Our Ref: SME/CM/224260

18th November 2024

c/o Claire Humphries
Shu Architects
43-45 Park Street
Bristol
BS1 5NL

By email: claire@shuarchitects.uk

mnp
mason navarro pledge

1st Floor, Bevan House
9-11 Bancroft Court
Hitchin
Hertfordshire SG5 1LH

Telephone: 01462 632012
Email: office@mnp.co.uk
www.mnp.co.uk

Dear Claire

**Re: 32 The Green, Richmond, TW9 1LX**

**Conservation Accredited Engineer: Structural Overview of the roof and floor structures, foundation and basement floor.**

Introduction

Mason Navarro Pledge have been engaged as project structural engineers on the planned refurbishment project to 32 The Green in Richmond. MNP were appointed on the basis of their specialist expertise in the structural care and repair of historic buildings.

Stuart Ellis (Associate Director, MNP) is directly undertaking inspection works, overseeing design calculations and specification and is the main point of contact for the project. Stuart is a Conservation Accredited Engineer (CARE) and has over 25 years' experience working almost exclusively on historic building projects. For 18 of these years, he was a direct employee of English Heritage / Historic England which included 5 years as Head of Historic England's Conservation Engineering Team where he was in-house advisor to Historic England's architects and inspectors on Planning Casework.

Roof Structure

Inspection

As part of the detailed inspection of the roof structure, it was noted that the two hip corners had dropped and were pushing outwards around the junction between the purlin and the hip member. The movement at this position was deemed to be excessive. A visualisation of this can be better seen on MNP sketches 9 and 10 appended.

The inspection also noted the excessive deflection of the purlin on the northwestern elevation. It was noted that the purlin originally had lower rafters between the two dormer windows which would have provided support to the purlin at midspan. The removal of these rafters has resulted in excessive deflection for the size of the purlin.

Furthermore, it was noted that the purlin above the stairs, which spans onto the corner hip member, is too long for its size and has dropped with the hip member. A further examination of this structural issue can be seen on MNP sketch 11 appended.

Recommendation

With regards to the outward movement and dropping of the hip members, it is recommended that a triform of steel work is installed on the underside of the hip member with legs along the top of the wall heads. This will stabilise the hip member and provide propping at the position of the bearing of the purlin. The legs on the wall head will carry the compression force to the wall heads and the intervention of vertical strapping down the inside face of the wall to a steel channel section embedded into the wall will provide restraint to the overturning induced by the downwards force at the purlin junction.

It is recommended that the purlin with excessive deflection on the north-west elevation is strengthened by introducing a steel channel section fixed onto the underside of the purlin. To combat the outward movement of this purlin, it is recommended that proprietary steel straps are introduced at the bearing positions to anchor the purlin back to the chimneys.

A vertical steel post should be installed beneath the over spanning purlin above the staircase to provide additional strength to the purlin and to reduce the load on the hip member at this location.

Upper Floor Structures

Inspection

The floor structures were inspected on 18th August 2024 and this informed that there had previously been extensive intervention, particularly on the second floor. Previous works had tried to create a new diaphragm floor within the existing second floor structure by introducing new timber engineered joists and by creating a plywood deck to behave as a stress skin panel. This method, in theory should work but the execution of this was poor. The inspection of the existing floor structures also noted the shallow size of the existing beams.

The inspection of the building also indicated that there was bulging on the walls at first floor level.

During the inspection of the ground floor structure, it was noted that the floor to the rear left-hand corner had been repaired with a timber splice connection around the midpoint of the beam. On closer inspection, the design of the splice was found to not be capable of supporting the bending stresses and furthermore, the beam was found to be supported off the basement brickwork vaulting below. This vaulting, with the additional loading from the beam, had caused the masonry to crack and the unrestrained wall to thrust outwards.

Discussions

The majority of the beams to the floor structures are deemed to be very shallow and showed excessive deflection, which was theoretically proven by conducting calculations on the beams.

The previous introduction of a new floor structure within the depth of the second floor has knock on effects to the behaviour of the structure as a whole. The new engineered joists, which now support the floor, are now supported on the inside face of the wall head, and in some

cases, on a previously installed modern timber stud wall installed off the joists of the floor below. Whilst the rafters which carry the outward thrust of the roof was supported on the outside of the wall head. Therefore, the wall is not fully restrained and is open to movement. Furthermore, the introduction of the new floor structure adds weight onto the existing, shallow beams.

The bulging that was noted during the inspection indicates outward movement of the walls around first floor level and therefore it is important that the floor structures are able to provide restraint to the walls.

During the survey, it was further noted that there was internal cracking, particularly around the chimney breasts in the rear left corners but some of the cracking was obscured by the panelling.

Recommendations

It is recommended that strengthening works are installed to the majority of the existing beams to combat the excessive deflection and to aid with the additional loads that the beams on the second floor are now required to support. The strengthening works will be carried out by installing a flitch plate inside the centre of the beam and bolting through so that the timber and steel work in composite.

To ensure that the first-floor structure is aiding the stability of the walls and to prevent further bulging, it is recommended that internal tie rods and external pattress plates are installed. It is also prudent to ensure that there is a positive connection between the joists and beams/walls.

Concerning the ground floor beam in the rear left corner, it is recommended that the load is removed from the brickwork vaulting beneath. To do this, the beam is required to act independently of the vaulting and carry bending forces, it is recommended that this is done by installing steel channel sections onto the side of the beam, below the joists, to provide additional strength.

With the floor load removed from the basement brickwork vaulting, the cracking in the vaulting can be repaired and the leaning wall stabilised by installing horizontal tie rods across the vaulting to anchor the wall in position.

It is recommended that the internal panelling is carefully removed so that any hidden cracking can be fully inspected and repaired. For this, an allowance should be made for repairing the cracks using helical ties and Cintec anchors.

<u>Existing Foundations and Sumps</u>

During the inspection it was noted that the basement floor had been previously lowered by approximately 400 mm, this does not appear to have affected the stability of the building as the foundations of the walls have not been undermined. The soil type on the surrounding area is gravel and therefore there are no concerns regarding the surrounding soil drying out.

The proposal is to introduce drainage sump units into the utility room in the and these will be specifically set into the centre of the room so that there is no influence on the existing foundations to the basement walls.

Other Items of Structural Note

The rear extension of the building has a poor build quality and there are elements which indicate that there is potential for it to pull away from the rear elevation. Therefore, it is prudent to provide strapping at the floor levels and to the walls to restrain the extension and hold it in its current position.

It was noted during the survey that there was cracking to the chimney breasts at second floor level and the form of the cracking indicates slight outward movement of the side elevation of the building. To prevent further movement, it is recommended that Cintec anchors are introduced to bond the side elevation to the cross wall that house the chimney breasts. Furthermore, there is localised poor brickwork on this elevation around second floor level which requires rebuilding.

The proposal is to raise the second-floor ceiling by lifting the ceiling joists to increase headroom. Structurally, the magnitude that the ceiling joists will be raised will not impede on the ability for the ceiling joists to act as a tie, aiding stability to the roof and overall, not fundamentally changing how the structure is working.

It was noted during the inspection that there were localised voids in the joists, particularly in the floor supporting the proposed kitchen. The proposal is to infill the voids in resin to re-establish the structural integrity of the joists.

Urgency of works

The building is at a critical stage of its life and has serious structural issues which require addressing on an urgent timescale. Without this work, the building will fall into a further state of disrepair.

Yours sincerely

**Stuart Ellis**
BSc Hons. CEng. MICE MIStructE. GradDiplCons (AA)

(Conservation Accredited Engineer)
**For Mason Navarro Pledge Ltd**

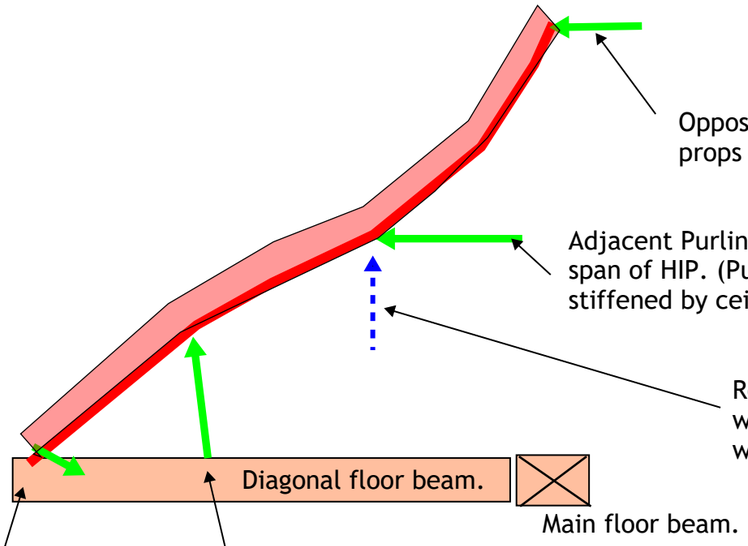
Deflected shape of HIP and interior supports

End of hip extending at corner, connection to end of diagonal floor beam / not seen.

Interior view of cornice. Note grey colour, suggests replaced. Due to outward movement? Also Note decayed Rafter foot.

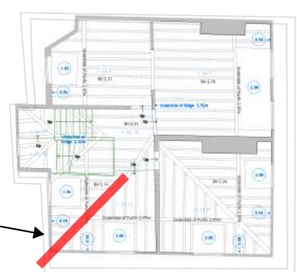
Interior view of sidewall support (vertical) and purlin prop (horizontal)

Note: origanal side wall is leaning out.




SCHEMATIC ELEVATION showing supports to HIP RAFTER (similar movement pattern associated with purlin deflection)

CONCERN THAT ADDING LOAD TO ROOF WILL EXAGERATE THIS DEFLECTION PATTERN




LOCATION REFERENCE

**32 The Green, Richmond**

Mr Shaun Brown 224260

**Front Left Roof Deflection Issues**

224160 - MNP - XX - XX - SK - S - 0009

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Author: SME Date: 23/07/2024

Scale: N.T.S

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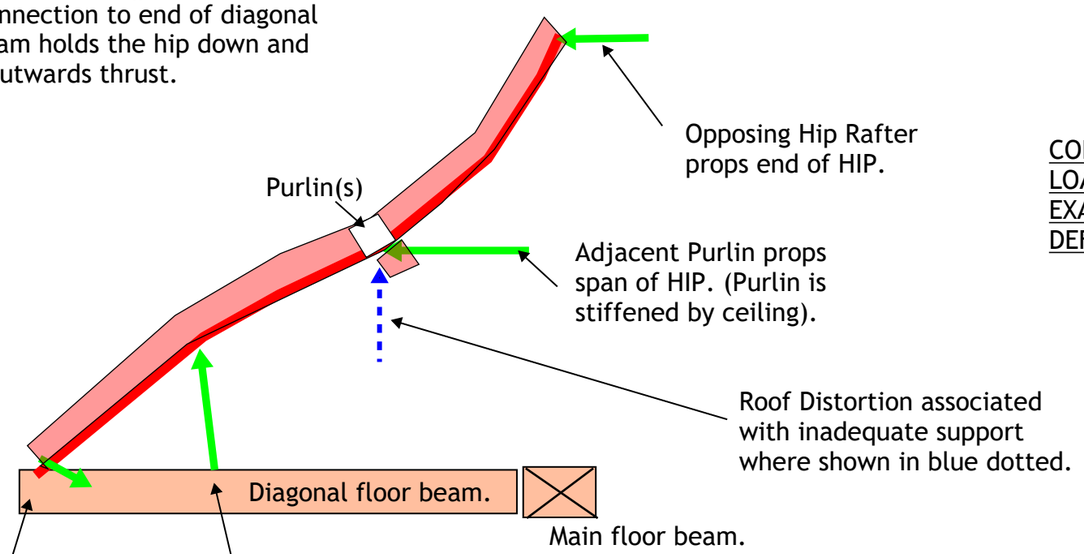
Deflected shape of HIP and interior supports

End of hip extending at corner, metal strap connection to end of diagonal floor beam holds the hip down and resists outwards thrust.

Interior view of sidewall support (vertical) and purlin prop (horizontal)

Note: origanal side wall is leaning out.




SCHEMATIC ELEVATION showing supports to HIP RAFTER (similar movement pattern associated with purlin deflection)

CONCERN THAT ADDING LOAD TO ROOF WILL EXAGERATE THIS DEFLECTION PATTERN


LOCATION REFERENCE

**32 The Green, Richmond**

Mr Shaun Brown 224260

**Front Right Hip Issues.**

224160 - MNP - XX - XX - SK - S - 0010

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Author: SME Date: 31/07/2024

Scale: N.T.S

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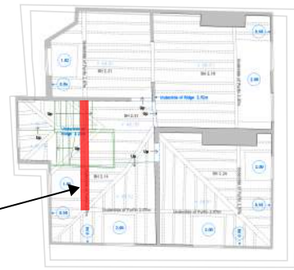
The purlin's span is too great for its size.

To prevent future deflection a mid span support is recommended. This might take the form of a post or a stair wall.

The stair wall immediately below where suport is required.




LOCATION REFERENCE

**32 The Green,  Richmond**

Mr Shaun Brown 224260

**Level 2 Front stair wall.**

224160 - MNP - XX - XX - SK - S - 00011

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Author: SME Date: 31/07/2024

Scale: N.T.S

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