

# DEVISE ENGINEERS

11 Doughty Street, London WC1N 2PL

Structural engineer's report and feasibility

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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:
  - o 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 mansard roof.

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

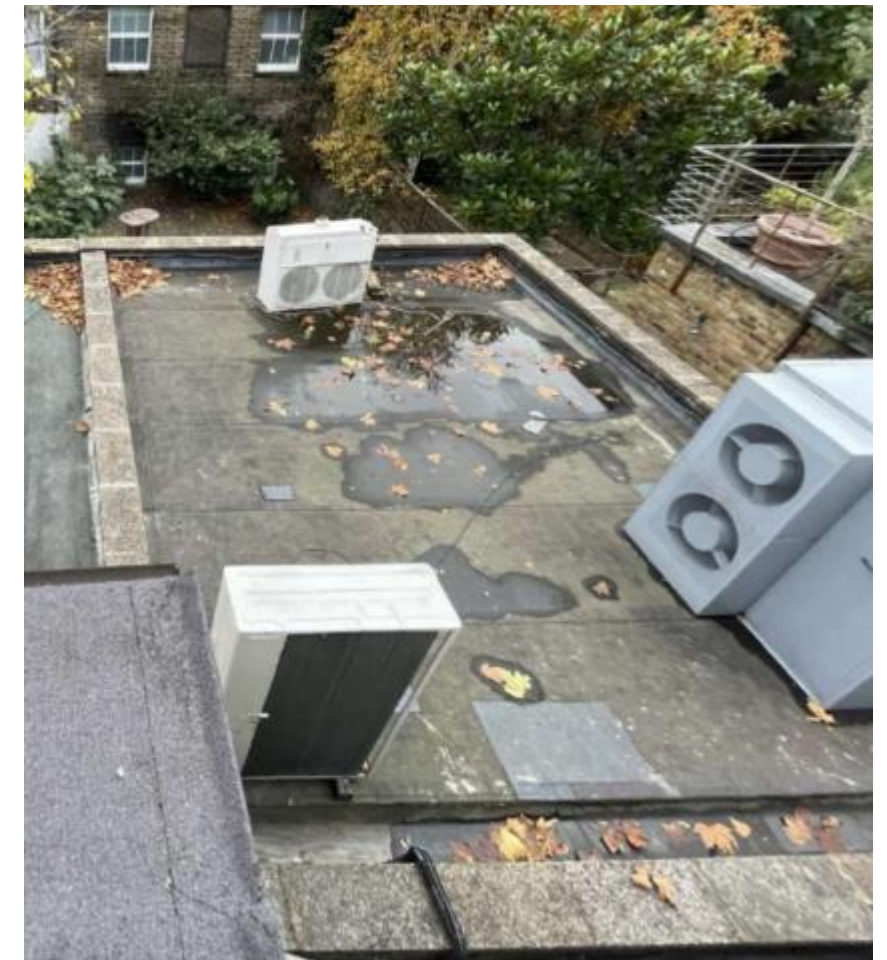


Figure 2: View of rear extension



# 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 and a tiled mansard roof at fourth floor level.



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 95x65 timbers at c.440mm 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 tank within the roof space. These works include the addition doubled up timber joists positioned above the existing loft floor construction.

The existing gable mansard roofs have a slate tile finish. The finishes seem to be in reasonable condition with no significant defects observed.



Figure 5: Existing Roof Construction

# Three

## 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<sup>2</sup>
- Ballasted panels installed on flat roofs, 60 kg/m<sup>2</sup>

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

The construction of the rear extension flat roof was not accessible though given the roof currently houses plant, which is to be removed, it will have adequate residual capacity for the proposed panels.



Figure 6: 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
<b>Existing Pitched Roof 35°</b>							
		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
<b>Proposed Pitched Roof 35°</b>							
		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
<b>Proposed Flat Roof</b>							
		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

<b>Loading Data</b>			
Gk	0.65 kN/m <sup>2</sup>	I <sub>yy</sub>	4644115 mm <sup>4</sup>
Qk	0.6 kN/m <sup>2</sup>	W <sub>yy</sub>	97770.8 mm <sup>3</sup>
b	65 mm	k <sub>mod</sub>	0.8
h	95 mm	k <sub>def</sub>	0.8
c/c	440 mm	γ <sub>m</sub>	1.25
Span	2500 mm	Timber Strength	C24
UDL	0.55 SLS	1.0Gk + 1.0 Qk	
	0.78 ULS	1.35Gk + 1.5Qk	
	0.47 FIRE	1.0Gk + 0.7Qk	
<b>Bending Strength</b>			
f <sub>cmk</sub>	24 N/mm <sup>2</sup>		
f <sub>cmd</sub>	15.36 N/mm <sup>2</sup>		
Design Moment	0.61 kNm		
σ <sub>myd</sub>	6.25 N/mm <sup>2</sup>		
	0.41 % utilisation		
<b>Shear Strength</b>			
f <sub>vk</sub>	2.5 N/mm <sup>2</sup>		
f <sub>vd</sub>	1.6 N/mm <sup>2</sup>		
Design Shear	1.62 kN		
τ <sub>d</sub>	0.39 N/mm <sup>2</sup>		
	0.25 % utilisation		
<b>Deflection Check</b>			
E <sub>omean</sub>	11000 N/mm <sup>2</sup>		
E <sub>ofin</sub>	6111.111 N/mm <sup>2</sup>		
ψ <sub>2</sub>	0		
u <sub>inst,total</sub>	5.48 mm		
u <sub>creep</sub>	4.10 mm		
u <sub>inst,imposed</sub>	2.63 mm		
Total Limit	10.0 mm		
Post Construction Limit	6.9 mm		
Total Deflection	9.58 mm	0.96 % utilisation	
Post Construction Deflection	6.73 mm	0.97 % utilisation	