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Replacement Balcony

at

14 Endsleigh Street

London WC1

Document History and Status

Revision	Status	By	Approved	Date
01	Draft issue	mor		27 August 2020
02	Updated to comments	mor		02 September 2020

1.0 Introduction

Ross and Partners have been appointed to provide professional Civil and Structural Engineering Services in support of the restoration of 14 Endsleigh Street, London WC1.

No 14 Endsleigh Street is a Grade II listed building that lies within a terrace of houses that were built c1825. The building has been unused for many years and the present project aims to restore the property to its original use.

The existing rear balcony at first floor is not thought to be an original part of the building as it is made entirely of a rolled steel angle with a York stone capping. The angle forms a gallows type bracket with an uncertain means of anchorage within the existing masonry. The angle has suffered from corrosion damage and the expansive forces associated with the corrosion process has lifted the stone of its seating.

It is proposed the existing balcony is duly repaired. The existing Yorkstone shall be retained; the failed steel gallows brackets and balustrade shall be replaced to match existing.

This report discusses the structural matters.

2.0 Terms of Reference

This report has been prepared by Ross and Partners on the instructions of, and for the sole use and benefit of the client, Overbury. No professional liability or warranty is extended to other parties by Ross and Partners as a result of this report being used by others without the written permission of Ross and Partners.

3.0 Statement of Intent

The client, design team and contractor are committed to the exercise of reasonable skill care and diligence in executing the works with due regard to the protection of historic assets that remain within the building and to working with all interested parties to achieve these goals.

4.0 Site Context

The property is located within a terrace of even houses on the western side of Endsleigh Street, London, W1. The building is arranged over basement, ground and first to third floors inclusive. There is a small garden to the rear.

5.0 Existing Rear Balcony at First Floor

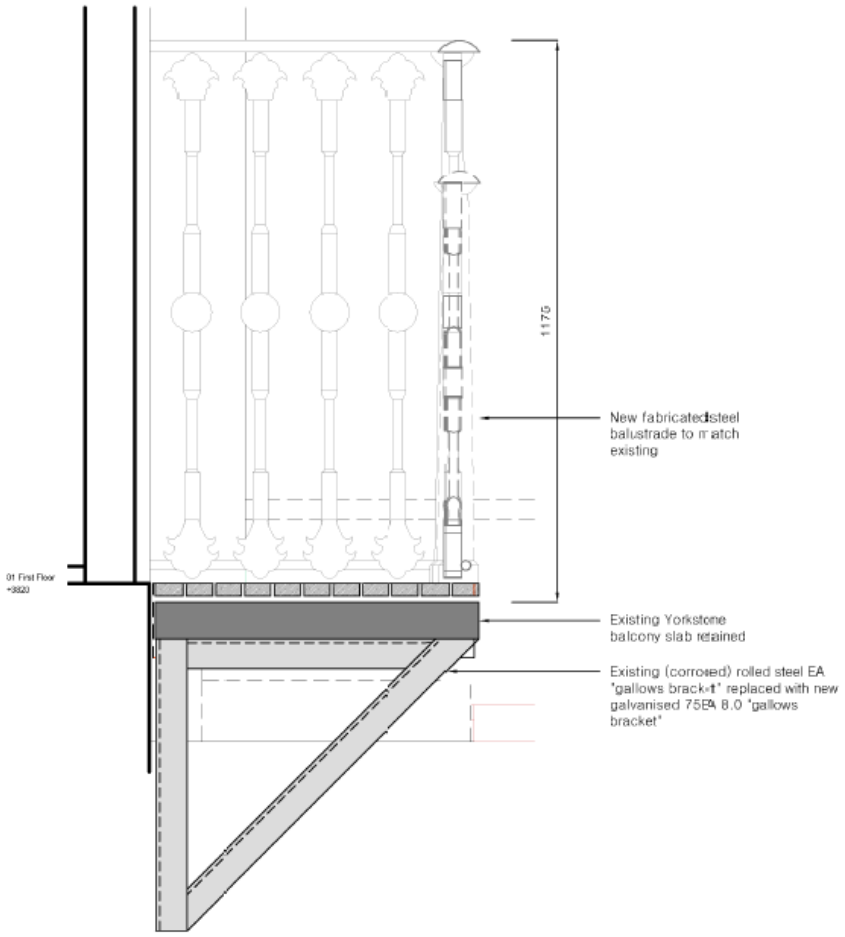
The existing rear balcony at first floor is not thought to be an original part of the building as it is made entirely of a rolled steel angle with a York stone capping. The angle forms a gallows type bracket with an uncertain means of anchorage within the existing masonry. The angle has suffered from corrosion damage and the expansive forces associated with the corrosion process has lifted the stone from its seating.

The balustrade is in a poor state of disrepair. One end has been cut away. Part of it on the lower left-hand side of the photograph below has failed and been subjected to an ill considered means of repair. The balustrade is not considered safe or suitable for re-use.

6.0 Proposed Balcony Repair

It is proposed the existing balcony is duly repaired. The existing Yorkstone shall be retained; the failed steel gallows brackets and balustrade shall be replaced to match existing.

The steelwork shall be grade S275 and galvanised for corrosion protection. The steel will receive an etching primer and finished in a new black paint finish to match existing. The balustrade height will be increased to comply with the requirements of the building regulations and to permit the occupants the enjoyment of the Juliet balcony.



Detail A
1:10@A1

Proposed Repairs Balcony

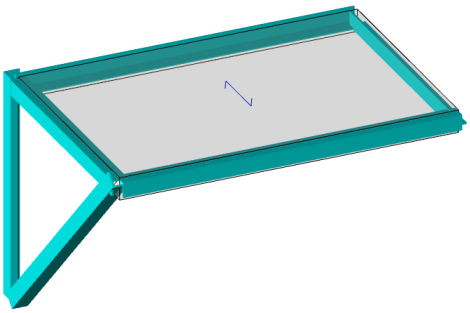
7.0 Methodology

The construction of the new balcony will be a simple process as follows:

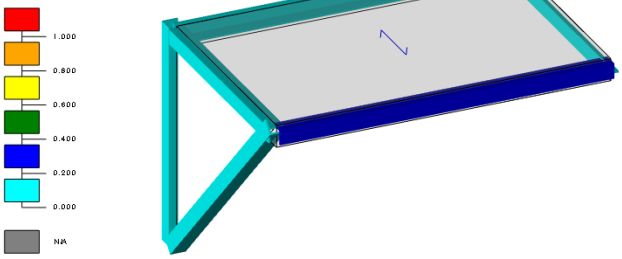
1. Erect scaffold tower to underside of the existing balcony
2. Carefully install four equally spaced Acro props to the underside of the existing stone balcony.
3. Cut away the existing balusters from the York Stone slab using a sharp-edged grinder. The grinder blade must be horizontal.
4. Cut off the corroded angle sections as far as the existing masonry. Touch up the ends with Galvafroid.
5. Clean the York Stone slab with a stiff brush and clean water only to remove any algae.
6. Erect the new steel equal angle gallows bracket into position.
7. Fix the steel equal angle to the brickwork using 10mm resin anchors in accordance with the manufacturers product data sheets
8. Install timber battend and boards
9. Erect new balustrade
10. Make good and damaged areas
11. Strike scaffold.

Design Calculations

Analytical model



Combine Stress Ratio



Static

Summary RSA 70x70x8(S355)

Design Condition	#	Design Value	Design Capacity	Units	U.R.	Status
Classification	1	Class 3	-	-	-	✔ Pass
Shear Major	No	Significant	Forces	kN	-	Not required
Shear Minor	-	No	Forces	kN	-	Not required
Buckling Shear Web	No	Significant	Forces	kN	-	Not required
Moment Major	1	-0.4	3.4	kNm	0.122	✔ Pass
Moment Minor	1	0.0	3.4	kNm	0.000	✔ Pass
Axial	-	No	Forces	kN	-	Not required
Axial Bending Combined	-	-	-	-	-	
Buckling Lateral Torsional	-	Fully	Restrained	-	-	-
Buckling Compression	-	No	Forces	-	-	Not required
Buckling Combined	-	-	-	-	-	
Torsion	-	No	Significant	Forces	-	Not required
Deflection Slab	-	No	Loads	mm	-	Not required
Deflection Dead	1	-0.7	3.0	mm	0.222	✔ Pass
Deflection Imposed	-	No	Loads	mm	-	Not required
Deflection Total	1	-0.7	7.5	mm	0.096	✔ Pass

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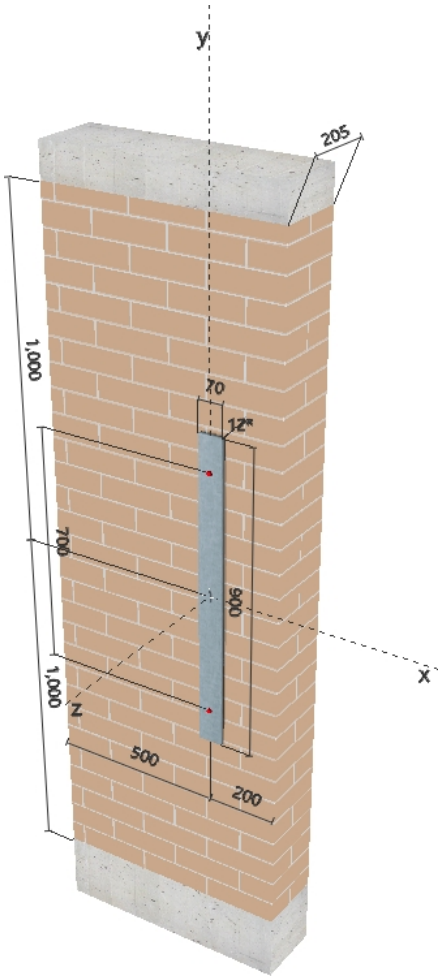
Address:	1 Bastwick Street, London	Sub-Project I Pos. No.:	Rear Balcony
Phone I Fax:	02075536050 |	Date:	02/09/2020
E-Mail:			

Specifier's comments:

1 Input data

Anchor type and diameter:	**HIT-HY 270 + HIT-V-F (5.8)** **M12, HIT-SC 18x50+18x85**
Effective embedment depth:	$h_{ef,opti}$ = 130 mm ($h_{ef,limit}$ = 130 mm)
Material:	5.8
Evaluation Service Report:	Hilti Technical Data
Issued I Valid:	- | -
Proof:	Design method ETAG 029, Annex C
Stand-off installation:	e_b = 0 mm (no stand-off); t = 12 mm
Anchor plate^R:	l_x x l_y x t = 70 mm x 900 mm x 12 mm; (Recommended plate thickness: not calculated
Profile:	Flat bar; (L x W x T) = 30 mm x 5 mm
Base material:	Brick layout: Double Stretcher; Brick: UK London yellow Multi Stock (solid brick), Clay, L x W x H: 215 mm x 100 mm x 65 mm; $f_{b,v}$ = 16.00 N/mm^2; E_{wall} = 3,830.42 N/mm^2 Mortar: M2,5 - M9; Vertical joints filled: YES; vertical: 5 mm; horizontal: 5 mm
Installation/Use:	Installation condition: Dry; Use condition: Dry; Cleaning: compressed air Temp. short/long: 40/24 °C

Geometry [mm]



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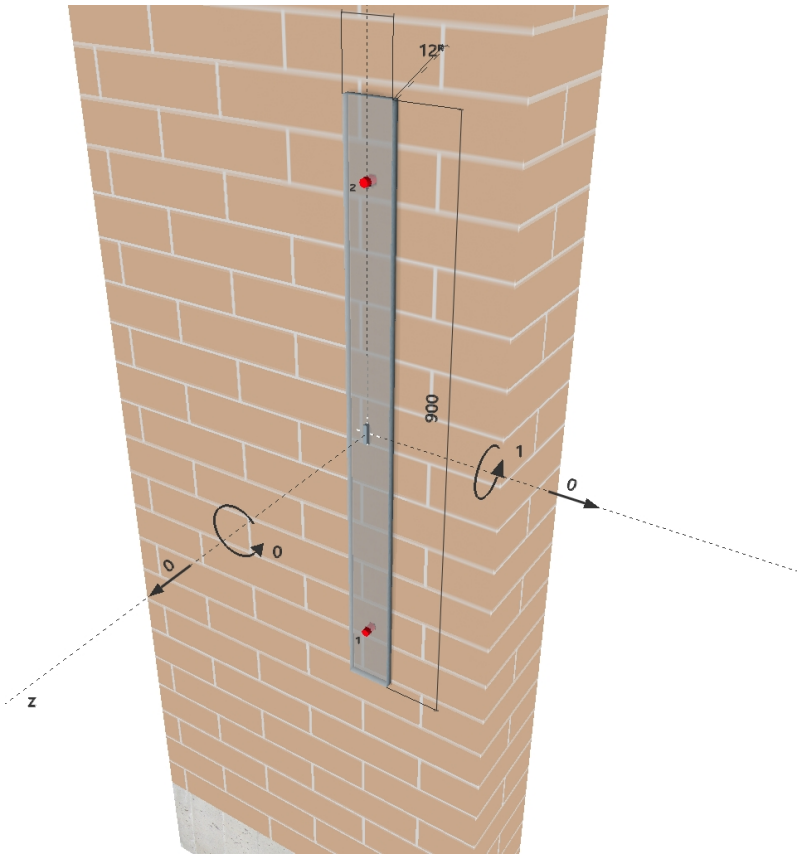
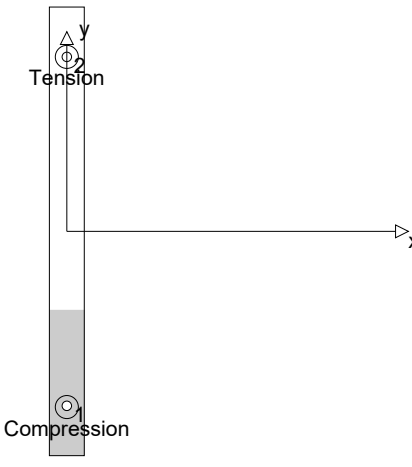
Geometry [mm] & Loading [kN, kNm]



2 Load case/Resulting anchor forces

Load case: Design loads



Anchor reactions [kN]
Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0.000	1.000	0.000	-1.000
2	1.424	1.000	0.000	-1.000

max. compressive strain:	0.04 [‰]
max. compressive stress:	0.14 [N/mm^2]
resulting tension force in (x/y)=(0/350):	1.424 [kN]
resulting compression force in (x/y)=(0/-352):	1.424 [kN]

3 Tension load (ETAG 029 Annex C, Section C.5.2.1)

	Load [kN]	Capacity [kN]	Utilization β_N [%]	Status
Steel Strength*	1.424	28.133	6	OK
Pullout Strength*	1.424	3.000	48	OK
Brick breakout**	1.424	3.000	48	OK
Pullout of one brick**	1.424	1.980	72	OK

* anchor having the highest loading **anchor group (anchors in tension)

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3.1 Steel Strength

$N_{Rk,s}$ [kN]	$\gamma_{M,s}$	$N_{Rd,s}$ [kN]	N_{Sd} [kN]
42.200	1.500	28.133	1.424

3.2 Pullout Strength

$N_{Rk,p}$ [kN]	α_j	$\gamma_{M,m}$	$N_{Rd,p}$ [kN]	N_{Sd} [kN]
7.500	1.000	2.500	3.000	1.424

3.3 Brick breakout

$s_{\parallel}$ [mm]	$s_{\perp}$ [mm]	$s_{cr,\parallel}$ [mm]	$s_{cr,\perp}$ [mm]	c [mm]	c_{cr} [mm]
0	0	215	140	200	100

$N_{Rk,b}$ [kN]	α_j	$\alpha_{g,N}$	$\gamma_{M,m}$	$N_{Rd,b}$ [kN]	N_{Sd} [kN]
7.500	1.000	1.000	2.500	3.000	1.424

3.4 Pullout of one brick

A^{H}_{act} [mm²]	A^{V}_{act} [mm²]	f_{vko} [N/mm²]	σ_d [N/mm²]
43,000	6,500	0.20	0.00

$N_{Rk,pb}$ [kN]	$\gamma_{M,m}$	$N_{Rd,pb}$ [kN]	N_{Sd} [kN]
4.950	2.500	1.980	1.424

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4 Shear load (ETAG 029 Annex C, Section C.5.2.2)

	Load [kN]	Capacity [kN]	Utilization β_V [%]	Status
Steel Strength (without lever arm)*	1.000	16.880	6	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Local brick failure**	2.000	9.600	21	OK
Brick edge failure in direction x+**	2.000	22.722	9	OK
Pushing out of one brick in direction **	N/A	N/A	N/A	N/A

* anchor having the highest loading **anchor group (relevant anchors)

4.1 Steel Strength (without lever arm)

$V_{Rk,s}$ [kN]	$\gamma_{M,s}$	$V_{Rd,s}$ [kN]	V_{Sd} [kN]
21.100	1.250	16.880	1.000

4.2 Local brick failure

$s_{\parallel}$ [mm]	$s_{\perp}$ [mm]	$s_{cr,\parallel}$ [mm]	$s_{cr,\perp}$ [mm]	c [mm]	c_{cr} [mm]
0	700	215	140	200	100

$\alpha_{g,V}$	α_j	$V_{Rk,b}$ [kN]	$\gamma_{M,m}$	$V_{Rd,b}$ [kN]	V_{Sd} [kN]
2.000	1.000	12.000	2.500	9.600	2.000

4.3 Brick edge failure in direction x+

k	d_{nom} [mm]	h_{ef} [mm]	$f_{b,v}$ [N/mm^2]	c_1 [mm]
0.45	12	130	16.00	200

$V_{Rk,c}$ [kN]	$\alpha_{g,V}$	$\gamma_{M,m}$	$V_{Rd,c}$ [kN]	V_{Sd} [kN]
28.403	2.000	2.500	22.722	2.000

5 Combined tension and shear loads (ETAG 029 Annex C, Section C.5.2.3)

β_N	β_V	α	Utilization $\beta_{N,V}$ [%]	Status
0.719	0.208	1.000	78	OK

$(\beta_N + \beta_V) / 1.2 \leq 1$

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6 Warnings

- The anchor design methods in PROFIS Anchor require rigid anchor plates per current regulations (ETAG 001/Annex C, EOTA TR029, etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Anchor calculates the minimum required anchor plate thickness with FEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Anchor. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Only the local load transfer from the anchor(s) to the wall is considered, a further load transfer in the wall is not covered by PROFIS!
- Wall is assumed as being perfectly aligned vertically – checking required(!): Noncompliance can lead to significantly different distribution of forces and higher tension loads than those calculated by PROFIS. Masonry wall must not have any damages (neither visible nor not visible)! While installation, the positioning of the anchors needs to be maintained as in the design phase i.e. either relative to the brick or relative to the mortar joints.
- The effect of the joints on the compressive stress distribution on the plate / bricks was not taken into consideration.
- If no significant resistance is felt over the entire depth of the hole when drilling (e.g. in unfilled butt joints), the anchor should not be set at this position or the area should be assessed and reinforced. Hilti recommends the anchoring in masonry always with sieve sleeve. Anchors can only be installed without sieve sleeves in solid bricks when it is guaranteed that it has not any hole or void.
- The accessories and installation remarks listed on this report are for the information of the user only. In any case, the instructions for use provided with the product have to be followed to ensure a proper installation.
- The compliance with current standards (e.g. ETAG 029) is the responsibility of the user.
- The Young's modulus of the wall E_{wall} (not plastered!) is determined in accordance to EN 1996-1-1:2012
- Drilling method (hammer, rotary) to be in accordance with the approval!
- Masonry needs to be built in a regular way in accordance with state-of the art guidelines!
- Please note that, for ETA approved masonry units, the resistance and parameters are only valid for that particular brick (hollow/solid) or for bricks of the same base material with larger size and larger compressive strength (solid), according to ETAG 029.
- Compressive stress (0.14 N/mm^2) on plaster/brick must be checked by user. Hilti will not take any responsibility for cracks or damage!

Fastening meets the design criteria!

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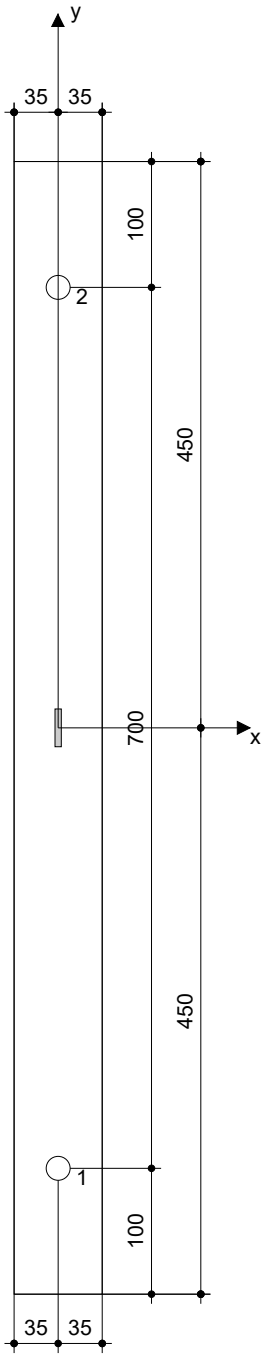
7 Installation data

Anchor plate, steel: -
Profile: Flat bar; (L x W x T) = 30 mm x 5 mm
Hole diameter in the fixture (pre-setting) : d_f = 19 mm
Hole diameter in the fixture (through fastening) : d_f = 0 mm
Plate thickness (input)^{R}: 12 mm
Recommended plate thickness^{R}: not calculated
Drilling method: Drilled in rotary mode
Cleaning: compressed air

Anchor type and diameter:
HIT-HY 270 + HIT-V-F (5.8) M12, HIT-SC 18x50+18x85
Installation torque: 0.006 kNm
Hole diameter in the base material: 18 mm
Hole depth in the base material: 145 mm
Minimum thickness of the base material: 195 mm



Coordinates Anchor mm

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	0	-350	500	200	650	1,350
2	0	350	500	200	1,350	650

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8 Remarks; Your Cooperation Duties

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- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.