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Report on Structural Inspection of Existing 1st Floor Balcony

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Quality Assurance

This document has been prepared and checked in accordance with CBP Architects IMS (ISO9001:2008)

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P01	First Issue
P02	Report updated after Intrusive investigation 01.06.2017.
P03	Additional information added after Structural Engineer Review

Disclaimer

We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above.

This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report at its own risk.

Contents

1. Introduction

CBP Architects have been instructed by CBRE to carry out a detailed assessment of the damaged / failing balcony at no. 47 Mecklenburg Square, London. There is a concern regarding the stability of the feature balcony located at the front of the property at first floor level.

The balcony is formed from stone slabs, on cast brackets, ornate handrail. The surface of the stone slabs have mastic asphalt addition to the surface.

The balcony is currently supported by temporary scaffolding and supports.

There is evidence of plant and vegetation growth, stone spalling, and paint deterioration to the structure.

The initial site inspection was undertaken on Wednesday 26th April 2017, the weather was dry and overcast.

A further intrusive survey was undertaken on Thursday 1st June 2017, where the Asphalt covering was removed and the sub-strate reviewed. The weather was dry and sunny.

2. Existing Form of Construction

The property forms the end building of a grand terrace of properties located opposite Mecklenburgh Square. It has a basement with a full width access well down to it to the front, steps up to the ground and three further upper floors.

The roof is pitched and slated front and rear with a deep flat section linking the two, which is believed to be a later addition.

The balcony structure comprises ornate cast iron cantilever brackets that are embedded in the front wall of the property and project approximately 780mm out from the wall. There are 6no. balcony support brackets that cantilever from the wall and these are located on the edge of the inner window reveal. The tall sash windows have an outer reveal in the facing brickwork which is 280mm deep and an inner reveal that is approximately 200mm deep and set 160-175mm inside the outer reveal. The cantilever support brackets are solidly built into the front wall which, for the purposes of this report and given the age of the property, is assumed to be constructed from solid brickwork with no cavities. The brackets are built up to 50-60mm back from the inner face of the wall, where this forms a void at this internal location.

The brackets are arranged so that two brackets support a stone slab which spans between them and cantilevers 385-440mm at each end, giving three stone slabs with two butt joints, between the brackets, along the length of the balcony. The stone slabs are 70- 90mm (approx.) thick. It is not clear how far they are embedded into the front brick wall of the property, without more intrusive investigation, but it could be up to 225mm. The stone slabs are currently finished with mastic asphalt although this is considered to be a later addition and not original. The mastic asphalt is of a thickness that results in no gap beneath the bottom rail of the handrail, preventing rainwater from freely running off the front of the balcony.

There is vegetation and plant growth forming on the stone slabs at the front edge, causing degradation of the stone at this location.

The cast iron balustrade around the edge of the balcony is formed from small section balusters with infill decoration and top and bottom rails. These are supported by structural balusters at each end which in turn are embedded in the stone balcony slabs and also support the curved cast iron handrail. Two of the main structural balusters, located at approximately $^{1}/_{3}^{rd}$ points along the balcony, are laterally braced back to the balcony slab by curved wrought iron support stays that are embedded into the stone balcony slabs approximately 320mm behind the line of the handrail.

The front wall is constructed using London common bricks from first floor upwards, with ashlar stone facings at basement and ground floor levels. A prominent stone string course is located just below 3rd floor window level.

View of front elevation.

3. Listing Description

The listing of the terrace of 5 buildings indicates that they were each built by different people. This may well explain the differing style of bracket used for each property. The listing is detailed as below.

> *"TQ3082SE MECKLENBURGH SQUARE 798-1/96/1113 (North side) 20/05/69 Nos.43-47 (Consecutive) and attached railings*
>
> *GV II*
>
> *5 terraced houses, being the remains of a terrace forming the north side of Mecklenburgh Square. c1824-5. By Joseph Kay. Built by T Weeding except No.43, Woolcot & Browning and No.47, S Wright. Yellow stock brick with later patching and rusticated stucco ground floors. 4 storeys and basements. 3 windows each. Round-arched doorways with reeded surrounds, patterned fanlights and double panelled doors. Gauged brick flat arches to recessed sashes; 1st floor with continuous balconies. Continuous stucco cornice at 3rd floor level and stucco coping to parapets. INTERIORS: not inspected. SUBSIDIARY FEATURES: attached cast-iron railings with urn finials to areas. (Survey of London: Vol. XXIV, King's Cross Neighbourhood (St Pancras part IV): London: -1952: 47-50)."*

This report to be read in conjunction with;

17023-A-0001-Exisiting Overall Elevations

17023-A-0002-Existing Balcony Details

17023-A-4001-Proposed Overall Elevations

17023-A-4002-Plans and Sections-Findings and Proposal

17023-A-7001-Balcony Details-Findings and Proposals

4. Visual Inspection – 26th April 2017.

The visual inspection carried on 26th April 2017 was undertaken externally from street level, directly from standing on the balcony and internally from within the lounge of the first floor flat. CBRE provided operatives that pulled back carpets and cut back the floor decking internally to reveal the timber floor joists and expose the ends of the cast iron brackets.

Inner Inspection

The cutting back of the internal flooring confirmed the rear of the support brackets project to approximately 50-60mm from the inner face of the brick wall. The floor joists span parallel to the external wall. The inner face of the brackets have surface corrosion only. Sitting directly above the cast iron brackets is a timber bearer spanning over the top of the bracket. See the following photographs. The stone slab of the balcony could not be viewed from the internal face.

View of inner face of brickwork and rear of bracket.

View of inner face of brickwork and rear of bracket.

View of inner face of brickwork and rear of bracket.

View of rear of bracket and timber bearer from opposite end of brick pier.

External Balcony Inspection

Access to the balcony was readily available via the large sash windows. The balcony is presently propped by scaffolding and as such, following an inspection of the underside from street level, access to the balcony was deemed safe.

The balcony appears sound when walked upon, which is understandable given that it is presently propped by scaffolding taken down to the floor of the basement well at the front of the property. There were up to 3 people at any one time on the balcony.

The front handrail, whilst not complying with current Building Regulations in terms of height, which is 790mm (Building Regulations requires 1100mm for balconies), is well fixed into the top of the stone slabs, with little outward deflection when pushed outwards.

The inspection revealed the following defects:

- There is minor cracking to the top surface of the asphalt covering to the stone slabs of the balcony. This may be allowing penetration of water to the substrate.
- The asphalt was built up to the underside of the handrail, allowing trapped water to sit on the asphalt finish, and affect the steel balustrade in terms of degradation.

- The junction between the asphalt and the window frames to each of the 3 windows has opened to varying degrees. This will allow water penetration to the substrate.

View showing gap between back of asphalt and window frame

- There is a small hole in the main front wall at balcony level directly adjacent to the left hand end as viewed from the front, within the stone string course, this was approximately 60mm deep when penetrated with screwdriver.

View showing small hole in wall

- There are minor vertical cracks in the facing brickwork approximately 100-150mm in from each window reveal. I believe these relate to the location of the balcony brackets below and may relate to the need for installation of the scaffold support.

Left hand window, left reveal

Left hand window, right reveal

Centre window, left reveal

Centre window, right reveal

Right hand window, left reveal

Right hand window, right reveal

- The render to each window reveal has horizontal and vertical cracking.

Window reveal render cracking

Window reveal render cracking

- Vegetation is growing around the edge of the balcony slabs.

Vegetation on edge of balcony

Vegetation on edge of balcony and collecting around bottom of the balustrade, trapping water

Vegetation on edge of balcony, balcony stone joint shown.

Street Level Inspection

The underside of the balcony was inspected from ground level. No access was available on the scaffold support tower.

The inspection revealed the following defects.

- There are 2 steel/iron straps that have been fixed to the underside of the balcony slab between the two support brackets either side of the right hand window over the front door/ entrance steps. There is no obvious indication of any cracking to the slab or any other reason, either above or below, as to why the straps have been installed. We speculate that as they are located above the main entrance door, they may have supported a light or ornamental decoration previously or may have been fixed there as part of the 2nd WW bomb repairs. The straps have clearly been in place for a considerable length of time and have surface corrosion. After the intrusive site visit 1st June 2017 identified that the steel straps are also located to the upper level and span over the steel support brackets of the balcony stone slab, with fixings through the slab to the underside metal straps.
- This area of the balcony visually appeared out of level falling to the next door property.

View indicating steel/iron support straps – surface degradation – brackets require replacement with new treated steel straps above and below, fixed through the stone slab.

View indicating steel/iron support straps – note corrosion

- The face of the stucco has clearly undergone repair work directly adjacent to the support bracket located to the right of the middle window.

View showing the repair

- The cast iron support brackets are showing signs of surface corrosion.

Bracket surface corrosion

- The underside if the balcony slabs have flaking and missing paintwork.

Flaking and missing paintwork – stone abutment shown between brackets

Structural Defects and Repair Drawing detailing the defects noted above is included in Appendix A.

5. Structural Assessment

The structural principle behind the embedment of the cantilever brackets within the wall is as follows:

a) The cantilever bracket is designed to support the load from the dead and imposed weights on the balcony.
b) The loads applied to the balcony slabs are transferred back to the brackets and this load results in an overturning moment within the wall.
c) The overturning moment is resisted by fixity of the bracket within the wall. The weight of the masonry, floors (if applicable) and roof bear down on the bracket, effectively clamping it in place.
d) The weight of the wall holding the bracket in place must be at least 3 times the weight carried by the cantilever section of the bracket.
e) The timber wall plate that is evident above the inner end of the bracket within the wall helps spread the load from the wall across the full width of the wall sections between the windows.
f) The successful transfer of weight from the bracket into the wall is also dependent upon the bearing capacity of the supporting masonry not being exceeded.

We have undertaken a structural load assessment on the balcony brackets and the calculations can be found in Appendix B at the rear of this report. The calculations confirm the following:

a) Total weight of the balcony on each bracket = 8.35kN (851kg)
b) Total weight of the wall and roof = 86.7kN (8838kg)
c) Factor of safety righting load/overturning load = 86.7/8.35 = 10.4 (>3 hence OK)
d) Maximum bearing stress on the bracket = 1.72N/mm^2
e) Permissible bearing stress on the bracket = 2.14N/mm^2 (>1.72 hence OK)

The above calculation results confirm the validity of the original design.

One further aspect to consider is the potential effect of the large tree located within 4-5 metres of the front corner of the property. The building is founded at a depth that is likely to be in excess of 2.5 metres and there is no evidence from the external elevations of any differential movement. As such the tree is not considered to have contributed to the problems currently associated with the balcony. However, leaf drop may lead to moisture being retained on the balcony surface, and also promoting the plant/ vegetation growth apparent during the site visit.

6. Bomb Damage

Dr Ramona Usher has researched potential WW2 bomb damage to this property, since there is evidence of slight out of plumb wall alignment to the external masonry at first floor level and different coloured brickwork over the window heads, which may demonstrate previous repairs to the elevations.

The map covering Mecklenburgh Square is included in Appendix C at the rear of this report.

The commentary to the map provided by Dr Usher is as follows

> *"The map indicates 47 Mecklenburgh Square suffered 'general blast damage – not structural'. This may account for the on site evidence of brickwork repair. The adjacent 46 and 45 Mecklenburgh Square appear to have been 'seriously damaged – repairable at a cost', and repairs must have been undertaken, as evidenced on site. 44-43 Mecklenburgh Square are depicted as 'damaged beyond repair', but the colour is slightly muddied, with an indication of orange beneath. Given the age of these buildings, it does appear they were repaired, and so a more accurate annotation would be the orange 'general blast damage – not structural'."*

It appears that 47 Mecklenburgh Square suffered to a lesser extent than the adjacent nos. 43-46. It is possible that some damage may have been sustained from the bomb damage, either directly from blast forces or possibly by overloading with debris and rubble following the blast.

7. Research on Previous Technical Review Work on 47 Mecklenburgh Square

There has been previous review work on the gable end of 47Mecklenburgh Square, and the report was produced in November 2015, by Thomasons Consulting Civil and Structural Engineers. It is not clear if the recommendations in the Structural Engineers report have been carried out to date to this gable facade.

In addition, there have been previous reviews from Thomasons Consulting Civil and Structural Engineers, on the balcony, between August 2011, and December 2012, and their recommendations at that time was for replacement of the supports and stone slabs. This assessment was based on limited intrusive works, whilst not taking the Conservation aspect into account to retain the original features and work through a calculated approach to address the issues encountered.

8. Discussion

This is an end of terrace property. The adjacent 3 properties each have balconies at the same level that are un-propped, with differing or no visual brackets in place.

According to the client the scaffold was put up on the 13/04/2015 propping the balcony up as it was deemed unsafe. Further research into the cause has been carried out and is discussed in the later section of this report, under Intrusive works 1st June 2017 and may contribute to the recommendations to ensure the balcony remains stable.

For the balcony to have deflected to any extent, one of the following 3 things must have occurred:

- The cantilever brackets will have bent/deflected from the point at which they meet the main wall. This is unlikely since they are made from cast iron which, whilst excellent in compression, does not perform well in tension. For bending of the bracket to occur the top would go into tension with the result being major fracturing of the bracket or total failure. This is not evident.
- The cantilever brackets would have failed at the point where they meet the main wall. Cast iron tends to fail in a catastrophic way when it becomes significantly overstressed. There is no visible evidence of failure.
- The cantilever brackets remain straight, but the section that is socketed in the wall rotates within the wall. This would result in crushing of the brickwork (bearing failure) above the bracket on the inner face or crushing of the stonework (bearing failure) below the bracket on the outer face. Again visual inspection both externally and on the exposed section internally did not reveal such a failure.

As part of any on-going investigation we recommend modification to the scaffold to allow closer and better visual access to the underside of the brackets. We also recommend the removal of the scaffold support from one of the pairs of brackets whilst in attendance to allow first hand inspection of the perceived problem.

The vertical cracking in the facing brickwork which is evident adjacent to each of the windows could potentially point to some potential stress associated with the balcony brackets and these cracks should be remediated using a low viscosity or thixotropic epoxy resin injection grout (Fosroc Nitofil LV/HV), applied under pressure.

The small hole to the stone string course, directly adjacent to the western end of the balcony should be cleaned out by compressed air and pointed with lime putty to completely fill the void.

It is clear that a repair has been undertaken directly adjacent to one of the brackets. The satisfactory support of each bracket is dependent on solid and stable support within the full extent of the wall. Closer inspection of each individual bracket where it embeds in the wall should be undertaken on site at construction stage. As a precautionary measure and to ensure there are no voids around the fixing brackets it would be prudent to drill small diameter holes into the stone, approximately 30mm from the face of the bracket and at 75mm centres. These holes should extend to within 75mm of the inner face of the wall. They should then be filled with a low viscosity or thixotropic epoxy resin injection grout (Fosroc Nitofil LV/HV), applied under pressure to ensure any minor cracks and voids located within

the wall depth are suitably filled and sealed. A shutter to the rear within the floor void should be inserted to ensure all the voids have been filled by the injection process to the full thickness of the external wall.

The cracked render reveals to the windows should either be pointed or the render removed and replaced.

The ornate handrail is well embedded in the stone balcony slabs and as such there is no structural reason to replace it.

The mastic asphalt covering to the balcony appears to have been in place for some time and has fine cracks evident in the top surface and there are gaps where it abuts the timber window frames. Sections of the asphalt have been removed to allow further inspection of the top of the balcony slabs in key areas as follows.

- Where the balcony abuts the main wall.
- Through a cracked section.
- Where the asphalt abuts the window frame.

the findings have been discussed in more detail under the section Intrusive works 1st June 2017.

It is likely that the mastic asphalt will need to be carefully removed from the balcony, as part of any remedial work package, to reduce the load on the balcony, and to eliminate the growth of the vegetation. The specification of the replacement surface finish in the form of an epoxy breathable application should be agreed with the local planning authority.

The vegetation growing on the edge of the balcony should be carefully removed and the stone inspected for localised stone repairs to be carried out.

The underside and external sides of the balcony and brackets should be cleaned down and painted with a suitable built up paint system.

9. Observations from site visit 26th April 2017.

It is clear that a problem has been perceived for some time previous to this site visit as a scaffold support tower has been erected from the floor of the basement well up to the underside of the balcony support brackets. The reason for the scaffold erection has been to offer temporary support to the balcony, and also to be allowed to be extended to the upper floors for ongoing maintenance of the existing building.

Problems with the balcony were observed as follows.

- There is minor cracking to the top surface of the asphalt covering to the stone slabs of the balcony/ and movement at the wall abutment. This may be allowing penetration of water to the sub strate.
- The junction between the asphalt and the window frames to each of the 3 windows has opened to varying degrees. This will allow water penetration to the sub strate.
- There is a small hole in the main front wall at the stone string course at balcony level directly adjacent to the left hand end as viewed from the front.
- There are minor vertical cracks in the facing brickwork approximately 100-150mm in from each window reveal.
- The render to each window reveal has horizontal and vertical cracking allowing water ingress to the sub strate.
- Vegetation is growing around the edge of the balcony stone slabs.
- The cast iron support brackets are showing signs of surface corrosion.
- The underside if the balcony slabs have flaking paintwork/ stone spalling.
- The internal brickwork around the brackets appeared to have voids/ missing brickwork.

A structural assessment in the form of calculations carried out by Collins Hall Green Structural Engineers related to the balcony support brackets has been undertaken to establish the validity of the original design and this proved the adequacy of the original design (see appendix B).

Further investigation of the balcony has been carried out on 1st June 2017 with discussions later in this document.

Localised areas of mastic asphalt was removed on 1st June 2017 to the stone balcony at the joints, and the stone balcony and wall abutment to establish if the stone is ‘built/ keyed’ into the brickwork wall.

The vertical cracking in the facing brickwork which is evident adjacent to each of the windows should be remediated using a low viscosity or thixotropic epoxy resin injection grout (Fosroc Nitofil LV/HV), applied under pressure as previously discussed.

The small hole directly adjacent to the western end of the balcony, at the stone string course should be cleaned out by compressed air and pointed with lime putty to completely fill the void and to shed water.

One further remedial measure would be to drill small diameter holes into the stone, approximately 30mm from the face of each bracket and at 75mm centres. These holes should extend to within 75mm of the inner face of the wall. They should then be filled with a

low viscosity or thixotropic epoxy resin injection grout (Fosroc Nitofil LV/HV), applied under pressure, with a shutter behind, to ensure any minor cracks and voids located within the wall depth are suitably filled and sealed to the thickness of the external wall.

Form internal shutter within the floor to all these internal voids within the masonry from the inside, and infill with epoxy resin to ensure all voids around the brackets are filled and solid to the surrounding masonry to the thickness of the external wall.

We would propose the removal in the mastic asphalt from the top surface of the balcony and replacement with either a new slip resistant breathable epoxy resin material that will allow water to drain from the top surface or a membrane type coating that is non-slip and bonded to the stone surface of the balcony slabs. When the mastic asphalt is removed the embedment of the balusters into the balcony deck can be checked. The replacement finish needs to be agreed with the local planning authority.

The cracked render reveals to the windows should either be pointed or the render removed and replaced.

The vegetation growing on the edge of the balcony should be removed.

The underside and external sides of the balcony and brackets should be cleaned down and painted with a suitable built up/ breathable paint system.

Localised repairs to the balustrades and handrails where noted.

Remedial works have been specified which will result in the defects noted above being rectified and the balcony being brought back into use, allowing the removal of the scaffold tower.

10. Site Visit and Intrusive Works 1st June 2017

The intrusive site inspection was undertaken on Thursday 1st June 2017. In attendance were Chris Perkins of CBP Architects, Robert Green of Collins Hall Green and Dane Hammond of CBRE Managed Services Ltd.

1. Confirmation of existing form of Construction:

   The construction of the balcony has been detailed above, and the following the intrusive investigation is updated and summarised below:

   - The balcony structure comprises ornate cast iron cantilever brackets that are embedded in the front wall of the property and project approximately 780mm out from the wall. There are 6no. Brackets that cantilever from the wall and these are located on the edge of the inner window reveal. The tall sash windows have an outer reveal in the facing brickwork which is 280mm deep and an inner reveal that is approximately 200mm deep and set 160-175mm inside the outer reveal. The cantilever brackets are solidly built into the front wall which, for the purposes of this report and given the age of the property, is assumed to be constructed from solid brickwork with no cavities. The brackets are built up to 50-60mm back from the inner face of the wall.

- The brackets are arranged so that two brackets support a stone slab which spans between them and cantilevers 385-440mm at each end, giving three stone slabs with two butt joints along the length of the balcony. The slabs are 70mm (approx.) thick. It is not clear how far they are embedded into the front wall of the property, but it could be up to 225mm. The left hand slab (as viewed from the front) is topped with 20-25mm of mastic asphalt overlying 25mm of cementitious screed. A repair to the top surface of the stone slab has been undertaken previously. The other two stone slabs have no screed build up but the thickness of the mastic asphalt is 45-50mm. In one area of the Eastern stone slab, a concrete repair had been carried out, flush with the stone surface. The build-up results in no gap beneath the bottom rail of the handrail, preventing rainwater from freely running off the front of the balcony.

- It is difficult to establish why the concrete repairs to the stone slabs are present, most of the concrete repairs were located by the external brick wall side of the balcony, indicating possible frost damage where rainwater has stood impregnated the stone, causing the surface of the stone to spall. The concrete repairs were deep to one side of the balcony, indicating that the damage could have been caused by other factors. The other factor as identified previously is the historic bomb damage encountered in Mecklenburgh Square in the Second World War.

- The cast iron balustrade around the edge of the balcony is formed from small section balusters with infill decoration and top and bottom rails. These are supported by structural balusters at each end which in turn are embedded in the stone balcony slabs and also support the curved cast iron handrail. Two of the main structural balusters/, located at approximately $^{1}/_{3}^{rd}$ points along the balcony, are laterally braced back to the balcony slab by curved wrought iron struts/ support stays that are embedded into the stone balcony slabs approximately 320mm behind the line of the handrail.

- The stone slab, with the steel bars under the soffit over the main entrance door visually appeared to have a fall toward to the Right hand side, as looking at the building, this possibly could be the fall in the surface mastic asphalt to shed water.

- Use of a 600mm long spirit level confirmed the finished surface falls from the main wall to the edge of the balcony (approx. 10mm in 600mm) and the end slab over the front door also surface falls toward the adjacent property.

11. Intrusive Inspection - Discussion

The intrusive inspection was undertaken in two stages as follows:

- The removal of the propping from below each of the cantilever brackets to allow further assessment from the balcony.
- Removal of two areas of mastic asphalt from the top surface of the balcony at the junction between adjacent stone slabs to establish the construction below.

Removal of the Propping:

The scaffold pole screw threads were loosened slightly below each timber pack, allowing the packs to be removed. There was no visible dropping or sag in the balcony when the timber packs were removed.

The balcony was stepped onto through one of the sash windows and there were 3 people on the balcony at one point with little or no indication of any movement.

When the balcony was subjected to being jumped upon, there was noticeable, but not significant vibration that was observed.

The packing timbers were replaced and the scaffold poles screwed up tight again.

Discussions with the scaffolder who was in attendance during this exploratory work, who originally installed the temporary propping, identified, that when installed in 2015, and the screw jacks installed to the soffit of the balcony, there was no noticeable movement with this upwards applied pressure.

The scaffold was designed to be robust, as the scaffold was to be extended to the upper storeys to allow maintenance to be carried out to the upper floors.

Mastic Asphalt Removal:

Significant areas of mastic asphalt were removed from 2 locations where the stone slabs abut each other. See the following photographs.

Removal from the Western Joint - Asphalt approximate 20/25mm thick on cementitious repair

Removal from the Eastern Joint over the front door, showing the reinforcing steel and fixings, Asphalt 50-60 mm thick

The Western mastic removal revealed a build-up over the stone slab of approximately 25mm of a cementitious screed with approximately 25mm of mastic asphalt. The screed to the Western slab has not been laid in one operation, with a section directly adjacent to the main wall laid separately to the remainder, as indicated below.

Western Joint - Detail of differing screeds. Note the screed that tapers out to the main wall.

A corner section of the screed against the main wall was cracked and was removed to reveal the screed thickness and the stone slab directly beneath. There appears to be an inverted T lead flashing running along the joint between stone slabs and under the screed.

Western Joint - Corner of screed removed with the inverted T shown between the joint.

The mastic asphalt was removed from both locations to the outer edge of the slabs. This revealed a thickness of existing stone slab similar to that of the neighbouring property – approximately 70mm thick.

The thickness of asphalt over the Eastern half is greater to allow for the insertion of the screed over the Western half. The investigation did not check at which point the screed stopped. Although all the Asphalt was not removed from the balcony to reduce the extent of temporary damage, if is thought there is a step in asphalt thickness part way along the stone slabs, with the difference in levels being made up of the cementitious repair.

The Western asphalt was removed right back against the main wall. The screed does not appear to have been taken into the existing wall construction.

Western slab at edge.

Western slab at edge.

Western slab at edge.

Eastern stone slab at edge.

Eastern stone slab at edge.

Eastern slab at edge.

Western end with asphalt removed up to wall.

Neighbouring property with no screed or asphalt on surface of balcony stone.

The Eastern end mastic asphalt removal revealed two steel straps that align with the straps on the underside, suggesting they have been installed later as a strengthening measure. The top strap extends further than the bottom one, carrying over the existing brackets to the balcony soffit.

View of steel straps from top require replacement and renewal to detail

View of steel straps from top, require replacement and renewal to detail

View of steel straps from top require replacement and renewal to detail

Small hole to the Western side of the balcony in the stone string course

Whilst on site, it was confirmed that the small hole in the main wall at the Western end of the balcony within the stone string course is approximately 50mm deep.

12. Conclusion and Proposal

The property forms the end building of a grand terrace of properties located opposite Mecklenburgh Square. It has a basement with a full width access well down to it at the front, ground and three further upper floors. There is a full width balcony located at the first floor.

The intrusive inspection was undertaken in two stages as follows:

- The removal of the propping from below each of the cantilever brackets to allow further assessment from the balcony.
- Removal of two areas of mastic asphalt from the top surface of the balcony at the junction between adjacent stone slabs to establish the construction below.

The intrusive survey revealed the following:

- Removal of the timber packs from beneath the cantilever brackets did not result in deflection or instability of the balcony.
- Removal of the mastic asphalt revealed previous cement render repairs to the top surface.
- Removal of the mastic asphalt revealed the steel straps of the Eastern stone slab are located both top and bottom and are a form of structural strengthening.

Remedial works have been specified in the Discussion section above. These will result in the defects noted above being rectified and the balcony being brought back into use, allowing the removal of the scaffold tower.

This is an end of terrace property. The adjacent 4 properties each have balconies at the same level that are un-propped with differing brackets and in one case no support brackets are in evidence.

Despite further enquiries, we have not at been able to establish the specific reason behind the propping of the balcony at this property other than the then tenant reporting that it was unsafe and a Structural Engineer review as previously highlighted earlier in this report. The propping has been in place for an extended period, refer to attached e mail to the scaffold Contractor and response for reference.

The removal of the timber packs from below the cantilever brackets did not reveal any deflection in the balcony and the balcony was stable when 'bounced' upon.

Removal of the two areas of asphalt was productive in that it revealed previous repairs to the top surface of the stone slabs and confirmed the steel straps to be a strengthening measure to the Eastern side of the balcony.

Based upon this and the previous inspection, the following remedial measures are proposed.

- The vertical cracking in the facing brickwork which is evident adjacent to each of the windows noted in the previous report should be remediated using a low viscosity or thixotropic epoxy resin injection grout (Fosroc Nitofil LV/HV), applied under pressure.

- The small hole directly adjacent to the western end of the balcony should be cleaned out by compressed air and pointed with lime putty to completely fill the void.

- Drill small diameter holes into the stone, approximately 30mm from the face of the bracket and at 75mm centres. These holes should extend to within 75mm of the inner face of the wall. They should then be filled with a low viscosity or thixotropic epoxy resin injection grout (Fosroc Nitofil LV/HV), applied under pressure to ensure any minor cracks and voids located within the wall depth are suitably filled and sealed ensure the rear of the void is shuttered and infill to the full thickness of the external wall.

- The cracked render reveals to the windows should either be pointed or the render removed and replaced.

- The mastic asphalt and screed repair to the top surface of the stone slabs should be carefully removed, ensuring no damage to the existing stone slabs. The stone slabs should be strengthened to its full length in sections by the insertion of stainless steel 'HeliBars' into both the top and bottom surfaces of the slabs paying attention to the areas across the joint/ stone abutment. These would be resin

bonded into small slots cut into the slabs. The suitability and design of these would need to be agreed with the Conservation Officer. If the existing concrete repairs preclude robust fixings, the stone slabs should be replaced with new feature reinforced concrete, set to falls, spanning onto the existing and new support brackets. The new concrete is to be keyed to the external brickwork to Structural Engineers details.

- The top surface of the stone slabs should be cleaned and protected with a new, thin, breathable, waterproof coating that is properly dressed into the main wall and over the window sills. The coating needs to be slip resistant. The specification of the replacement finish should be agreed with the local Conservation Officer.

- The ornate handrail is well embedded in the stone balcony slabs and as such there is no structural reason to replace it. It does not comply with height requirements of the current Building Regulations and this should be considered as part of any review.

- The vegetation growing on the edge of the balcony should be removed, and the stone repaired to eliminate cracks and avoid the vegetation taking hold in the future. In addition a regular maintenance regime should be carried out to remove the vegetation/ moss growth and other detritus.

- The underside and external sides of the balcony and brackets should be cleaned down and painted with a suitable built up paint system to offer protection.

- The existing metal straps fitted to the soffit of the stone, and bolted through to the top straps, should be fully exposed, and the fixings reinforced/ or replaced with galvanised steel, with new fixings with required ties over the cast steel brackets to Structural Engineers details.

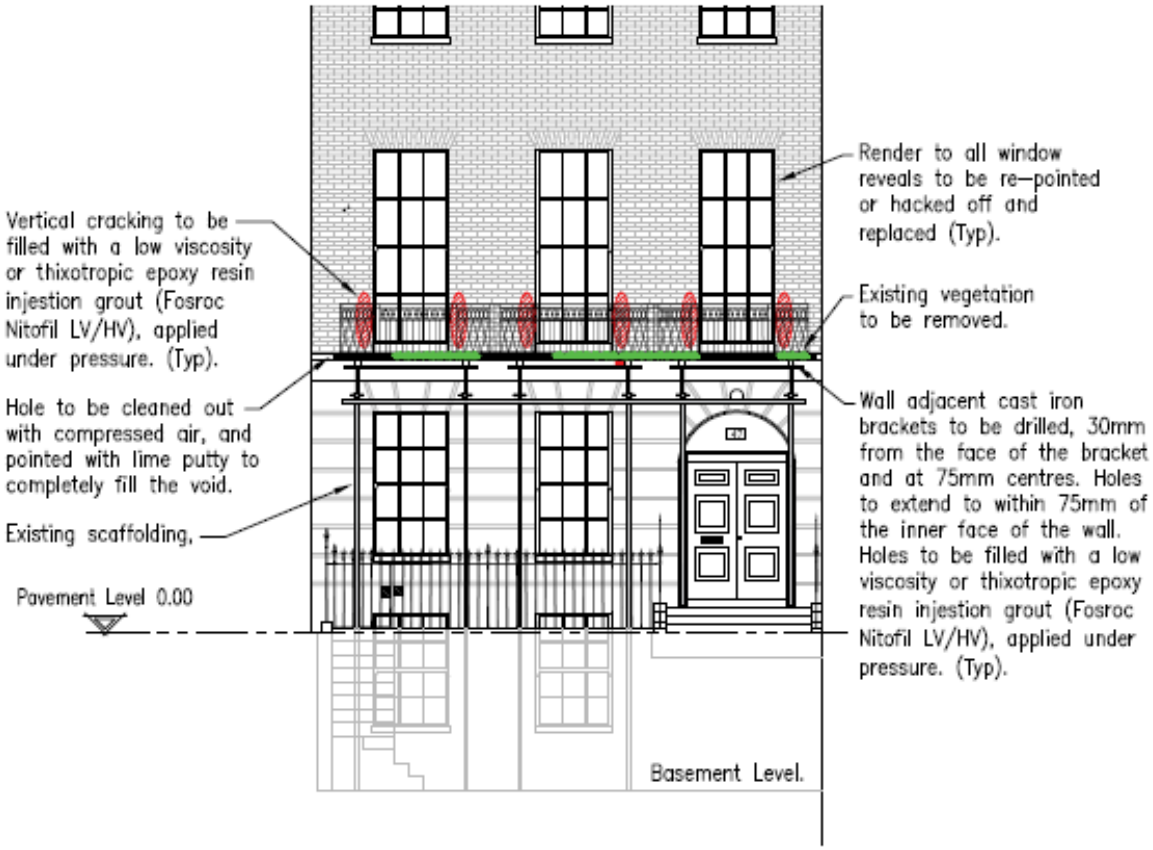
- Install new strengthening brackets at 45^{o} to the underside of the existing cantilever brackets and stone slab. The brackets and stone soffit support would be fixed in an appropriate manner to the underside of the existing cast brackets and to the face of the brick wall/ underside of the stone soffit. The suitability and design of these are to the Structural Engineers detail, and would need to be agreed with the Conservation Officer.

- Alternative solutions would be for the stone slabs (should there be not enough structure/ thickness in the stone slabs after the concrete repairs/ replacement/ helibar installation being carried out) and handrail be removed completely, ensuring sufficient stone is left against the main wall to prevent instability of the wall. The deck would be replaced with new lightweight steel/ concrete deck, and new support balcony brackets, with a new handrail to the currently compliant height. This option requires approval from the Conservation Officer.

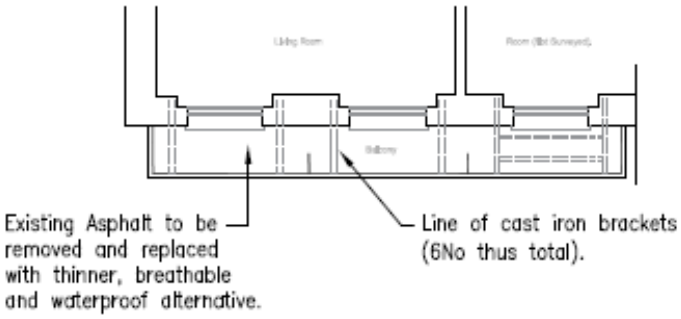
Appendix A

Structural Defects and Repair Drawing

collinshallgreen LTD



Elevation (1:100).



Plan View (1:100).

Ref:	GEN009
Ver:	2
ISD:	01/02/17

Appendix B

Structural Load Calculations for Balcony

collinshallgreen
21 Stoney Street
The Lace Market
Nottingham NG1 1LP
Tel: 0115 941 7145

Project	Goodenough College / 47 Mecklenburgh Square			Job Ref.	E244
Part of Structure	Balcony load assessment			Sheet No./Rev	1
Calc. by	Date	Chck'd by	Date	App'd by	Date
JW	28/05/2017				

Ref.	Calculations	Output

Assess load applied to existing balcony bracket

a) Wall recorded with 460 mm width, assumed solid but allow for 20% voids for frog to outer facing brick.

$(0.11 \times 20 \times 0.8) + (0.35 \times 20) = 8.76$ kN/m²

Take load width of $1.415 \times \frac{1}{2} = 0.71$ m with 10.5m high wall (uninterrupted)
" " " $1.22 \times \frac{1}{2} = 0.61$ m with 4.0m high wall (windows)

∴ load = $8.76 \times 10.5 \times 0.71 + 8.76 \times 4.0 \times 0.61$
= 86.7 kN

b) Roof, allow $3.0 \times \frac{1}{2} \times 1.0$ kN/m² = 1.5 kN/m dead
$\times 0.75$ kN/m² = 0.75 kN/m imposed

∴ load applied to bracket = $1.5 \times \left(\frac{1.45 + 1.32}{2}\right)$ = 2.0 kN dead
$0.75 \times$ " = 1.0 kN imposed

c) Balcony loads.

Support bracket built into wall.

Loads applied to bracket:
L1 • Stone slabs with asphalt, allow 2.5 kN/m² $\times \frac{2.64}{2} = 3.3$ kN/m
L2 • Balustrade self weight + allow 1.0 kN/m² $\times \frac{2.64}{2} = 1.32$ kN
L3 • 1 kN vertical imposed to edge
L4 • 0.36 kN/m horizontal imposed load to Cl. 12, $\times \frac{2.64}{2} = 0.5$ kN

BS6399-1 Cl. 6a
Cl. 12
BS6399-1, Table 8

L5 • Imposed floor load = 1.5 kN/m² UDL or 1.4 kN concentrated point acting at 0.2 m of end of cantilever.

Σ Vertical balcony loads to be resisted:
Dead = $(3.3 \times 1.1) + 1.32 +$ self wt $1.0 = 5.95$ kN
Imposed = $1.0 + 1.4$ kN = 2.4 kN

Uplift forces at support due to balcony loads = 8.35 kN (SLS)
Downward force from wall = 86.7 kN (SLS)

Wall load > 10 × balcony load

Check bearing under total applied load of Dead = $5.95 + 86.7 + 2.0 = 94.7$ kN
Imposed = $2.4 + 1.0 = 3.4$ kN
factored load = $1.4 \times 94.7 + 1.6 \times 3.4 = 138$ kN (ULS)

bearing area 400 m (bearing into wall) × 200 mm (approximate bracket width).

collinshallgreen
21 Stoney Street
The Lace Market
Nottingham NG1 1LP
Tel: 0115 941 7145

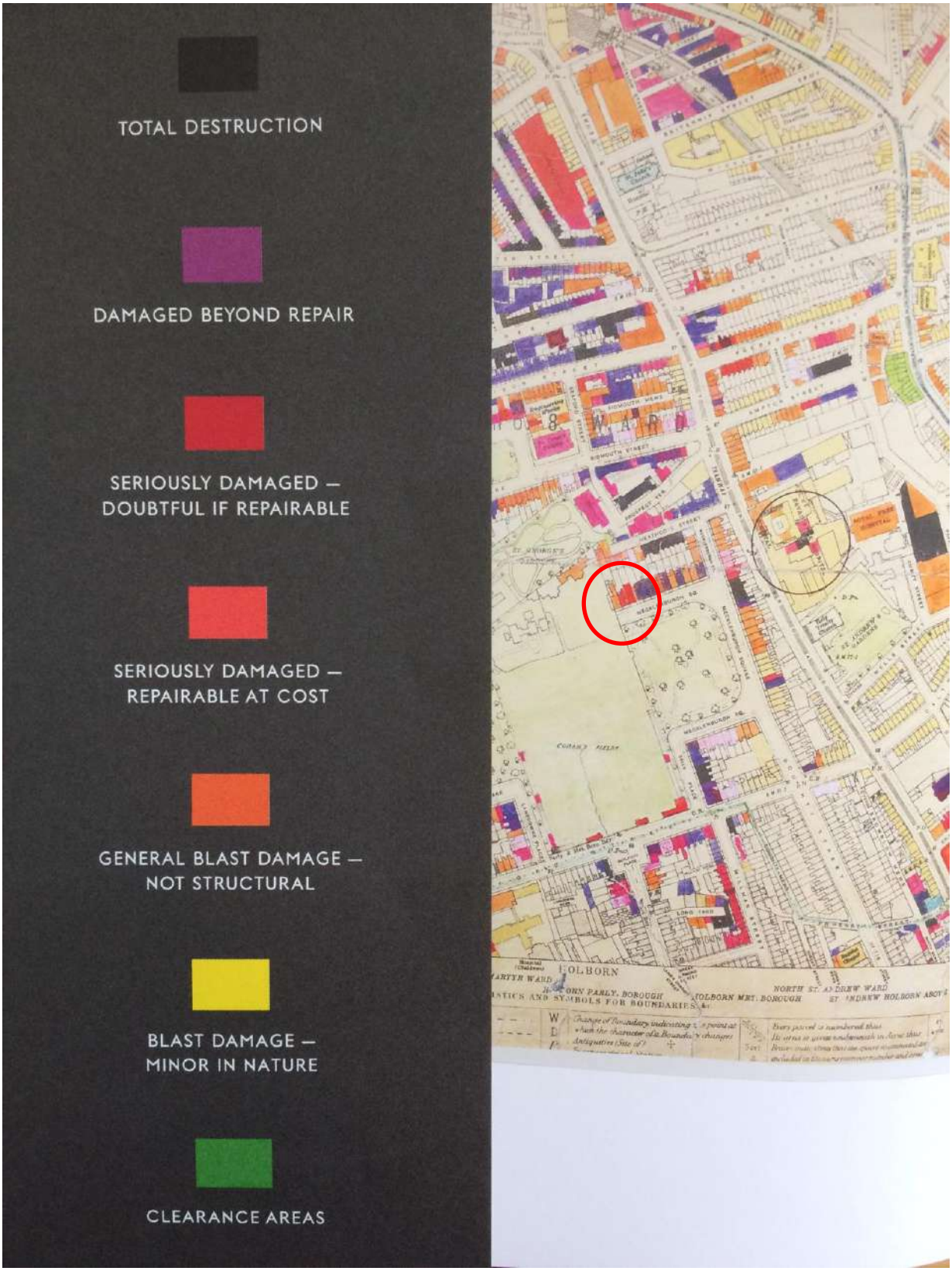
Project				Job Ref. E244	
Part of Structure				Sheet No./Rev 2	
Calc. by JH	Date 08/05/2017	Chck'd by	Date	App'd by	Date

Ref.	Calculations	Output
BS 5628-1	Bearing checks Design bearing stress applied = $\frac{F}{(B \times L)} = \frac{138 \times 10^3}{1400 \times 200} = 1.72\ N/mm^2$ Allowable bearing stress = $\frac{\beta_{bw} \times f_k}{\gamma_m} = \frac{1.50 \times 5.00}{3.5} = 2.14\ N/mm^2$ > applied ∴ ok (above assumes ρ_{wall} = 20 kN/m³, mortar iii)	

Appendix C

Bomb Damage Map for Mecklenburgh Square

Ward, L., 2015. *Bomb Damage Maps 1939 – 1945.* London: Thames & Hudson. Map 50, p. 80.



Ward, L., 2015. *Bomb Damage Maps 1939 – 1945.* London: Thames & Hudson. Map 50, p. 80.

The map indicates 47 Mecklenburgh Square suffered ‘general blast damage – not structural’. This may account for the on site evidence of brickwork repair. The adjacent 46 and 45 Mecklenburgh Square appear to have been ‘seriously damaged – repairable at a cost’, and repairs must have been undertaken, as evidenced on site. 44-43 Mecklenburgh Square are depicted as ‘damaged beyond repair’, but the colour is slightly muddied, with an indication of orange beneath. Given the age of these buildings, it does appear they were repaired, and so a more accurate annotation would be the orange ‘general blast damage – not structural’.

Appendix D

Temporary Scaffold Information

From: Chris Perkins
Sent: 02 June 2017 15:58
To: kevin@wjbutcher.co.uk
Subject: 17023 Goodenough College - balcony

Hi Kevin

We spoke yesterday on the mobile, regarding the temporary scaffold support to 47 Mecklenburgh Square London.

As mentioned on the telephone, we are trying to piece together the historical reasons why the temporary props have been installed under the scaffold which may give an indication of the issue we are trying to research on site.

It appears from the Client side, they instructed you to place supports under the balcony in 2015, as there had been a concern raised and the College reacted to place the temporary supports under.

When I spoke to your colleague he mentioned that when he installed the temporary propping, there appeared to be no movement or slack taken up when the jacks were tightened up, nor did the balcony move when the support were installed.

What would be useful, you mentioned that a structural Engineer e mailed you with some proposals for supports, this might shine a light on why the SE looked at the balcony, and what he saw as the problem at that time which would be helpful in establishing reasons. If you could forward this e mail that would greatly assist in understanding possible reasons why the concern was raised, and what the issue might have been at that time.

It was also interesting to note that the scaffold was put in place to also support an upper scaffold, to allow the Town Houses to be painted in the future, hence the structure of the scaffold in place looked quite robust.

Many thanks in anticipation to your response

Regards

Chris
Chris Perkins | Director
chris.perkins@cbp-arch.co.uk | 07730210909

CBP Architects
Office: 0115 9481144 | Fax: 0115 9580976
44 The Ropewalk, Nottingham, NG1 5DW

www.cbp-arch.co.uk

From: kevin <Kevin@wjbutcher.co.uk>
Sent: 07 June 2017 11:16
To: Chris Perkins
Cc: Jackie Enifer; Nick Kelly
Subject: FW: G20561 No47 Balcony - Prelim drawing
Attachments: G20561-sk01.pdf

Chris

Please find enclosed original sketch received from Neil Jones at Thomasons.
I will also send you subsequent emails
Hope this helps

Kevin

Regards

Kevin Bailey M.D.

Tel: 01708 745217
Mob: 07889 755116

W.J. Butcher Ltd Granary Cottage, Frog Street, Brentwood, Essex CM15 0JJ

From: Neil Jones [mailto:njones@thomasons.co.uk]
Sent: 02 December 2014 14:22
To: Kevin Bailey <Kevin@wjbutcher.co.uk>; gerardmurray <gerardmurray@fcmltd.co.uk>
Cc: Jackie Enifer <Jackie@wjbutcher.co.uk>; Tim Howard <Tim.Howard@goodenough.ac.uk>; Paul Jarvis <pjarvis@Thomasons.co.uk>
Subject: G20561 No47 Balcony - Prelim drawing

Dear Kevin,
Please find enclosed a preliminary sketch showing our proposal for supporting the balcony for discussion. Do you have any comments regarding its integration with your proposed scaffold?

When we previously discussed your proposals for the new scaffold, you mentioned that it would be preferable to build the scaffold off the propped balcony. This is feasible provided the position of the scaffold bases correspond to the position of the soldier props below. Could the scaffold be positioned so that part of it is supported on the balcony and part of it is supported on the lower ground level floor (in the lightwell)?

We have shown Mabey soldier props to support the balcony due to the height of the balcony above the lower ground level which is approximately 7.5m. The cross bracing which provides stability will require design by yourself or a specialist to ensure that it can resist the required wind and notional horizontal loads.

Can you provide vertical loads from the scaffold so we can ensure that the soldier props can support the gravity loads.

We have shown some of the props on the stair from ground to lower ground level – will access to the stairs need to be maintained during the works? **Gerard**, can you advise?

Kind regards,

Neil Jones for

Thomasons

86 Epsom Road, Guildford, Surrey, GU1 2BX
Tel 01483 540110
Fax 08721 104 552

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From: gerardmurray [mailto:gerardmurray@fcmltd.co.uk]
Sent: 28 November 2014 08:18
To: Neil Jones
Cc: Paul Jarvis; Tim Howard
Subject: RE: G20789 Gable wall inspection [Filed 28 Nov 2014 15:48]

Thanks Neil

I understand Kevin from Butchers has been in touch regarding the balcony propping plan and is awaiting a response could you forward the propping plan please.

Regards

Gerard Murray

Senior Clerk of Works F.C.M. Ltd

F C M
Fox Curtis Murray

81 Oxford Street

London, W1D 2EU

Tel. 0207 323 5758
Fax. 0207 323 5859

2

M. 07833576292

email: gerardmurray@fcmltd.co.uk

www.fcmltd.co.uk

From: Neil Jones [mailto:njones@thomasons.co.uk]
Sent: 27 November 2014 15:08
To: gerardmurray
Cc: Paul Jarvis
Subject: G20789 Gable wall inspection

Dear Gerard,
Please find enclosed our report for the gable wall inspection to House No 47 Mecklenburg Square.

Kind regards,

Neil Jones for

Thomasons

86 Epsom Road, Guildford, Surrey, GU1 2BX
Tel: 01483 540310
Fax: 08721 204 552

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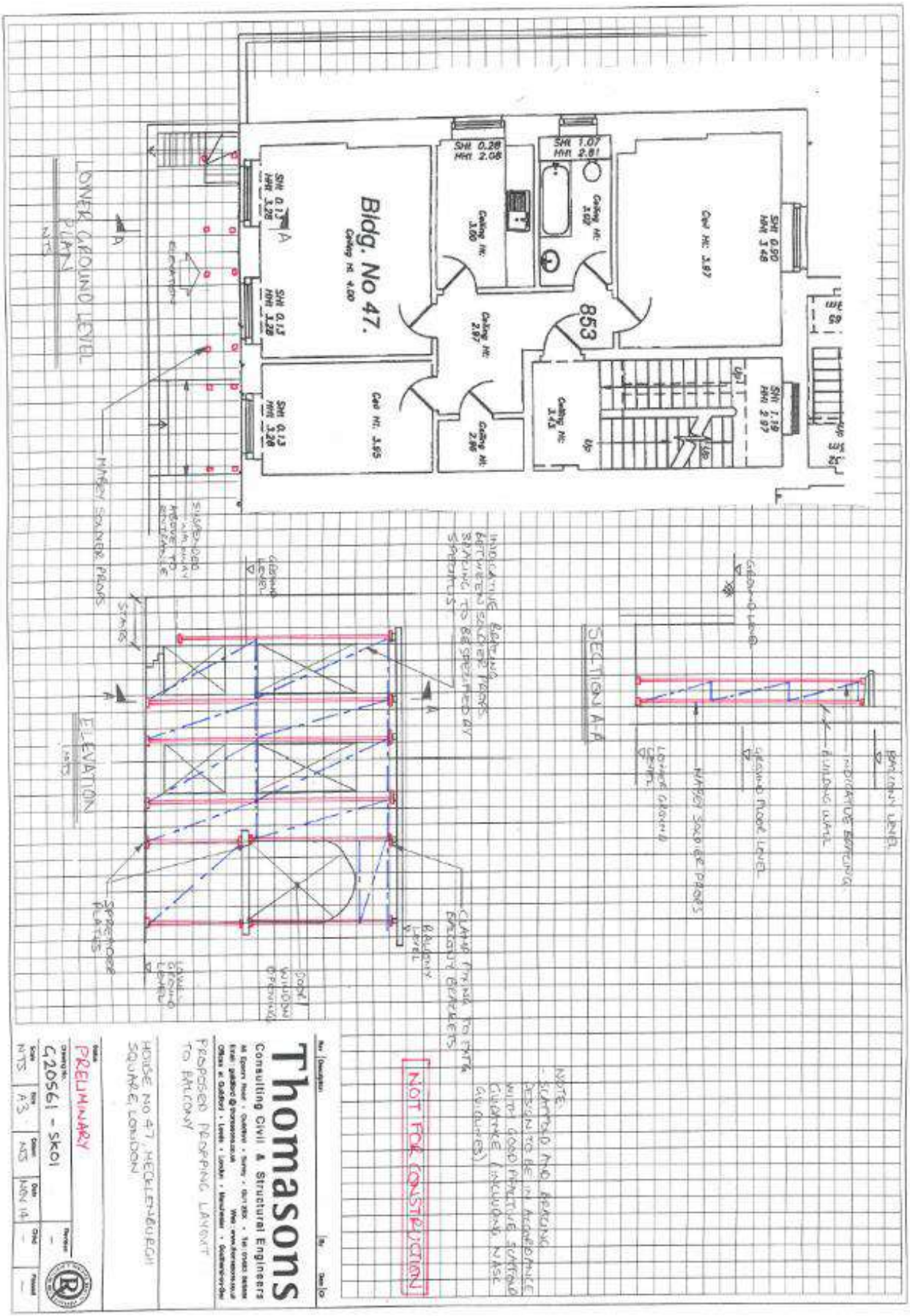

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