

Technical Note

Tudor House west cross-frame structural proposals

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1.0 Executive summary

Nos. 99 and 101 Crane Street form a Grade I listed building. 'Tudor House' is a 15th-century element within the North Range of Church House. The building comprises approximately 900 mm thick stone external walls up to eaves level. Two of the internal walls comprise timber square-panel cross-frames from first-floor level.

The beam at the base of the west cross-frame has rotated significantly at its north end, with the surrounding frame showing local displacement as a result. The movement is considered to be predominantly historic, although there is evidence of more recent movement. The rotation is considered to have arisen from the eccentric position of the ground-floor partition supporting the beam, with the effect compounded by eccentric loading from the secondary beams. If the beam continues to rotate, the stability of the cross-frame and the Solar floor are likely to be compromised.

The building is due to undergo development imminently. To mitigate the risk of further movement and to ensure that the structure continues to perform safely, remedial designs have been produced. Sympathetic, conservation-led strengthening proposals have been developed to minimise the removal of historic fabric. The proposals will be concealed from view and are reversible where practicable. Two strengthening areas have been identified.

A steel frame has been devised to be concealed within the existing fabric at the north end of the rotated beam. The steelwork provides a direct load path to ground for vertical load from the cross-frame, thereby relieving part of the demand on the main beam. More importantly, it provides rotational restraint and resists lateral westward movement.

The incoming central secondary beam is currently hung from the side of the main beam. To help resist further rotation, a rigid connection will be formed by inserting a stainless steel plate along the centreline of the secondary beam for its full length, with a perpendicular plate welded to the end at the main beam connection.

2.0 Brief

Andrew Waring Associates Ltd (AWA) is providing structural consultancy advice to Clydesdale Group in relation to the development of the Church House site in Salisbury. As part of this commission, AWA carried out a structural condition survey which identified the need to address movement within the west cross-frame of Tudor House. This technical note has been prepared to set out the proposed remedial works.

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3.0 Project

LOCATION	OS grid ref.	SU 14170 29798
	What3Words	///hush.alive.sheets
	Address	99 & 101 Crane Street, Salisbury, SP1 2QD

Table 1 - Site location information

To provide context for the proposals, the wider site is described first (Section 3.1), followed by the more localised description of the North Range and west cross-frame (Sections 3.2 and 3.3).

3.1 Site description

Nos. 99 and 101 Crane Street are a Grade I listed building (List Entry No. 1023638), located approximately 200 metres north-west of Salisbury Cathedral, adjacent to the River Avon. The building comprises a series of historic additions and alterations forming several ranges. The earliest part is the 15th-century 'Tudor House' at the north edge of the site, while the most recent is the 20th-century 'South New Build' at the south-east corner.

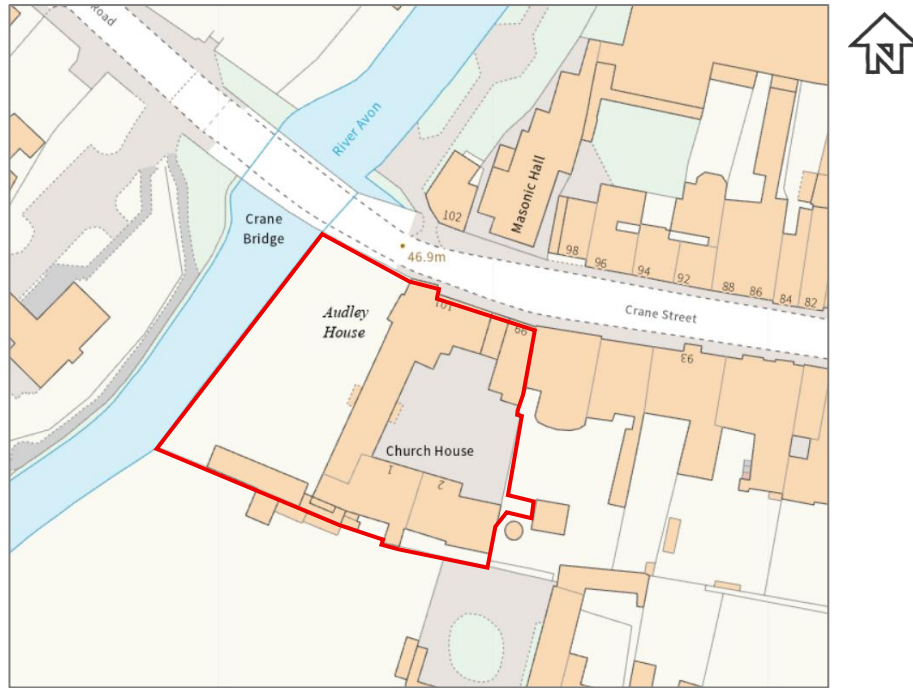


Figure 1 - Site plan

[source: Ordnance Survey (Crown copyright & database rights 2026 Ordnance Survey)]

The building currently comprises a mixture of commercial office accommodation and residential use. Planning permission and listed building consent have been granted to convert the commercial accommodation to residential use.

KEY

- Tudor House ①
- Gatehouse - Ground Floor Flat ②
- Gatehouse - First Floor Flat ③
- River House ④
- South Block Corner Flat GF ⑤
- South Block Ground Floor ⑥
- South Block Flat 1A ⑦
- South Block Flat 1B ⑧
- South Block Flat 2 Maisonette ⑨
- Communal ⑩
- South New Build ⑪
- Boat House ⑫
- Beam above
- Timber roof element
(thick = truss, thin = other)



Figure 2 – Existing ground floor plan with proposed zone designations

3.2 North Range description

'Tudor House', together with the adjoining 'Gatehouse', forms the North Range. The principal 15th-century building has a rectangular plan with a central vehicular access passage. At the west end, 16th-century cross-gables have been added, together with a two-storey 16th-century infill between the south cross-gable and the main building.

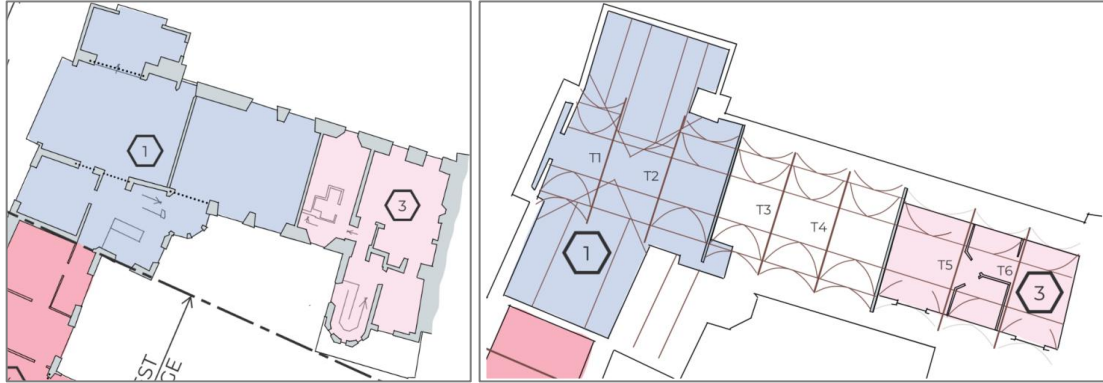


Figure 3 – North Range first floor (L) and roof (R) plan



Figure 4 – north elevation, east end



Figure 5 – north elevation, west end



Figure 6 – west elevation



Figure 7 – south elevation

The principal roof of the North Range (with ridge running east-west) is formed in nine bays, with intermediate timber cross-frame walls at every third bay. Timber trusses with mid-height collars and arched braces support purlins at third points. Concave wind bracing is present between the purlins and principal rafters in the upper position. The three central roof bays are exposed within the Hall. The three western bays are visible only from within the roof void, while the three eastern bays are visible from the Gatehouse second floor. The principal rafters on the two westernmost trusses are tied at their bases with steel rods.



Figure 8 – east cross-frame, W elevation



Figure 9 – west cross-frame, E elevation



Figure 10 – Solar undercroft, looking north



Figure 11 – Solar, looking north

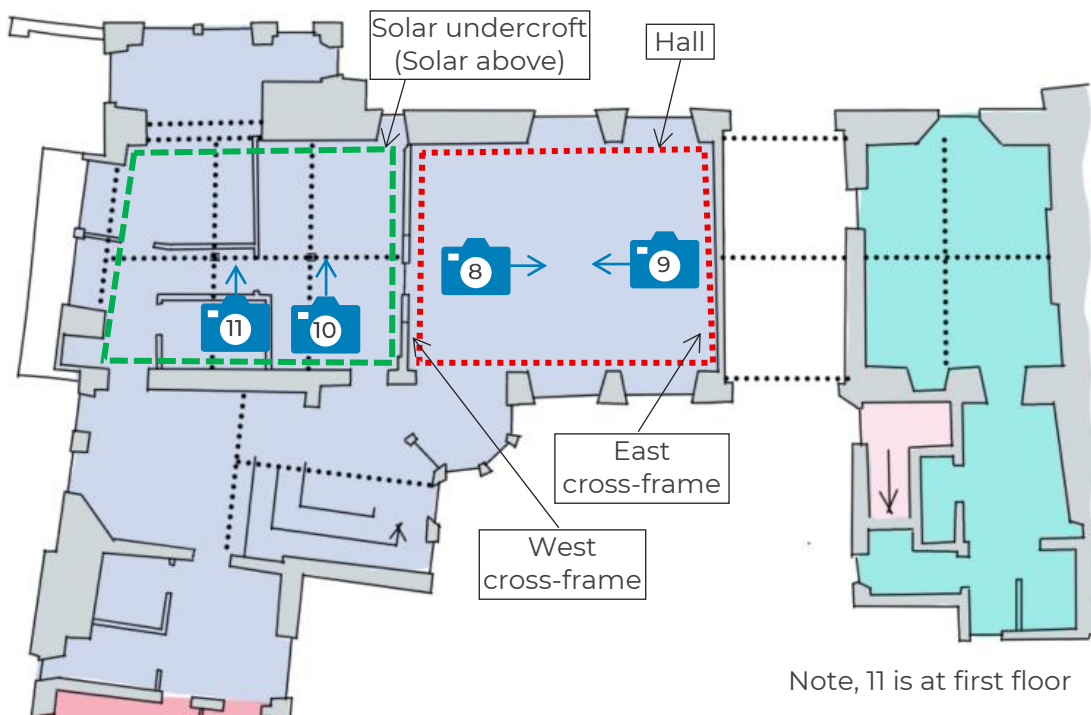


Figure 12 – Ground floor plan with figure (photo) locations and room notation

The North Range comprises approximately 900 mm thick stone external walls up to eaves level. Two of the internal walls are timber square-panel cross-frames from first-floor level, aligned with the roof truss spacing. The east cross-frame separates Tudor House Hall from the Gatehouse. The west cross-frame separates the Hall from the Solar (most recently used as a boardroom) and the Solar undercroft (most recently used as office space). The lower part of the west cross-frame comprises an

early 20th-century partition of masonry and studwork. Within the Hall, wall pieces (posts) are located beneath each truss support and extend down to a stone corbel at approximately 5 metres above ground-floor level. These wall pieces appear to be decorative rather than structural.

3.3 West cross-frame description

The cross-frame spans between the north and south external walls. The first-floor element comprises five timber studs with mid-rails, supported on a girding beam hereafter referred to as the 'main beam'. The studs and rails form square panels, each incorporating a diagonal timber brace and infilled with wattle and daub. The frame continues up to ridge level, incorporating a tie beam at eaves level and a collar above. The frame is exposed on the Hall side and within the roof space.

Additional decorative timber elements are present at high level, including an arched brace intended to echo the adjacent roof trusses and vertical ribs visible on the Hall elevation only. The purlins are supported on the principal rafters, which form part of the cross-frame. At low level, the Solar elevation is clad with decorative timber wall panelling, with a plain plastered area above that is assumed to be supported from the cross-frame by battens.



Figure 12 – cross-frame, Hall elevation



Figure 13 – cross-frame, roof space elevation

It is considered likely that the cross-frame originally extended down to ground level. This interpretation is based on the presence of mortice holes to the underside of the main beam, which may formerly have received post or jowl tenons. At present, a partition comprising masonry at the north and south ends and studwork centrally, sits beneath the main beam. The partition is tight to the underside of the beam and appears to be load-bearing.



Figure 14 – partition below cross-frame, Solar undercroft elevation



Figure 16 – partition below cross-frame, Hall elevation

The main beam now bears onto the ground-floor brick and stud partition. The beam is heavily moulded on the Solar undercroft (west) side. Presumably to avoid the moulded face, the partition below the main beam is not centred beneath it, but instead is positioned below the flat, unmoulded portion toward the Hall side. In addition to supporting the cross-frame elements, the main beam also supports secondary beams forming part of the Solar floor. These beams are of similar character, with moulded soffits.

4.0 Defect

4.1 Observation and analysis

The main beam has rotated significantly at its north end, with the top moving westwards towards the Solar. The remainder of the cross-frame has moved locally with it. A substantial gap is present between the wall-piece corbel and the cross-frame, which illustrates the scale of movement. The movement is considered to be predominantly historic, as indicated by intact finishes, earlier strengthening attempts (including a saddle and bolts), and pieces of timber inserted to fill gaps. It is understood that the building has not been subject to significant maintenance or renovation for several decades. Notwithstanding that most of the movement is likely to be historic, there is evidence of more recent change.



Figure 15 – north elevation, east end



Figure 16 – north elevation, west end



Figure 17 – west elevation



Figure 18 – south elevation

The movement of the cross-frame does not appear to have caused significant adverse effects to the surrounding fabric beyond the areas listed below, which may reasonably be attributed to that movement:

- Purlins withdrawing from principal rafters
- Wind braces withdrawing from purlins
- Cracks and deformation in stone lintels to west of cross-frame
- Cracked single glazing
- Secondary beams withdrawing from main beam
- Splits in main beam

There is evidence of earlier attempts to address the movement. A wrought-iron saddle is present on the central secondary beam, with an access panel formed in the main beam on the opposite side. A bolt, possibly a coach screw, is present at the north end of the main beam, fixing into the north secondary beam. A timber post supports the end of the central secondary beam furthest from the cross-frame, as shown in Figures 10 and 15. This post does not match the appearance of the surrounding beams and may have been inserted to provide additional support.



Figure 19 – central secondary beam saddle



Figure 20 – timber access panel on opposite side to saddle

4.2 Root cause analysis

The rotation of the beam is considered to have arisen from the off-centre ground-floor partition supporting the main beam. This rotational tendency is further compounded by eccentric loading from the secondary beams. There is little inherent resistance to this rotation beyond the stiffness of the mortice-and-tenon stud connections and, potentially, some degree of horizontal diaphragm or propping action at the top of the beam at floorboard level.

4.3 Concern

The effects of the main beam rotation have so far been accommodated by the structure, although the extent of any previous remedial works is unknown. If the beam continues to rotate, the stability of the cross-frame and the Solar floor are likely to be compromised.

5.0 Proposals

The building is due to undergo development imminently and, for that reason, it is not considered practicable to undertake a period of monitoring. It is evident that most of the movement is historic and that any more recent movement has been relatively limited. However, to mitigate the risk of further movement and to ensure that the structure continues to perform safely, remedial works should be undertaken.

The structure is Grade I listed and of exceptional historic importance. Accordingly, conservation-led strengthening proposals have been developed to minimise the removal of historic fabric. The proposals will be concealed from view and are reversible where practicable.

Remedial work proposals have been detailed in the following sketches:

- 14914-SK30 – Structural – Tudor & Gate House
- 14914-SK31 – Structural – Tudor House west cross-frame 1 of 3
- 14914-SK32 – Structural – Tudor House west cross-frame 2 of 3
- 14914-SK33 – Structural – Tudor House west cross-frame 3 of 3

Two areas of strengthening have been chosen:

5.1 Main beam north end

Refer to sketches 14914-SK31 & 14914-SK32.

A concealed steel frame has been devised within the existing fabric. A single timber stud is currently present at the north end of the ground-floor partition. As the partition does not align with the window reveal, the stud has been heavily chamfered. The proposal is to replace this stud with a steel box-section post, securely fixed to the external wall and tied into the brick partition.

The post will support a small steel PFC (parallel flange channel) positioned within an existing void at the end of the main beam. The channel is cranked to avoid projecting beyond the profile of the main beam. Its purpose is to brace the head of the box-section post and to provide vertical support to an angle fixed to the cross-frame stud above.



Figure 21 – general view from Solar undercroft Figure 22 – partition stud viewed within Solar undercroft



Figure 23 – beams within Solar



Figure 24 – void at end of main beam viewed from Solar

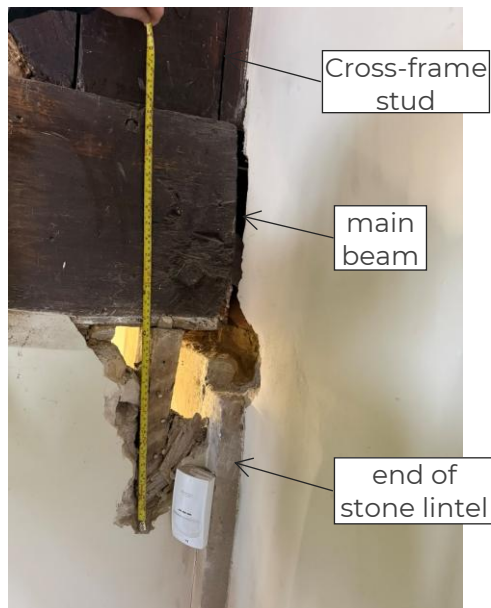


Figure 25 – general view from Hall



Figure 26 – deep void at north end of main beam viewed from Hall

The steelwork provides a load path to ground for vertical load from the cross-frame, thereby relieving part of the demand on the main beam. More importantly, it provides rotational restraint and resists lateral westward movement.

5.2 Main beam mid-span

Refer to sketch 14914-SK33.

The incoming central secondary beam is currently hung from the side of the main beam. To resist further rotation, a rigid connection will be created. A stainless steel plate will be inserted into the centre of the secondary beam for its full length, extending as far as the timber post support. A perpendicular plate will be welded to the end at the main beam connection, and the plate will be bolted to the main beam. The fixings will be concealed within the existing timber panelling.

The flitched beam will act as a substantial lever arm clamped to the main beam. Rotation of the main beam will be resisted through vertical support at the timber post. The partition below the main beam will continue to provide vertical support to the beam.

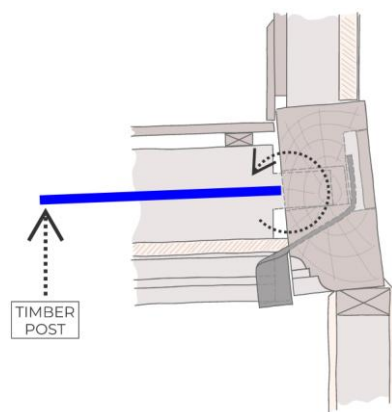


Figure 27 – Diagram to illustrate how flitch will resist rotation [blue = flitch]

A channel will need to be cut in the top of the secondary beam to house the steel plate. This is typically undertaken using a modified chainsaw. The procedure can be carried out almost entirely from above, with several floorboards removed. The saddle can likely remain in-situ. Some further opening-up will need to be undertaken to confirm the constructability of the proposals.

An alternative proposal to install plates at either side of the secondary beam was discounted due to the large number of incoming joists which would need to be cut and rehung.

6.0 Conclusion

In summary, the observed rotation of the west cross-frame main beam appears to be principally associated with eccentric support conditions at ground floor level, compounded by loading from the secondary beams. Although most of the deformation is considered historic, there is sufficient evidence of more recent movement to justify remedial intervention in advance of the planned development works.

The proposed strengthening measures have been developed to improve the stability of the cross-frame and associated floor structure while minimising intervention to the historic fabric. By concealing the new steelwork within existing construction and adopting reversible solutions where practicable, the proposals provide a proportionate and conservation-led response that supports the continued safe use of Tudor House.