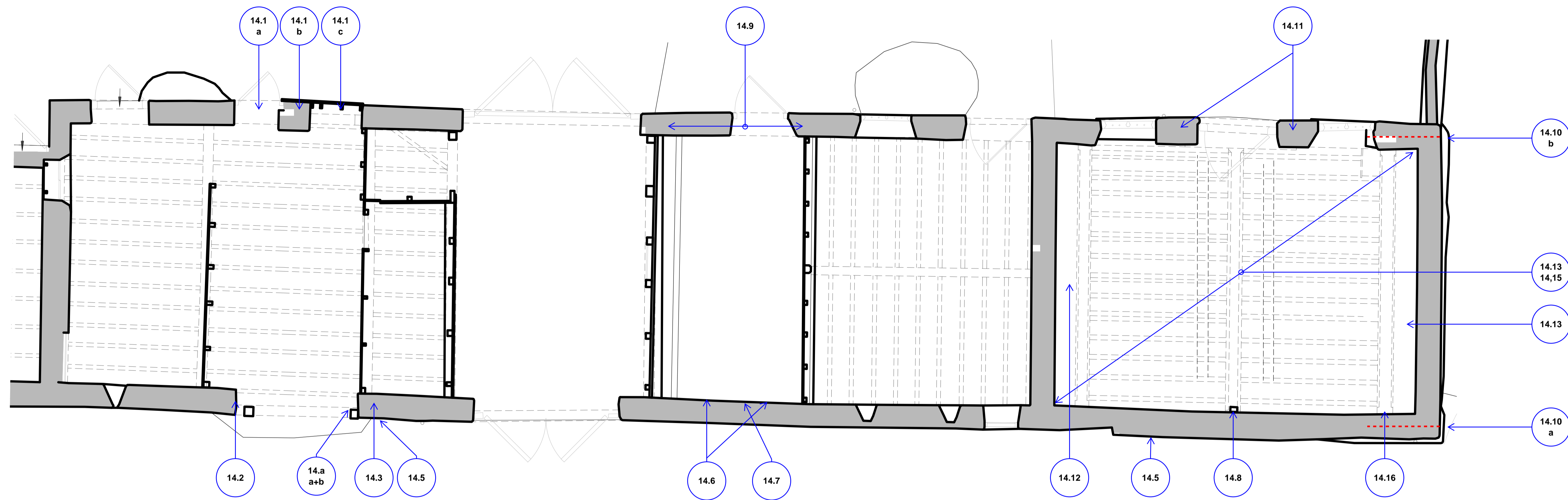
REV P1	DESCRIPTION Issued for planning	BY HP	DATE 31.08.21	PROJECT ASTON HALL BARN	MANN WILLIAMS CONSULTING CIVIL AND STRUCTURAL ENGINEERS 7 OLD KING STREET QUEEN SQUARE BATH BA1 2JW T 01225 466419 F 01225 468551 E bath@mannwilliams.co.uk
DRAWN HP	CHKD -	SIZE A1	SCALE 1:50	DATE AUG '21	
TITLE OUTLINE STRUCTURAL REPAIR PROPOSALS - SHEET 8				PRELIMINARY	
PROJECT SOUTH-EAST BARN - UP TO 1ST FLOOR - PAGE 1/3				DRAWING 10854	REV P1
P-PRELIMINARY		T-TENDER		CONSTRUCTION	



Reference	Defect Description	Photo	Repair Description	Indicative Sketch	Notes
14.7	Decayed sill beam at mid height, including compromised mortices. Appears to affect full section locally.		Replace section using new heartwood oak, matching existing section size (circa 200x150 tbc). Spliced to adjoining sections of wall plate using half-lap scarf joints with s/s coach screws. To allow insertion with wall in-situ, affected post/bracing tenons (2-3 no.) will need to be cut and joints made good using steel bracketry and screws. Also make good top course of rubble masonry where weathered on outside face.		<ul style="list-style-type: none"> Extents of replacement TBC following full exposure. If only decayed on one face re-facing half thickness of timber will be preferable to complete replacement. Affected length circa 1m long TBC. Architects to consider a flashing detail / improved arrangement at btm of timber cladding to reduce wetting of plate.
14.8	Existing remedial prop to be "formalised"		Review prop requirements and install new concrete pad footing if necessary.		<ul style="list-style-type: none"> Footing take to same formation level as existing walls.
14.9	Decayed sill beam at mid height, concentrated at stud mortices. Appears to affect mainly outer face.		Remove decayed face and surface patch / re-face using reclaimed oak.		<ul style="list-style-type: none"> Extents of patching TBC following full exposure. May require a continuous re-facing circa 2-3m long rather than local patching at mortices. If decay affects full thickness complete replacement of section may be necessary. Assume a combination of mechanical fixings (s/s screws) and epoxy adhesive, details TBC

Reference	Defect Description	Photo	Repair Description	Indicative Sketch	Notes
14.10 a+b	Fractures in front and rear walls where gable end appears to be pulling away.		Cintec anchor wall junctions at both elevations and make good associated cracks by deep raking out and repointing. Loose rubble may require local rebuilding prior to anchoring.		<ul style="list-style-type: none"> Applies to full height of walls. Number and spec of anchors tbc. Anchor heads recessed.
14.11	Fractures in rubble stone piers.		Stitch using Heilbar in coursed rubble joints and make good cracks by repointing in lime mortar. Consolidate loose masonry over lintel.		<ul style="list-style-type: none"> Heilbar extents and detailed spec tbc.
14.12	Void in floor		Infill with oak joists matching extg.		
14.13	Void in floor ; Gable end wall leaning & inadequately restrained		<ul style="list-style-type: none"> Repaired first floor deck in end room to incorporate a 2-layer plywood diaphragm, screwed to all joists and beams. Floor infill strip adjacent to gable wall to incorporate a pole-plate, connected into the new floor diaphragm and supported on cintec anchors at 600mm centres (anchors providing both vertical support to floor + lateral restraint to wall) Pitched roof also to incorporate an equivalent plywood diaphragm screwed to all rafters. 		

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		TITLE OUTLINE STRUCTURAL REPAIR PROPOSALS - SHEET 9 SOUTH-EAST BARN - UP TO 1ST FLOOR - PAGE 2/3						STATUS PRELIMINARY	PROJECT 10854	DRAWING SK14-2	REV P1	



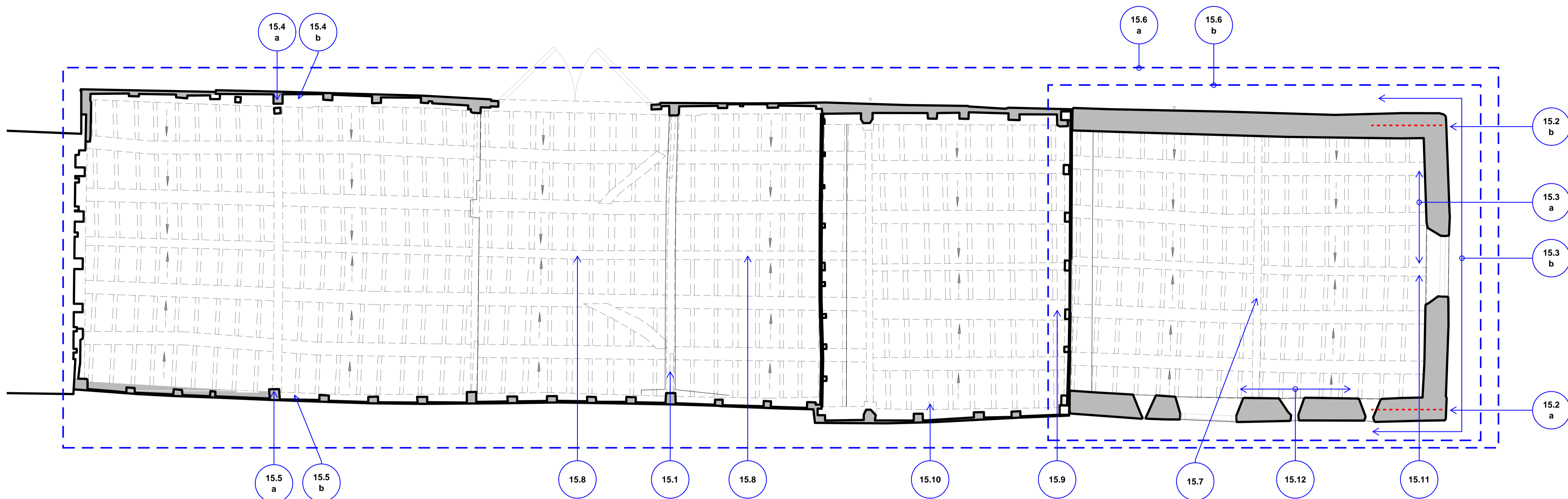
Reference	Defect Description	Photo	Repair Description	Indicative Sketch	Notes
14.14	Joists too slender to support domestic use at first floor.		<ul style="list-style-type: none"> Remove existing partner joists where applicable, and replace with new partners to every joist. Use new oak, grade TH1, minimum 90mm wide x 140mm deep. Connection details for new joists TBC. Provisionally allow for using concealed proprietary joist hangers e.g. Simpson Strongtie ETB90-B or equiv. approved. New joists to be screwed alongside existing bowed joists but set level / not profiled to match. 		<ul style="list-style-type: none"> Recommendations assume that 1st floor gym loading requirements will be no greater than / equiv. to domestic type loading (e.g. use as private exercise / yoga room OK, but not heavy "resistance" machines or dynamic/crowd use). Perimeter of joists hangers potentially require protection with intumescent mastic – TBC.
14.15	3 primary floor beams too slender to support domestic use at first floor		Either introduce props (with foundations) to reduce spans, or strengthen/stiffen beams with heavy steel flitch plates.		<ul style="list-style-type: none"> Propping option is structurally preferable if it can be accommodated architecturally. This is because flitching irreversibly damages the beams, and the plates required will be very heavy (approx. 40mm thick) so installation will be very difficult. Propping will also be more effective. Recommendations assume that 1st floor gym loading requirements will be no greater than / equiv. to domestic type loading (e.g. use as private exercise / yoga room OK, but not heavy "resistance" machines or dynamic/crowd use).
14.16	Decayed embedded timber bearer below primary floor beam. Former post support cut off.		<p>Replace bearer using reclaimed heartwood oak of matching section size (provisionally circa 125x200, tbc once bearing length established).</p> <p>Beam end requires detailed inspection to determine whether it remains sound. If not, the bearing will be strengthened either by re-introducing a prop (with a foundation) or using an exposed steel splice detail (steel plates bolted either side).</p>		<ul style="list-style-type: none"> Temporary propping required for bearer replacement.

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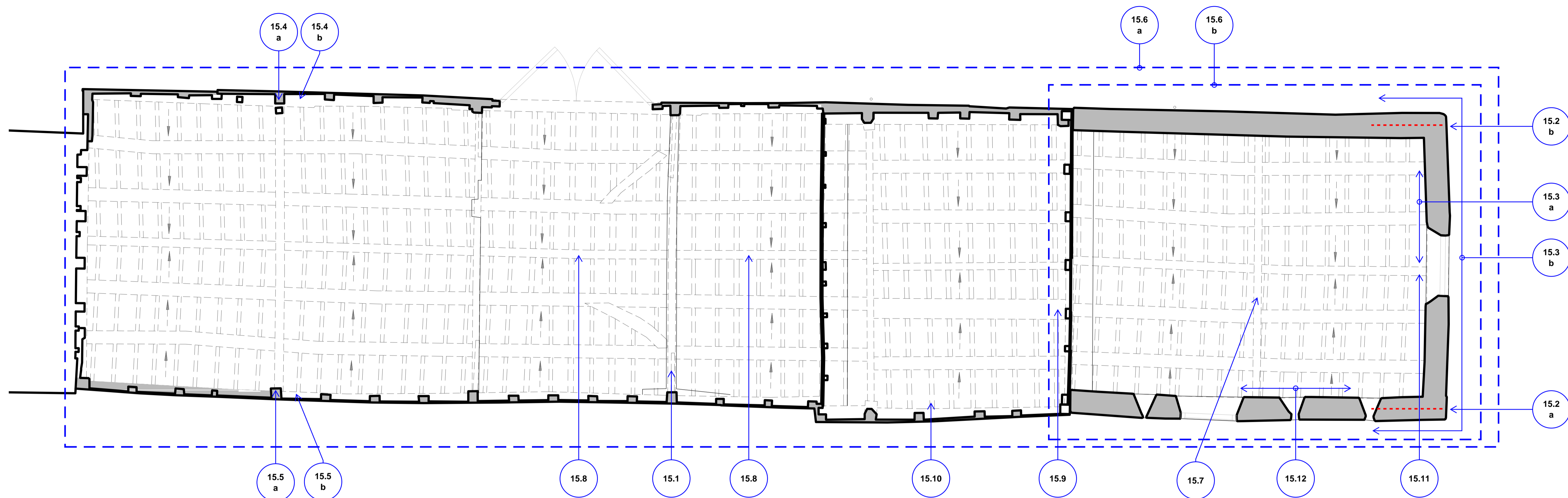
REV P1	DESCRIPTION Issued for planning	BY HP	DATE 31.08.21	PROJECT ASTON HALL BARN	<p>MANN WILLIAMS CONSULTING CIVIL AND STRUCTURAL ENGINEERS 7 OLD KING STREET QUEEN SQUARE BATH BA1 2JW T 01225 466419 F 01225 468551 E bath@mannwilliams.co.uk</p>
PROJECT 10854	DRAWING SK14-3	REV P1	DATE AUG '21	STATUS PRELIMINARY	
TITLE OUTLINE STRUCTURAL REPAIR PROPOSALS - SHEET 10				SOUTH-EAST BARN - UP TO 1ST FLOOR - PAGE 3/3	
PROJECT 10854		DRAWING SK14-3		REV P1	



Reference	Defect Description	Photo	Repair Description	Indicative Sketch	Notes
15.1	Raking strut missing (inadequate modern replacement)		Replace using new or reclaimed oak, section size matching opposing strut. Connect using existing mortice holes / traditional detailing.		<ul style="list-style-type: none"> Screwed & glued half-lap splice joint near one end of new strut probably necessary to enable installation into extg mortice holes.
15.2 a+b	Fractures in front and rear walls where gable end is pulling away.		Cintec anchor wall junctions at both elevations and make good associated cracks by deep raking out and repointing. Loose rubble may require local rebuilding prior to anchoring.		<ul style="list-style-type: none"> Applies to full height of walls. Number and spec of anchors tbc. Anchor heads recessed.
15.3a	Cracks in gable wall, especially beside and FF above doorway.		Stitch cracks on inside face using Helibar in coursed rubble joints and make good cracks by repointing in lime mortar. Parts of doorway reveals will require localised rebuilding. Gable end wall also requires more general deep-pack repointing on inside face.		<ul style="list-style-type: none"> Helibar detailed spec tbc. Provisionally allow for installing 8mm dia bars, 4no. @ 1.0m long and 3no. @ 2m long.
15.3b	Outward movement / distortion of gable end elevation generally		Strengthen gable end using helibar in external face, full width and returning around side elevations by 1.5m. This will enhance the wall's ability to span between the points of restraint.		<ul style="list-style-type: none"> Helibar detailed spec tbc. Allow for 5no. continuous bars between ground level and u/s FF opening, full with and returns; plus 3no continuous bars to gable above opening (no returns).

Reference	Defect Description	Photo	Repair Description	Indicative Sketch	Notes
15.4a	Decayed principal post and truss end bearing, with former repair.		<ul style="list-style-type: none"> Re-face decayed west side of original post using reclaimed oak (approx. 220x100). Renew supporting lintel (see 14.1a) Renew modern horizontal element using new oak to achieve a bearing onto the original post, potentially using s/steel bracket. Remove modern timber prop Enhance notched diagonal strut (part of the modern repair) using a partner. Enhance connection fixings generally 		<ul style="list-style-type: none"> Extg repair detail is essentially sound except for requiring more substantial fixings, however there is opportunity to improve it generally with more traditional/sympathetic detailing, and to remove the need for supporting steel and blockwork beneath. Temporary propping required Detailed specification / drawings to be produced.
15.4b	Wall plate junction partially failed		Screw repair through existing mortice and tenon joint, to compensate for snapped pegs		<ul style="list-style-type: none"> Both parts of wall plate appear to remain intact (including tenon, albeit deformed), but connection has failed by snapping peg(s) due to the adjacent post dropping. Detailed specification / drawing to be produced.
15.5a	Large fracture at head of principal post, suggestive of northwards dragging of tie-beam		<ul style="list-style-type: none"> Main fissure to be repaired by cleaning and then resin-filling (detailed specification to be prepared) followed by through-bolting or using external steel girdles. Distorted joints (esp. base of diagonal strut) to be repaired/strengthen by packing gaps using very dry oak then reinforcing with structural screws (detailed specification to be prepared) Missing or damaged pegs to be renewed (provisionally 4no.) 		<ul style="list-style-type: none"> Main fissure in post is 30-75mm wide, almost but not quite full thickness. Detailed specification / drawing to be produced.
15.5b	Wall plate junction failed		Clean and then resin-fill gaps in joint, then reinforce with structural screws.		<ul style="list-style-type: none"> The plates themselves appear to remain adequate, only the connection has failed due to distortion (snapped pegs) Detailed specification / drawing to be produced.

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		TITLE OUTLINE STRUCTURAL REPAIR PROPOSALS - SHEET 11	PROJECT SOUTH-EAST BARN - ABOVE 1ST FLOOR - PAGE 1/2	STATUS PRELIMINARY	PROJECT 10854	DRAWING SK15-1		REV P1				



Reference	Defect Description	Photo	Repair Description	Indicative Sketch	Notes
15.6a	Gable end wall leaning & inadequately restrained		<ul style="list-style-type: none"> Full pitched roof to incorporate a 2-layer plywood diaphragm screwed to all rafters to enhance overall structural stiffness and resilience. Also ensure common rafters are well secured to wall plates generally. Strengthen connections (e.g. using Expamet HD9090 brackets) where necessary. 		<ul style="list-style-type: none"> Detailed specs to be developed.
15.6b			Fixings between roof the masonry wall heads to be improved: <ul style="list-style-type: none"> Fixings wall plates at eaves level down into the wall head, provisionally using M12 s/s threaded bar resin anchors @ 0.9m ctrs. Provide a new pitched "wall plate" on the gable end, resin anchored into the wall head (provisionally using M12 s/s threaded bar resin anchors @ 0.6m ctrs) and tied into the new plywood diaphragm. Also resin anchor purlins / ridge beam bearings into wall. Additionally allow for local consolidation of masonry along the gable wall heads. 		<ul style="list-style-type: none"> Detailed specs to be developed. Recommend trial of wall head anchors to ensure wall head not excessively voided, especially on rubble side.
15.7	Missing retention pins		Renew using traditional dry oak pins		
15.8	Weak ridge-beam bridle joints near mid-spans, incapable of resisting necessary bending moments.		Reinforce with steel angle through-bolted from above.		<ul style="list-style-type: none"> Detailed specs to be developed. Applies to 2no, or potentially 3no. spans.

Reference	Defect Description	Photo	Repair Description	Indicative Sketch	Notes
15.9	Purlin bridle joint separating		Reinforce with steel angle through-bolted from above.	As 15.8	<ul style="list-style-type: none"> Detailed specs to be developed.
15.10	Decay and splits affecting some individual rafter ends		Partner with new oak rafter alongside extg. matching size (approx. 100x7)		<ul style="list-style-type: none"> Only one specific instance identified to date in this barn, but more are likely to become evident when roof is stripped – provisionally allow for say 10no. (TBC on site). Typically only necessary to partner a single span (e.g wall plate to purlin, depending position of decay).
15.11	Probable decay at ridge beam bearing		Splice on new end using seasoned oak (preferably reclaimed) of matching section size. Tabled scarf joint with s/s coach screws.		New bearing to be fully isolated from masonry using continuous DPM sock.
15.12	Loose rubble masonry		Rebuild area around first floor level on inside face, up to around window cill level, and consolidate masonry around base of slit window reveals. Also deep-pack repoint / consolidate loose masonry to area of wall at GF below.		<ul style="list-style-type: none"> All masonry work to use lime mortar only

NOTES 1. This drawing is copyright and may not be reproduced without the permission of Mann Williams. 2. All drawings are to be read in conjunction with the project specification with all works carried out in accordance with the latest British Standards and codes of practice. 3. Any ambiguities or discrepancies between this drawing and any other information given elsewhere must be reported to Mann Williams for clarification before work proceeds. 4. All dimensions to be checked on site and any discrepancies reported to the engineer before work commences. 5. Only figured or calculated dimensions should be used and no drawing, in any format should be scaled for construction purposes.	NOTES CONTINUED	REV P1	DESCRIPTION Issued for planning	BY HP	DATE 31.08.21	PROJECT ASTON HALL BARN	MANN WILLIAMS CONSULTING CIVIL AND STRUCTURAL ENGINEERS 7 OLD KING STREET QUEEN SQUARE BATH BA1 2JW T 01225 464419 F 01225 468551 E bath@mannwilliams.co.uk	DRAWN HP	CHKD -	SIZE A1	SCALE 1:50	DATE AUG '21
		TITLE OUTLINE STRUCTURAL REPAIR PROPOSALS - SHEET 12	PROJECT SOUTH-EAST BARN - ABOVE 1ST FLOOR - PAGE 2/2	DRAWING SK15-2	REV P1	STATUS PRELIMINARY						