DEVISE ENGINEERS

53-54 Doughty Street, London WC1N 2PL

Structural engineer's report and feasibility

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DESIGN-FOCUSED SUSTAINABILITY-DRIVEN ENGINEERING

Kemp House | 152-160 City Road | London | EC1V 2NX

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One

Introduction

Devise Structural Engineers were appointed by Doughty Street Chambers to visit the above property to carry out a structural inspection and confirm the feasibility of the proposed photovoltaic panels. We were specifically asked to review the following items from a non-intrusive inspection:

- General structural condition of the roof
- Feasibility to:
    - Install photovoltaic panels on areas of the existing flat and pitched roofs

During the inspection, a general review of the structural integrity of the property was carried out as far as practicable without the removal of finishes.

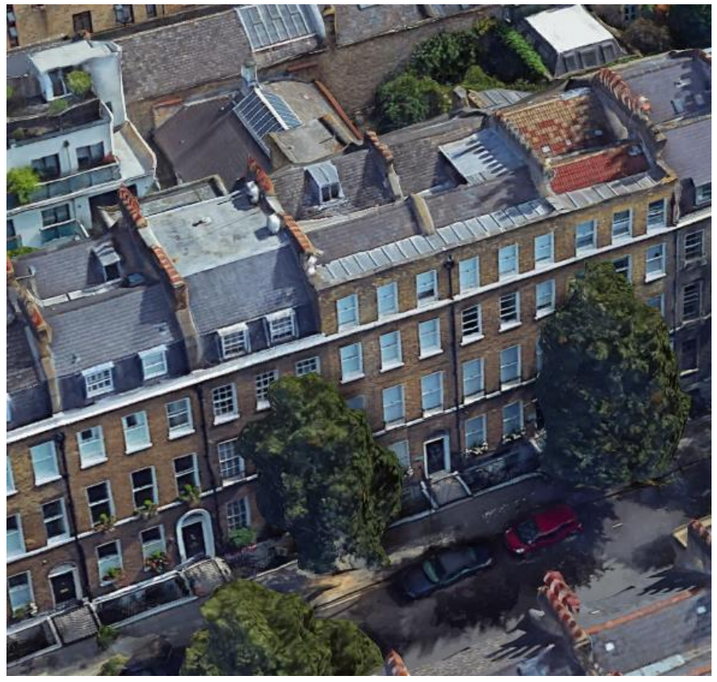

Figure 1: Birdseye View of property (Google Earth)

Construction

The property is a 5-storey masonry constructed town house of solid masonry (c.330thk) external walls and masonry and timber internal walls. The property is currently being used as offices.

The main volume of the property has a double gable roof which has an area of flat roof behind the front parapet and above a plant space between the gables on no. 54.

Beyond the main volume of the property is a single storey extension with hip roof which is of more recent construction.

Figure 2: View of rear extension

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Two

Structural Inspection

External observations

The front elevation appears to be in reasonable condition and comprises of rendered up to ground floor with exposed brickwork above.

Figure 3: Front Elevation

Some slight staining to the brickwork below was observed and some spalling to the brickwork seen but no significant structural defects were observed.

No significant structural defects were observed to the single-storey rear extension.

The chimney stacks show signs of historic movement, however they have been relatively recently repointed and are generally in reasonable condition for the age of the property.

Internal observations

The internal finishes have been well maintained with the occasional hair line crack visible.

No significant structural defects were observed though it should be noted that not all areas were accessed.

Loft & Roof observations

The rear gable roof was accessed, and the existing roof structure inspected.

The main roof rafters are 95x60 timbers at c.380mm centres with central ridge board.

There are signs of historic water ingress, and some local areas of damp however no significant structural defects were observed in the areas that were accessible.

Figure 4: Existing Roof Construction

Strengthening works have been carried out to support the water tanks within the roof space. These works include the addition of a new steel beam and doubled up timber joists positioned above the existing loft floor construction.

Figure 5: Strengthening Works

The existing gable roofs have a slate tile finish with lead work to the areas of flat roof. The finishes seem to be in reasonable condition with no significant defects observed.

Figure 6: Existing Roof Construction

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Feasibility of proposed alterations

Installation of Photovoltaic Panels

The existing roof structure has been assessed for the increased loading of the panels.

The loads assumed are:

- Panels installed on gable roofs,15 kg/m^2
- Ballasted panels installed on flat roofs, 60 kg/m^2

Calculations carried out in critical areas (see Appendix II) confirm that the existing roof construction is capable of supporting the proposed panel layout without additional strengthening works.

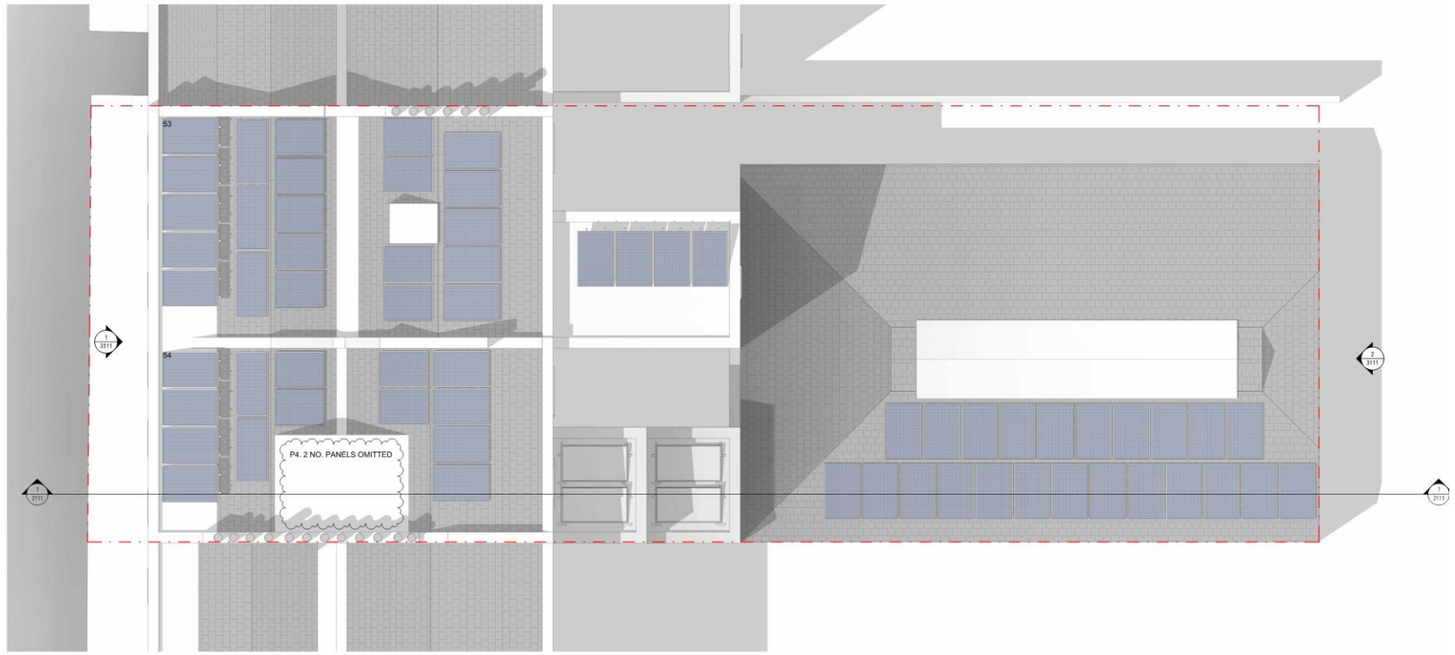

Figure 7: Proposed Roof Plan

Four

Conclusions

The property is in good condition for its age and constructed of good quality materials.

The photovoltaic panels proposed generally seem achievable as long as they are installed by a suitable contractor to the manufacturers specifications.

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Appendix 1

Terms and limitations:

- The appointment for the inspection and report is in accordance with ACE Agreement II
- This report was carried out without receipt of any further information from the Client unless specifically stated
- Access was available to those areas stated only
- No intrusive investigation was carried out nor was it possible to view behind furniture and fittings
- This report written in relation to the structural aspects of the building only
- This report is strictly for the use of the Client stated and submission to the local authority and should not be relied upon by any other third party
- Copying of this report for third parties is prohibited without express consent.

Appendix 2

Structural Calculations:

Loading Schedule

							Permanent, Gk	Variable, Qk
Existing Pitched Roof 35^0								
		thickness	width		centres	density		
Gk	Joists 95x65 @ 440	95	65		440	6	0.08	
	Sarking board	20	1		1	6	0.12	
	Slate Tiles	3	1		1	25	0.08	
	Insulation	100	1		1	1	0.10	
Gk, total							**0.46** kN/m2	
Qk	Access							0.6
Qk,total								**0.6** kN/m2
Proposed Pitched Roof 35^0								
		thickness	width		centres	density		
Gk	Joists 95x65 @ 440	95	65		440	6	0.08	
	Sarking board	20	1		1	6	0.12	
	Slate Tiles	3	1		1	25	0.08	
	PV	-	-		-	-	0.15	
	Insulation	100	1		1	1	0.10	
Gk, total							**0.65** kN/m2	
Qk	Access							0.6
Qk,total								**0.6** kN/m2
Proposed Flat Roof								
		thickness	width		centres	density		
Gk	Joists 95x60 @ 380	95	60		400	6	0.09	
	Sarking board	20	1		1	6	0.12	
	Finishes	5	1		1	20	0.10	
	PV	-	-		-	-	0.60	
	Insulation	100	1		1	1	0.10	
	Plasterboard 2x12mm	24	1		1	9	0.22	
Gk, total							**1.22** kN/m2	
Qk	Access							0.6
Qk,total								**0.6** kN/m2

Gable Rafter Check

Loading Data

Gk	0.65	kN/m^2	Iyy	4286875	mm^4
Qk	0.6	kN/m^2	Wyy	90250	mm^3
b	60	mm	kmod	0.8	
h	95	mm	kdef	0.8	
c/c	380	mm	γm	1.25	
Span	2500	mm	Timber Strength	C24	

UDL	0.475	SLS	1.0Gk + 1.0 Qk
	0.68	ULS	1.35Gk + 1.5Qk
	0.41	FIRE	1.0Gk + 0.7Qk

Bending Strength

f_{cmk}	24	N/mm^2
f_{cmd}	15.36	N/mm^2
Design Moment	0.53	kNm
σ_{myd}	5.85	N/mm^2
	0.38	% utalisation

Shear Strength

f_{vk}	2.5	N/mm^2
f_{vd}	1.6	N/mm^2
Design Shear	1.62	kN
τ_d	0.43	N/mm^2
	0.27	% utalisation

Deflection Check

E_{omean}	11000	N/mm^2
E_{ofin}	6111.111	N/mm^2
ψ_2	0	
$u_{inst,total}$	5.12	mm
u_{creep}	3.84	mm
$u_{inst,imposed}$	2.46	mm
Total Limit	10.0	mm
Post Construction Limit	6.9	mm

Total Deflection	8.96	mm	0.90 % utalisation
Post Construction Deflection	6.30	mm	0.91 % utalisation

Flat Roof Check

Loading Data

Gk	1.22	kN/m^2	Iyy	4286875	mm^4
Qk	0.6	kN/m^2	Wyy	90250	mm^3
b	60	mm	kmod	0.8	
h	95	mm	kdef	0.8	
c/c	380	mm	γm	1.25	
Span	1800	mm	Timber Strength	C24	

UDL	0.6916	SLS	1.0Gk + 1.0 Qk
	0.97	ULS	1.35Gk + 1.5Qk
	0.62	FIRE	1.0Gk + 0.7Qk

Bending Strength

f_{cmk}	24	N/mm^2
f_{cmd}	15.36	N/mm^2
Design Moment	0.39	kNm
σ_{myd}	4.34	N/mm^2
	0.28	% utalisation

Shear Strength

f_{vk}	2.5	N/mm^2
f_{vd}	1.6	N/mm^2
Design Shear	1.62	kN
τ_d	0.43	N/mm^2
	0.27	% utalisation

Deflection Check

E_{omean}	11000	N/mm^2
E_{ofin}	6111.111	N/mm^2
ψ_2	0	
$u_{inst,total}$	2.00	mm
u_{creep}	1.94	mm
$u_{inst,imposed}$	0.66	mm
Total Limit	7.2	mm
Post Construction Limit	5.0	mm
Total Deflection	3.94	mm
	0.55	% utalisation
Post Construction Deflection	2.60	mm
	0.52	% utalisation