PULL OUT TEST

CLIENT: CJ O'Shea

SITE ADDRESS: 42-45 Belsize Park, London, NW3 4EE

REPORT NUMBER: SC-550-PT-001

JOB NUMBER: SC-0550

Test Procedure Requirements:

BS 8539:2012 Code of practice for the selection and installation of post-installed anchors in concrete and masonry

CFA Procedure for Site Testing Construction Fixings 2012

TEST DETAILS:

- There are 8no. Pull out tests in total
- These tests were carried out on 12mm diameter Hilti HIT V-R anchors.
- The anchors had been resin fixed into the inner leaf of the retained brick facade using Hilti Hit HY-70 max.
- These bolts were being tested to failure to determine the allowable resistance.

FAILURE CRITERIA:

These tests are being carried out to the point of failure.
The failure load will be recorded as:

- The point at which either the base material will fail (cone failure) this is taken when the base material can no longer sustain load.
- The point at which the anchor fails in tension (steel failure)
- The point at which there is bond failure between the anchor and the resin or the resin and the brick (Bond failure).

Report By: Conor McHugh

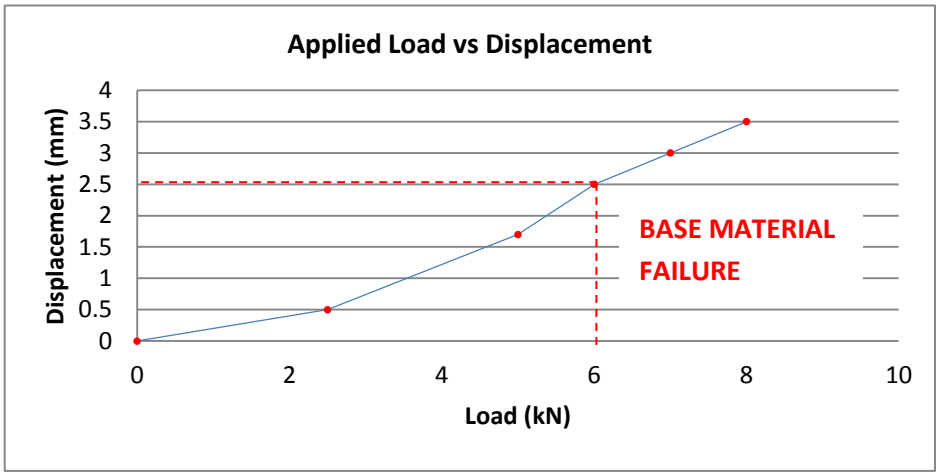
Checked By: Tim Lohmann

Date: 27th August 2013

Test Carried Out By	Conor McHugh - Theodoros Isokratous
Date of Test	23rd August 2013
Purpose of Test	Determine the allowable resistance
Test Requested By	Niall O'Shea
Report Number	SC-0550-PT-01
Clients Contact	Niall O'Shea
Anchors Installed By	Mr P Singh (C J O'Shea)
ANCHOR DETAILS	
Anchor manufacturer	Hilti
Anchor Type, Size and Finish	Hilti HIT-V M12
Purpose of Anchor	Façade retention
Characteristic Resistance	
Design Resistance	
TEST DETAILS	
Type of Loading	Tension Load - Incremental
Proof or Allowable Resistance	Allowable resistance
Required Proof Load	Test to failure
TEST LOCATION	
Location	Façade
Anchor reference	1-8
Edge Distance	n/a
Centre Spacing	n/a
BASE MATERIAL	
Material type and Strength	Solid Bricks
Thickness	Unknown
INSTALLATION DETAILS	
Hole Diameter	14mm
Drill Bit Cutting Diameter	14mm
Hole Depth	230mm
Resin Type	Hilt HIT-HY 70 max
Embedment Depth	220mm
Hole Cleaning Method	Brush and blow
Temperature When Installed	
Manufacturer Curing Time	
TEST EQUIPMENT	
Hydraulic Jack	Hydrajaws 2000
Pressure Gauge	30kN Hydrajaws pressure gauge. Calibration Reference: SWX1F 62078
Measurement Gauge	Hydrajaws linear gauge

BOLT #1 - Ground Floor		
LOAD APPLIED	**GAUGE READING**	**DISPLACEMENT**
kN	**mm**	**mm**
0	17	0
2.5	17.5	0.5
5	18.7	1.7
6	**19.5**	**2.5**
7	20	3
8	20.5	3.5

BASE MATERIAL FAILURE



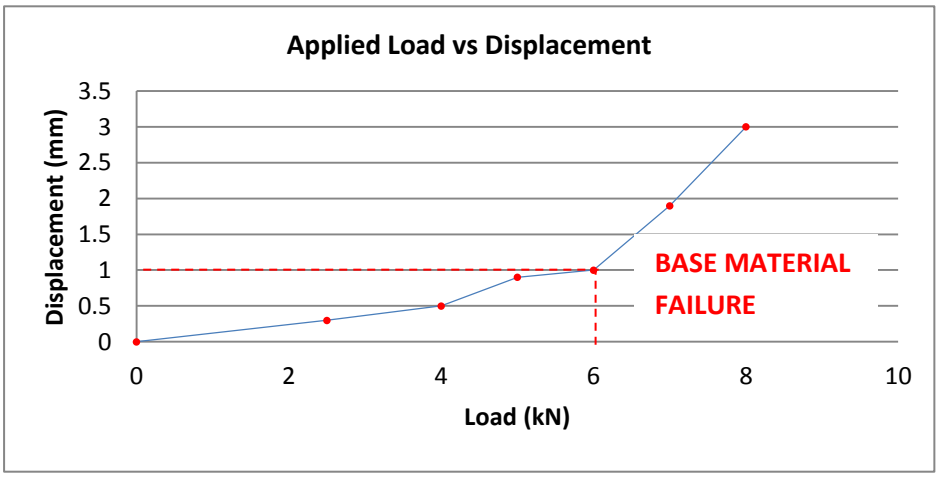
BEFORE TESTING

AFTER TESTING

BASE MATERIAL FAILURE

BOLT #2 - Ground Floor		
LOAD APPLIED	**GAUGE READING**	**DISPLACEMENT**
kN	**mm**	**mm**
0	23	0
2.5	23.3	0.3
4	23.5	0.5
5	23.9	0.9
6	**24**	**1**
7	24.9	1.9
8	26	3

BASE MATERIAL FAILURE



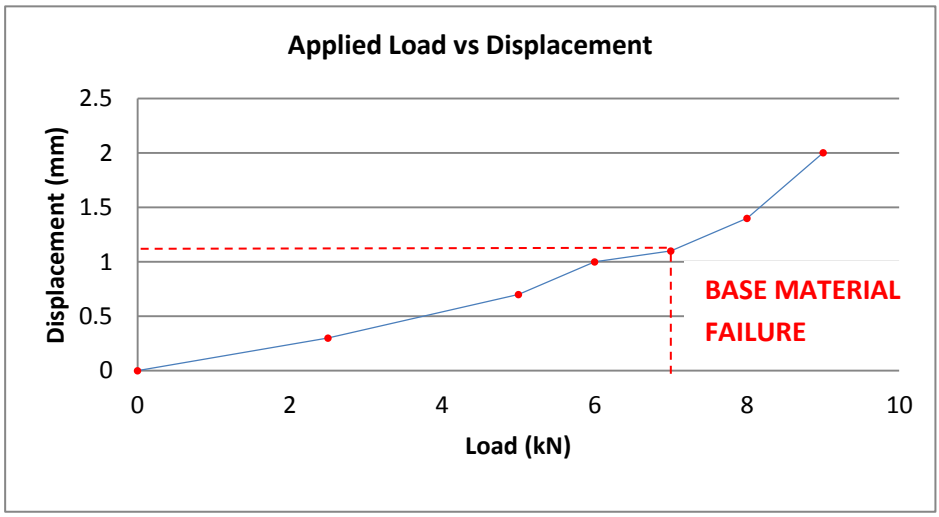
BASE MATERIAL FAILURE

BEFORE TESTING

AFTER TESTING

BOLT #3 - First Floor		
LOAD APPLIED	**GAUGE READING**	**DISPLACEMENT**
kN	**mm**	**mm**
0	5.8	0
2.5	6.1	0.3
5	6.5	0.7
6	6.8	1
7	**6.9**	**1.1**
8	7.2	1.4
9	7.8	2

BASE MATERIAL FAILURE

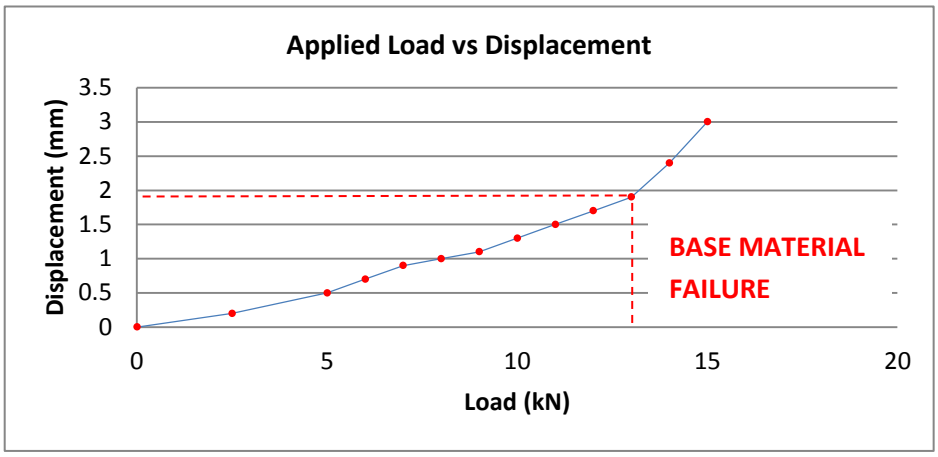


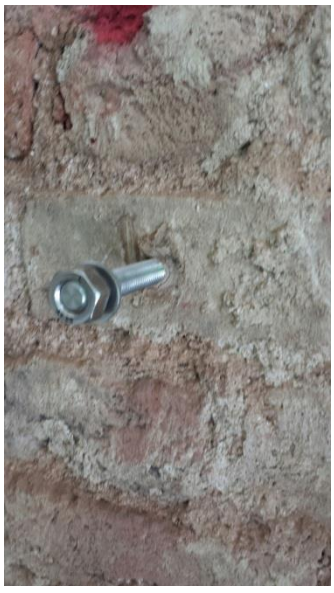
BASE MATERIAL FAILURE

BEFORE TESTING **AFTER TESTING**

BOLT #4 - First Floor		
LOAD APPLIED	**GAUGE READING**	**DISPLACEMENT**
kN	**mm**	**mm**
0	18	0
2.5	18.2	0.2
5	18.5	0.5
6	18.7	0.7
7	18.9	0.9
8	19	1
9	19.1	1.1
10	19.3	1.3
11	19.5	1.5
12	19.7	1.7
13	**19.9**	**1.9**
14	20.4	2.4
15	21	3

BASE MATERIAL FAILURE





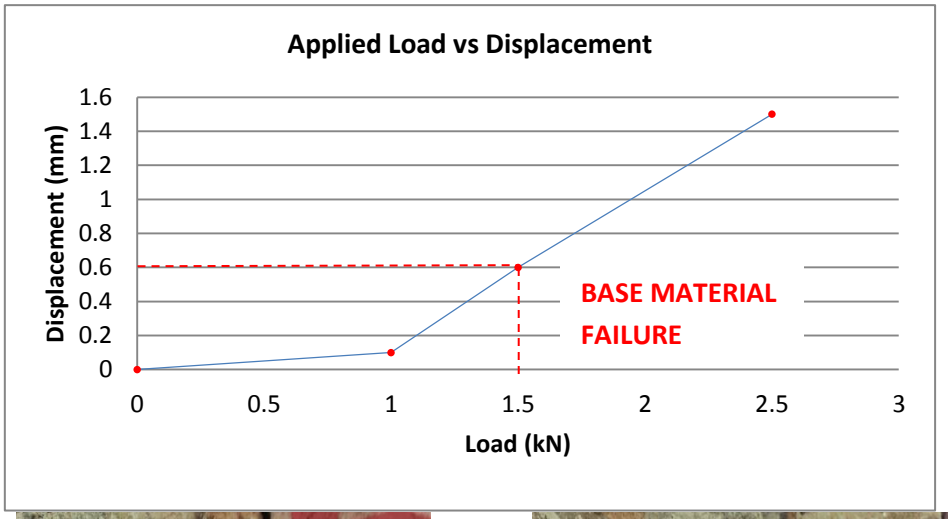
BEFORE TESTING

AFTER TESTING

BASE MATERIAL FAILURE

BOLT #5 - Second Floor		
LOAD APPLIED	**GAUGE READING**	**DISPLACEMENT**
kN	**mm**	**mm**
0	16.9	0
1	17	0.1
1.5	**17.5**	**0.6**
2.5	18.4	1.5

BASE MATERIAL FAILURE

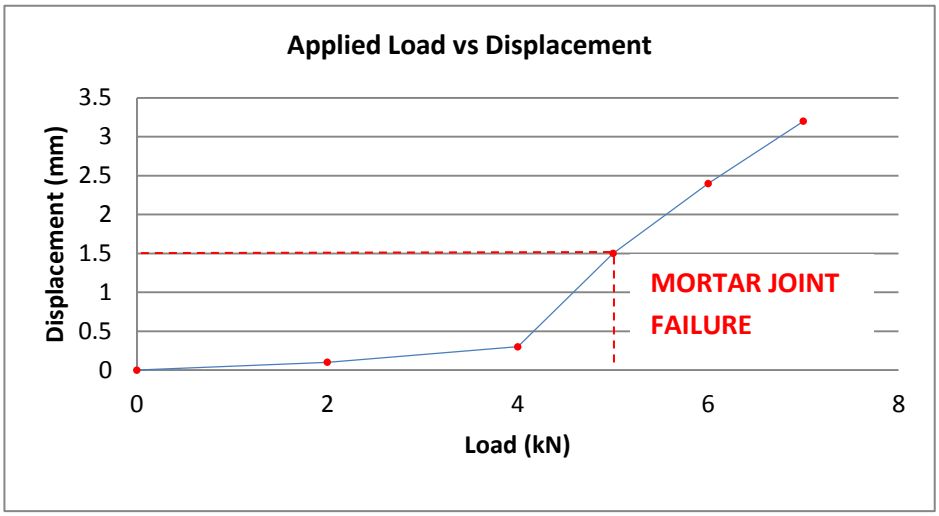


BEFORE TESTING

AFTER TESTING

BOLT #6 - Second Floor		
LOAD APPLIED	**GAUGE READING**	**DISPLACEMENT**
kN	**mm**	**mm**
0	8	0
2	8.1	0.1
4	8.3	0.3
5	**9.5**	**1.5**
6	10.4	2.4
7	11.2	3.2

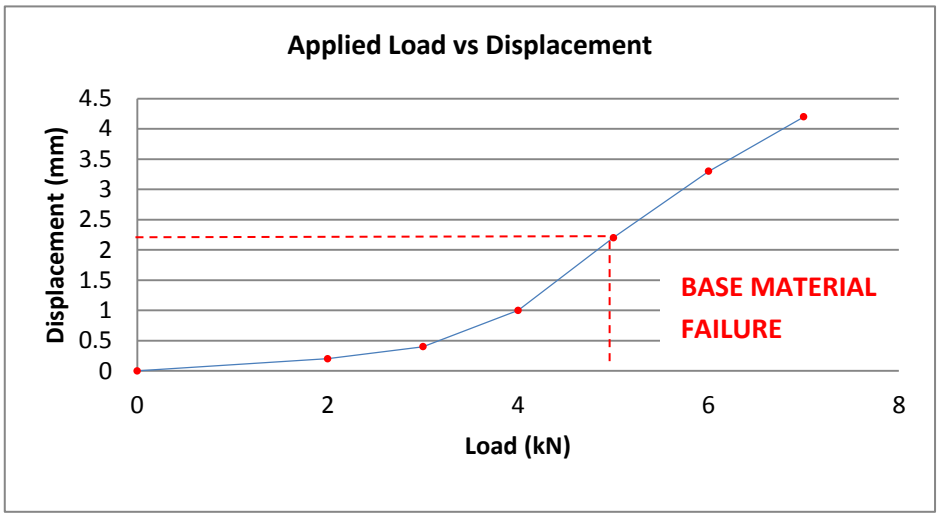
MORTAR JOINT FAILURE

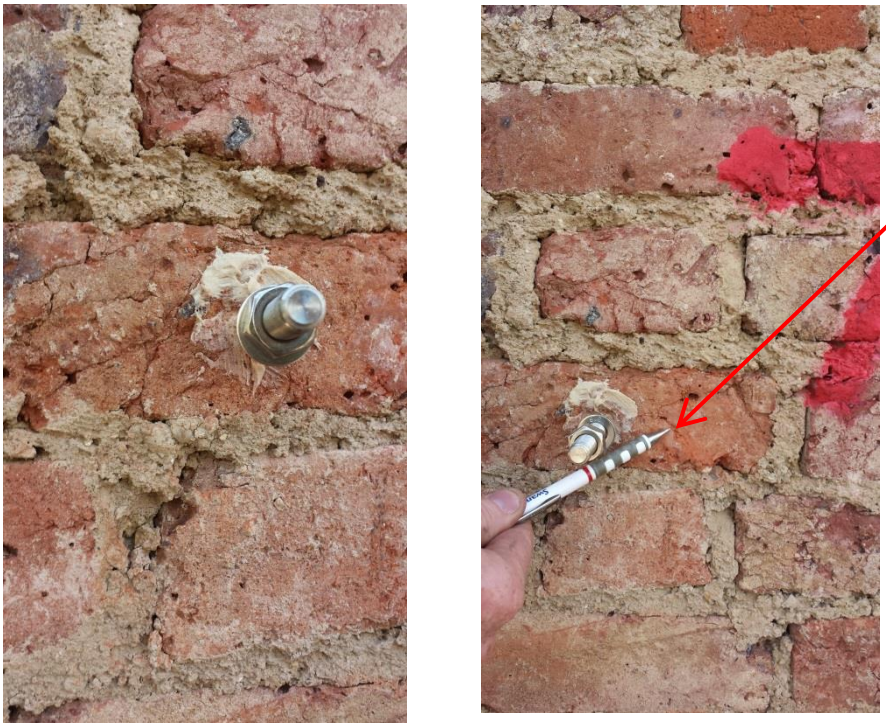


BEFORE TESTING **AFTER TESTING**

BOLT #7 - Third Floor		
LOAD APPLIED	**GAUGE READING**	**DISPLACEMENT**
kN	**mm**	**mm**
0	14.8	0
2	15	0.2
3	15.2	0.4
4	15.8	1
5	**17**	**2.2**
6	18.2	3.3
7	19.3	4.2

BASE MATERIAL FAILURE





BEFORE TESTING

AFTER TESTING

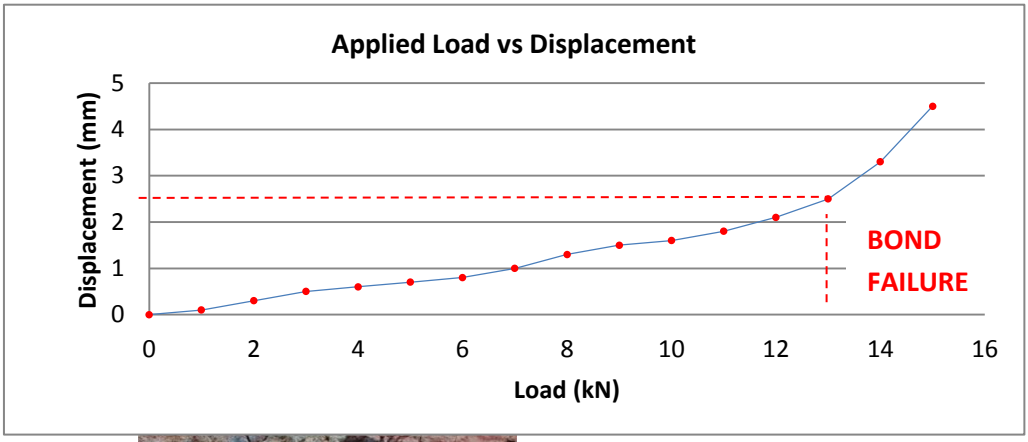
BASE MATERIAL FAILURE

BOLT #8 - Third Floor		
LOAD APPLIED	**GAUGE READING**	**DISPLACEMENT**
kN	**mm**	**mm**
0	8.5	0
1	8.6	0.1
2	8.8	0.3
3	9	0.5
4	9.1	0.6
5	9.2	0.7
6	9.3	0.8
7	9.5	1
8	9.8	1.3
9	10	1.5
10	10.1	1.6
11	10.3	1.8
12	10.6	2.1
13	**11**	**2.5**
14	11.8	3.3
15	13	4.5

BOND FAILURE

NOTE:

Anchor #8 was resin fixed into a concrete mortar joint. This concrete mortar may be stronger than the actual masonry itself and therefore this test result cannot be included in determining the allowable resistance of the masonry.



BEFORE TESTING

BOND FAILURE

AFTER TESTING

Results

Based on equation *B.2.3.2.2 of BS 8539:2012*

$N_{RK1}=N_{Ru,m}(1-K*v)*\Omega$

BOLT NUMBER	FAILURE LOAD kN
1	6
2	6
3	7
4	13
5	1.5
6	5
7	5
SUM	43.5
STDEV	3.2
MEAN	6.2

$N_{Ru,m}$= 5.4 kN

v = 0.3, K=3, Ω=0.9

Characteristic Resistance N_{Rk1}

N_{Rk1}=6.2(1 - 3*0.3)*0.9= **0.56kN**

$N_{R,all} = N_{Rk1}/\nu$ *(Equation B.10)*

ν= 2.5 Global safety factor

Allowable Resistance $N_{R,all}$

= 0.22kN

If we remove bolts #4 and #5 as they are the highest and lowest result which lead to a much higher standard deviation and overall lower allowable resistance then the results are as follows

$N_{RK1}=N_{Ru,m}(1-K*v)*\Omega$

BOLT NUMBER	FAILURE LOAD kN
1	6
2	6
3	7
6	5
7	5
SUM	29
STDEV	0.7
MEAN	5.8

$N_{Ru,m}$= 3.6 kN

v = 0.19, K=3.4, Ω=0.9

Characteristic Resistance N_{Rk1}

N_{Rk1}=5.8(1 – 3.4*0.12)*0.9= **3kN**

$N_{R,all} = N_{Rk1}/\nu$ *(Equation B.10)*

ν= 2.5 Global safety factor

Allowable Resistance $N_{R,all}$

= 1.2kN

Conclusions

- The majority of the tests resulted in a base material failure, with the exception of test #6. Test #8 was not included in determining the allowable resistance as the anchor was resin fixed into the concrete mortar joint.
- The results varied from 1.5kN failure to 13kN failure which leads to a higher standard deviation and a lower overall resistance value.
- By removing these tests from the overall result gives a more accurate allowable resistance of 1.2kN