Jennings Aldas (2019) Limited
97 Innsworth Lane
Gloucester GL2 0TT

Airtightness Testing Report

Prepared for:

St Sidwell's Point
Paris Street, Exeter, EX1 2JB

On behalf of:

Kier Construction

Author:

Paul Jennings

Date:

7th February 2022

Reference:

P3819-11

DOCUMENT HISTORY

Role	Name	Date
Author	Paul Jennings	5th February 2022
Checked & Authorised	Duncan Jennings	6th February 2022

Design recommendations and specifications provided in this report are based on the best professional endeavours of the authors. All calculations are based on the best information available to us at the time of report production. Where third party equipment is referred to Aldas rely on manufacturer performance statements, guarantees, and warranties. We are not liable for any errors in calculations or omissions resulting from data provided by the customer or third parties.

Aldas works to all relevant professional standards and holds professional indemnity insurance as airtightness specialists. Aldas is the trading name of Jennings Aldas (2019) Limited.

CONTENTS

EXECUTIVE SUMMARY

The results achieved in the acceptance Airtightness Testing of the newbuild Passivhaus leisure centre, at St Sidwell's Point in Paris Street, Exeter, which was carried out on the 17th December 2021, are detailed in the table below:

Testing carried out by:	**Test Engineer: Paul Jennings**
Required Air Permeability, $m^3/hr/m^2$ @ 50 Pa:	**≤0.4 (Passivhaus Institute requirement)**
Target Air Permeability, $m^3/hr/m^2$ @ 50 Pa:	**≤0.2 (Exeter City Council aspiration)**
Achieved Air Permeability, $m^3/hr/m^2$ @ 50 Pa:	**0.30**
Achieved Air Changes, AC/hr @ 50 Pa:	**0.10**
Average Data consistency, r^2 (requirement, $r^2 > 0.98$):	**0.998**
Average Slope, n (requirement, $0.5 < n < 1.0$):	**0.64**
Average measured Equivalent Leakage Area, ELA, cm^2:	**772.5**

This result demonstrates that the new St Sidwell's development meets the required airtightness target for Passivhaus certification (≤0.4 $m^3/hr/m^2$ @ 50 Pa). No significant areas of air leakage were identified in the acceptance test.

Full information on the test set-up and procedure is detailed in Appendix I and the test data for the depressurisation and pressurisation tests carried out is provided in Appendices II & III. Details of the envelope area and volume calculations underpinning the calculated results are provided in Appendix IV. An Air Leakage Certificate is included as Appendix V .

The exceptional airtightness of St Sidwell's was achieved through the rigorous efforts of an extensive team led by Stephen Booth & Joe Sibley of Kier Construction, who generated a collaborative approach from day one. Airtightness testing and consultancy support and guidance was provided by Paul Jennings of Aldas & Mike Roe of Warm. Specialist sealing works were undertaken by a dedicated team from DDF who fully embraced the delivery process. The whole team worked tirelessly to successfully deliver the many complex building interfaces, which in turn led to the excellent final airtightness result and the delivery of a remarkable and outstanding building.

1.0 INTRODUCTION

This report documents acceptance air leakage testing and leakage checking undertaken by Aldas for Kier Construction at the new St Sidwell's Point Passivhaus leisure centre in Paris Street, Exeter, on the 17th December 2021. We present direct observations from what was noted during our attendance on site.

The purpose of this report is to:

- Detail the measurements recorded and the test procedures followed
- Provide a photographic record of the test configuration, including any temporary sealing undertaken, and pictures of any significant leakage issues identified
- Confirm the air tightness result achieved
- Identify typical and atypical airtightness faults that did or may impede successful delivery of the required airtightness standard
- Detail the envelope area and volume measurements and calculations that underpin the results achieved
- Provide air leakage certificates for buildings where conforming airtightness tests were completed

2.0 TEST SET-UP AND PROCEDURES

2.1 Set-up

Acceptance air leakage testing of the new St Sidwell's Point Passivhaus leisure centre, in Paris Street, Exeter, was carried out on the 17th December 2021. Testing was carried out using a Retrotec 3000SR fan. This was mounted in the L1 entrance in a flexible “bag door” system. Testing was carried out in accordance with the requirements of BS EN 13829 and the ATTMA Quality Procedure, in conformance with the standards ATTMA TSL1 (2016) and ATTMA TSL4 (2018), in compliance with Method A (acceptance testing). The additional requirements of the Passivhaus Institute when testing building aiming for Passivhaus certification were also complied with. Any queries or complaints about this test should be addressed in the first instance to the test engineer and in the second instance to the scheme manager at ATTMA.

ATTMA contact	Scheme Manager, ATTMA, Unit 3, Tannery Road Industrial Estate, Tannery Road, High Wycombe, Buckinghamshire HP13 7EQ	
details:	e-mail: manager@attma.org	www.attma.org

All external doors and windows, other than that where the test equipment was mounted, were shut for the duration of testing, whilst internal doors and walls were either not yet fitted or were kept open for the duration of testing so free movement of air within the property was assured. Since we were advised that the ventilation systems operated continuously, temporary sealing of these units was deemed acceptable to eliminate ventilation leakage from the overall leakage of the building. The large ventilation grilles were temporarily sealed externally, with Pro-Clima’s Compego airtightness tape used to provide a robust edge seal to maintain the temporary membranes over the openings after the problems experienced with failed temporary sealing during the preliminary airtightness testing. The position of this temporary sealing is detailed in Appendix I.1.

2.2 Measurement procedures

Test procedures in accordance with the following standards: ATTMA TSL1, 2016 and ATTMA TSL4, 2018, Method A. After a preliminary single- point depressurisation test and initial leakage check of the building, primarily to confirm that the temporary sealing to ventilation grilles was effective, full multi-point depressurisation testing was carried out. As required by the PHI for Passivhaus certification a full multi-point pressurisation test was then undertaken.

Measurements Recorded

Averages of zero flow pressure differentials were recorded before and after the test, as were internal and external temperatures, windspeed and the barometric pressure.

2.3 Building envelope area and volume

The PHI-compliant envelope area and volume was prepared by Adam Scott of Gale & Snowden, using their Revit and SketchUp models, following consultations regarding the precise airtightness boundary. This is detailed in Appendix IV.

Volume under test	Volume (m^3)	Envelope area (m^2)
	PHI conventions	PHI conventions
St Sidwell's Point Leisure Centre, Paris Street, Exeter	28,483.5	9,721.7

2.4 Equipment Calibration

All test equipment and accessories are calibrated. The table below provides details of the equipment and the calibration validity for each:

Equipment	Serial No.	Calibration expiry date
Retrotec DM32 Digital Gauge	Serial No: 413166	Expires 2nd May 2022
Retrotec 3000SR High-Power Fan	Serial No: PH001057	Expires 30th July 2022
Testo 925 Digital Thermometer	Serial No: 34850785/1220	Expires 25th April 2022
Digitron K-type Temperature Probe	Serial No: 34835580/910	Expires 25th April 2022
Testo 511 Digital Barometer	Serial No: 39120237/1220	Expires 25th April 2022

3.0 LEAKAGE OBSERVATIONS

Leakage sites identified in the building tested are grouped into categories and described in detail below. Photographs, including thermographic images where applicable, are provided for key leakage sites where possible.

No significant areas of leakage were identified during the acceptance airtightness testing. The extensive temporary sealing to ventilation grilles were inspected prior to and during the testing to ensure that they remained in place for the duration. The testing was arranged to (a) undertake depressurisation testing first (which had a much lower risk of causing temporary sealing to fail) and (b) to incrementally increase the applied pressure during the second, pressurisation, test to avoid sudden shocks that might cause the temporary sealing to fail.

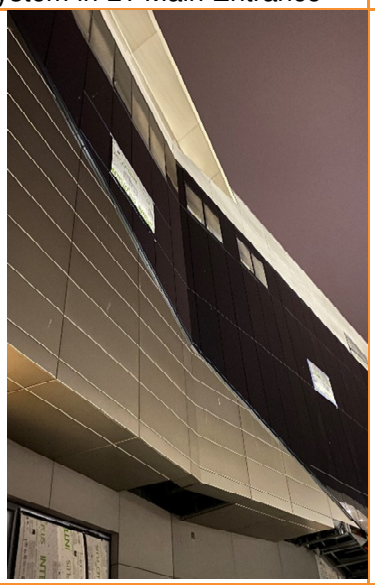
APPENDIX I - Set-up images

Site Address: St Sidwell's Point,
Paris Street, Exeter, Devon EX1 2JB

AI.1 – Test equipment

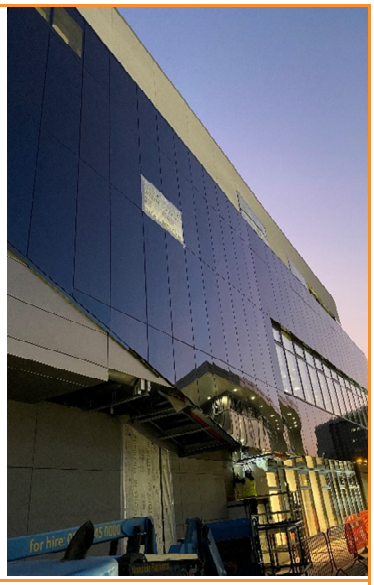
A1.1) Internal view of test equipment mounted in bag door system in L1 Main Entrance

A1.2) External view of test equipment mounted in bag door system in L1 Main Entrance



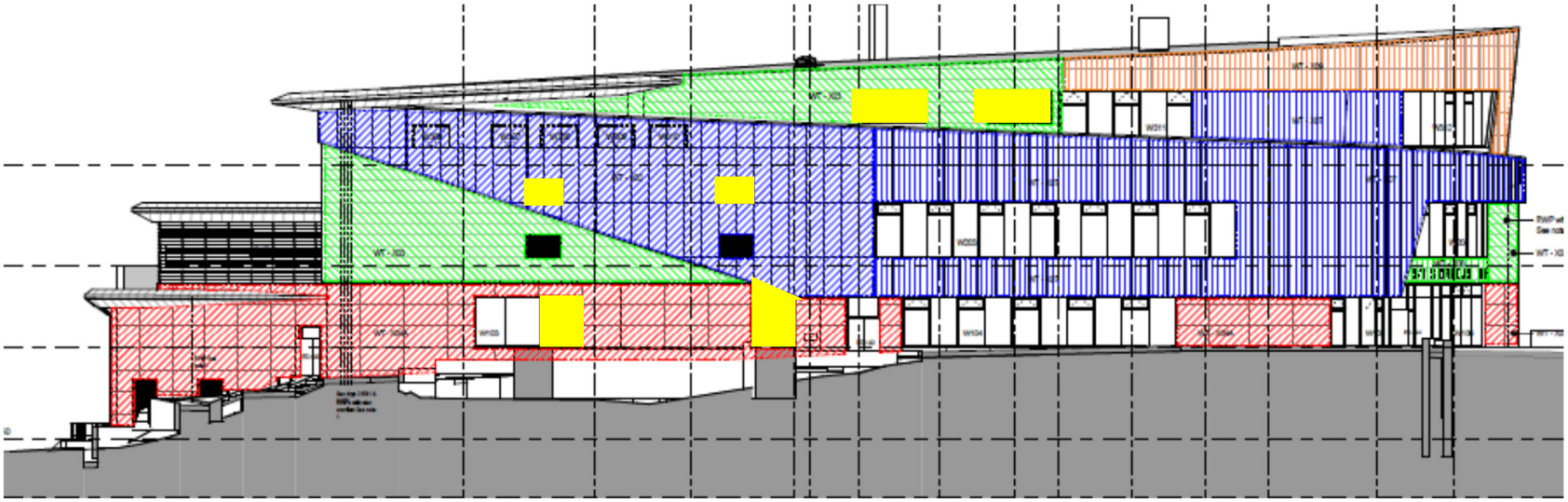
A1.3) External view of temporary sealing over ventilation grilles

A1.4) External view of temporary sealing over ventilation grilles from L2 roof

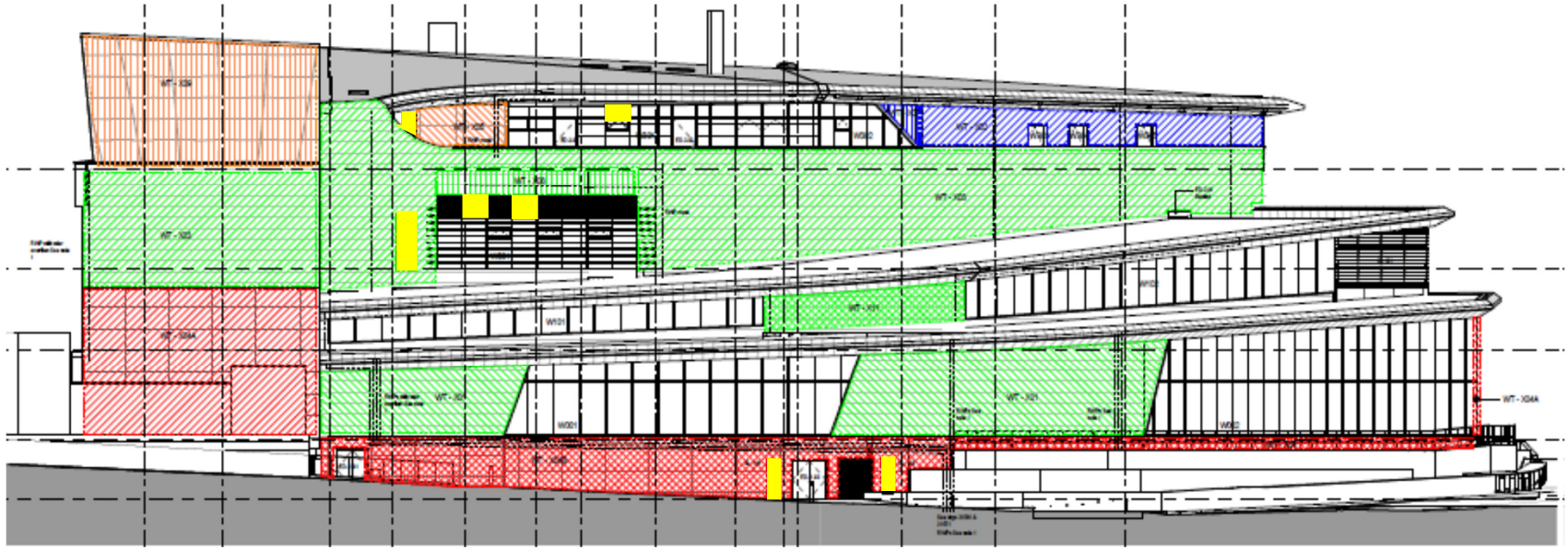
	
A1.5) External view of temporary sealing over ventilation grilles	A1.6) External view of temporary sealing over ventilation grilles
	
A1.7) L0 Wall section, formerly used for access, where permanent sealing (Wraptite) complete but cladding not yet installed	A1.8) Verification that roof access hatch was shut for the duration of acceptance testing

AI.2 – Temporary Sealing

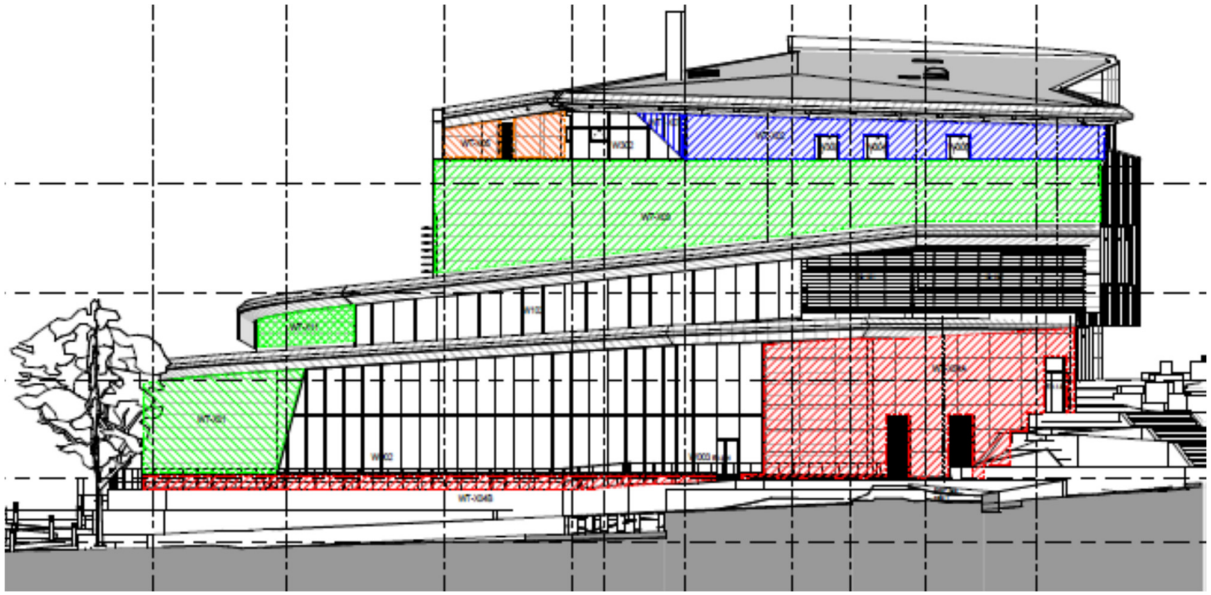
The four elevations, below and on the following pages, detail the external temporary sealing to the numerous ventilation grilles in the external façade at the time of the acceptance airtightness testing. These are marked in yellow, verified by Steve Booth of Kier.Construction. Because many of the waste pipes from showers in the changing rooms at St. Sidwell's are not fitted with individual traps, and are therefore not sealed during the acceptance test by water in the trap, additional temporary sealing was carried out to eliminate residual leakage via these routes.



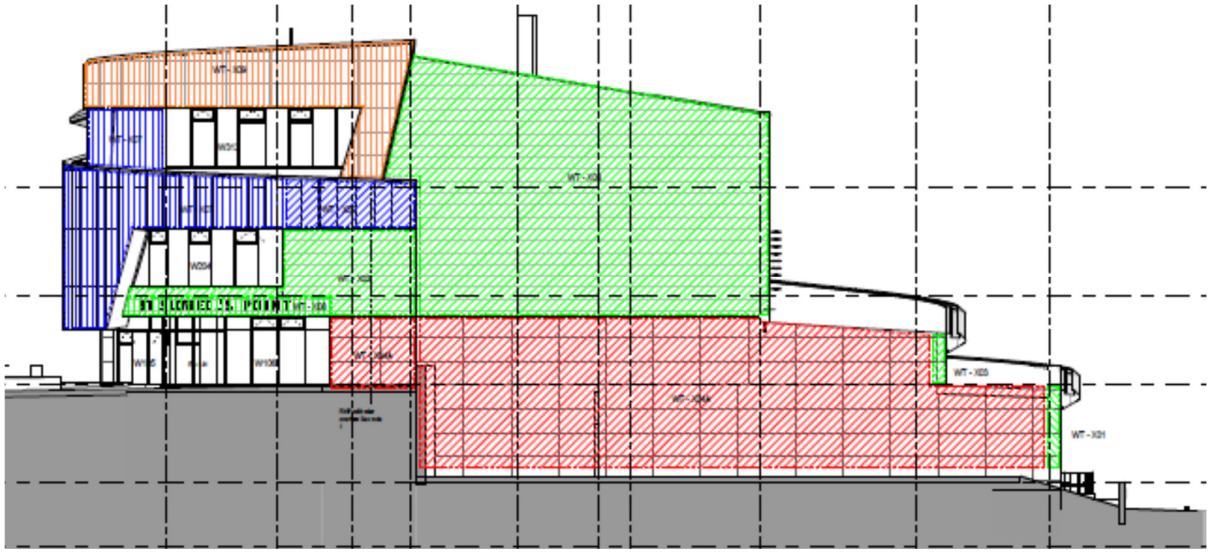
North Elevation – temporary sealing of external louvres to continuously running ventilation systems



South Elevation – temporary sealing of external louvres to continuously running ventilation systems



East Elevation – no temporary sealing to grilles



West Elevation – no temporary sealing to grilles

APPENDIX II – Negative Pressure Differential vs Airflow Data Set

Site Address: St Sidwells' Point
Paris Street, Exeter, Devon EX1 2JB

Date:	**17th December 2021**	Time:		**19:44**	to	**20:05**	
Environmental Conditions:							
Barometric Pressure:		**103.4**	**kPa**	Wind speed:		**0.5**	**m/s**
Temperatures, initial:	Indoors:	**18.6**	**°C**	Outdoors:		**8.3**	**°C**
Temperatures, final:	Indoors:	**19.3**	**°C**	Outdoors:		**7.8**	**°C**

Test Data:

At least **10** static pressures taken for **10** secs each.
A minimum of **10** induced pressures taken for >**20** sec each.

Existing Pressure Differentials (Static pressure):

Baseline, initial [Pa]	**-1.4**	**-1.8**	**-1.8**	**-1.6**	**-3.8**	**-2.2**	**-1.7**	**-1.4**	**-1.2**	**-1.1**
Baseline, final[Pa]	**-1.0**	**-0.9**	**-0.8**	**-1.7**	**-2.0**	**-1.7**	**-1.2**	**-1.0**	**-0.9**	**-1.0**

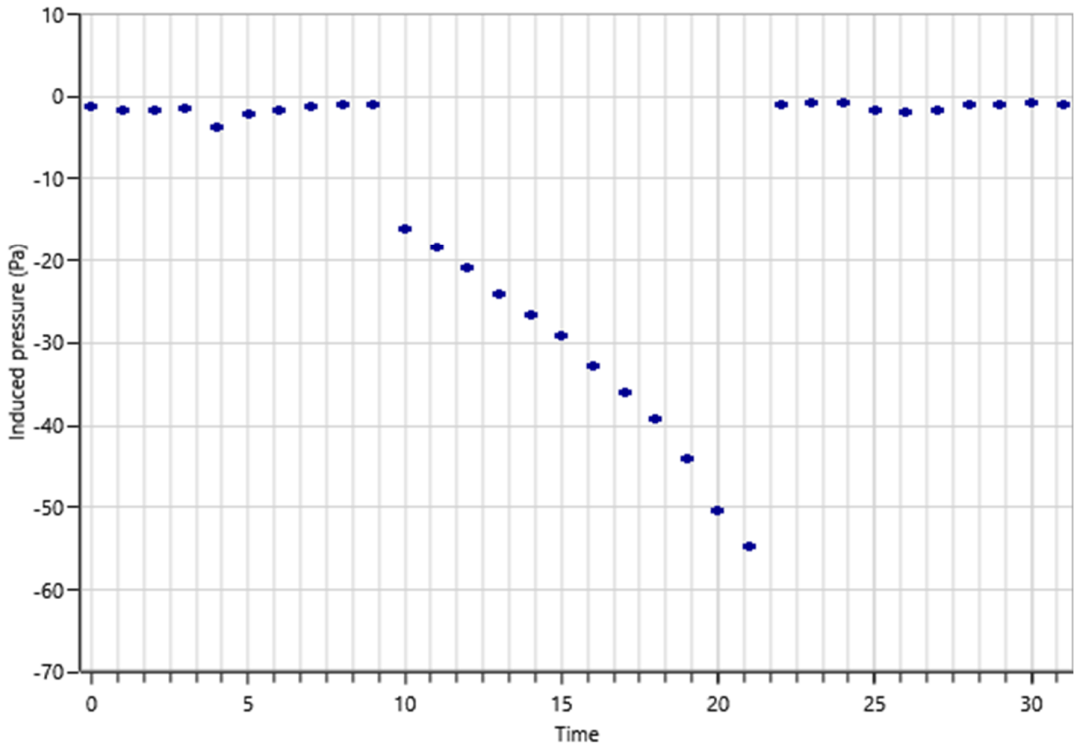
Static Pressure Averages:	**initial [Pa]**	ΔP_{01}	**-1.80**	$\Delta P_{01\text{-ve}}$	**-1.80**	ΔP_{01+ve}	**0.00**
	final[Pa]	ΔP_{02}	**-1.22**	$\Delta P_{02\text{-ve}}$	**-1.22**	ΔP_{02+ve}	**0.00**

Results:

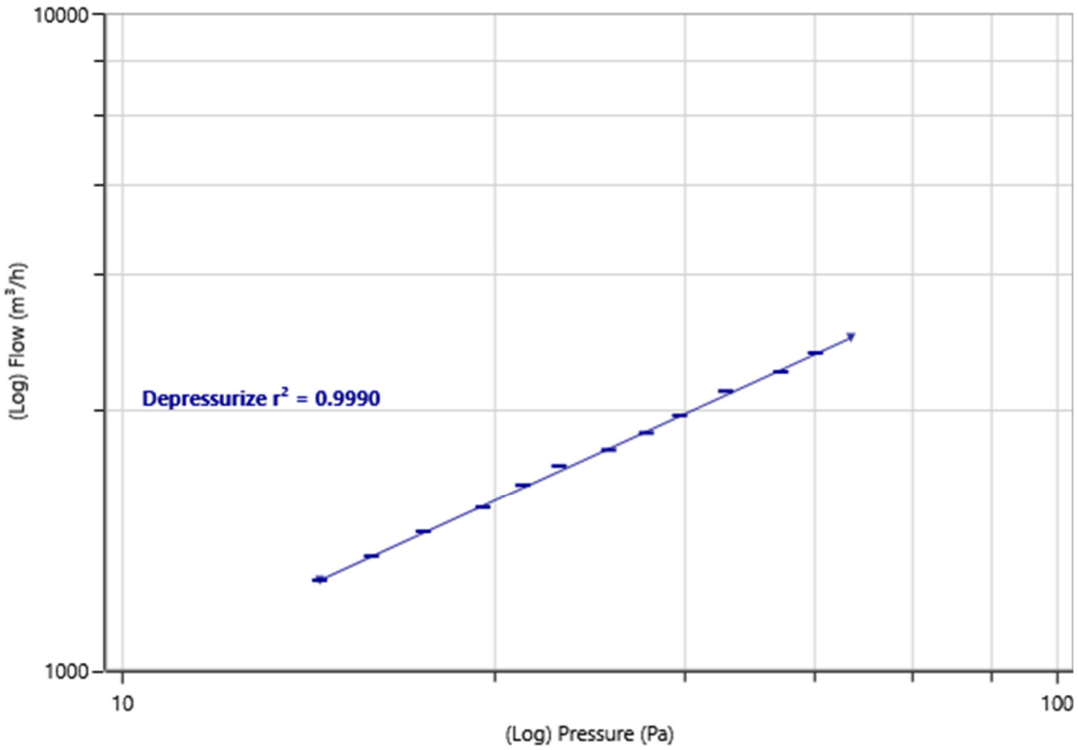
All results are compared to the standards set in Building Regulations 'Approved Document L1A – Conservation of fuel and power in new dwellings (2010)'. Results are calculated using the formulae set out in ATTMA TSL1 (Appendix A). Readings collected are detailed below:

Reading	1	2	3	4	5	6	7	8	9	10	11	12
Induced Pressure [Pa]	**-17.7**	**-19.9**	**-22.4**	**-25.7**	**-28.2**	**-30.7**	**-34.5**	**-37.7**	**-40.8**	**-45.5**	**-51.9**	**-56.4**
Total flow, Q_r [m^3/h]	**1466.0**	**1594.6**	**1738.7**	**1893.2**	**2049.1**	**2192.1**	**2317.5**	**2459.0**	**2613.2**	**2844.5**	**3044.1**	**3249.0**
Corrected flow, Q_{env} [m^3/h]	**1374.8**	**1495.4**	**1630.5**	**1775.4**	**1921.6**	**2055.7**	**2173.2**	**2305.9**	**2450.5**	**2667.4**	**2854.6**	**3046.7**
Error [%]	**-0.3%**	**-0.2%**	**0.2%**	**-0.8%**	**0.7%**	**1.7%**	**-0.7%**	**-0.8%**	**0.0%**	**1.1%**	**-0.9%**	**0.0%**

G1: Graph of imposed pressure differentials, Depressurisation, St Sidwell's Point:



G2: Graph of imposed pressure differential against airflow, Depressurisation, St Sidwell's Point:



Depressurisation Test Results – St Sidwell's Point Paris Street, Exeter, Devon EX1 2JB						
	Results				Results	Uncertainty
Correlation, r^2	**0.999**	95% confidence limits		Air flow at 50 Pa, Q_{50} [m^3/h]	**2932.0**	**+/-0.9%**
Intercept, C_{env} [$m^3/h.Pa^n$]	**226.5**	**215.4**	**238.2**	Permeability at 50 Pa, AP_{50} [$m^3/h.m^2$]	**0.30**	**+/-1.0%**
Slope, n	**0.65**	**0.63**	**0.66**	Equivalent leakage area at 50 Pa [cm^2]	**756.9**	**+/-0.9%**
				Air changes, n_{50}	**0.10**	**+/-1.0%**

APPENDIX III - Positive Pressure Differential vs Airflow Data Set

Site Address: St Sidwell's Point
Paris Street, Exeter, Devon EX1 2JB

Date:	**17th December 2021**	Time:	**20:12**	to	**20:51**	
Environmental Conditions:						
Barometric Pressure:		**103.4**	**kPa**	Wind speed:	**0.5**	**m/s**
Temperatures, initial:	Indoors:	**19.3**	**°C**	Outdoors:	**7.8**	**°C**
Temperatures, final:	Indoors:	**19.8**	**°C**	Outdoors:	**8.7**	**°C**

Test Data:

At least **10** static pressures taken for **10** secs each.
A minimum of **10** induced pressures taken for >**20** sec each.

Existing Pressure Differentials (Static pressure):

Baseline, initial [Pa]	**-1.0**	**-0.9**	**-0.8**	**-1.7**	**-2.0**	**-1.7**	**-1.2**	**-1.0**	**-0.9**	**-1.0**
Baseline, final[Pa]	**1.2**	**0.9**	**0.6**	**0.0**	**0.2**	**0.1**	**0.2**	**0.8**	**0.0**	**-0.1**

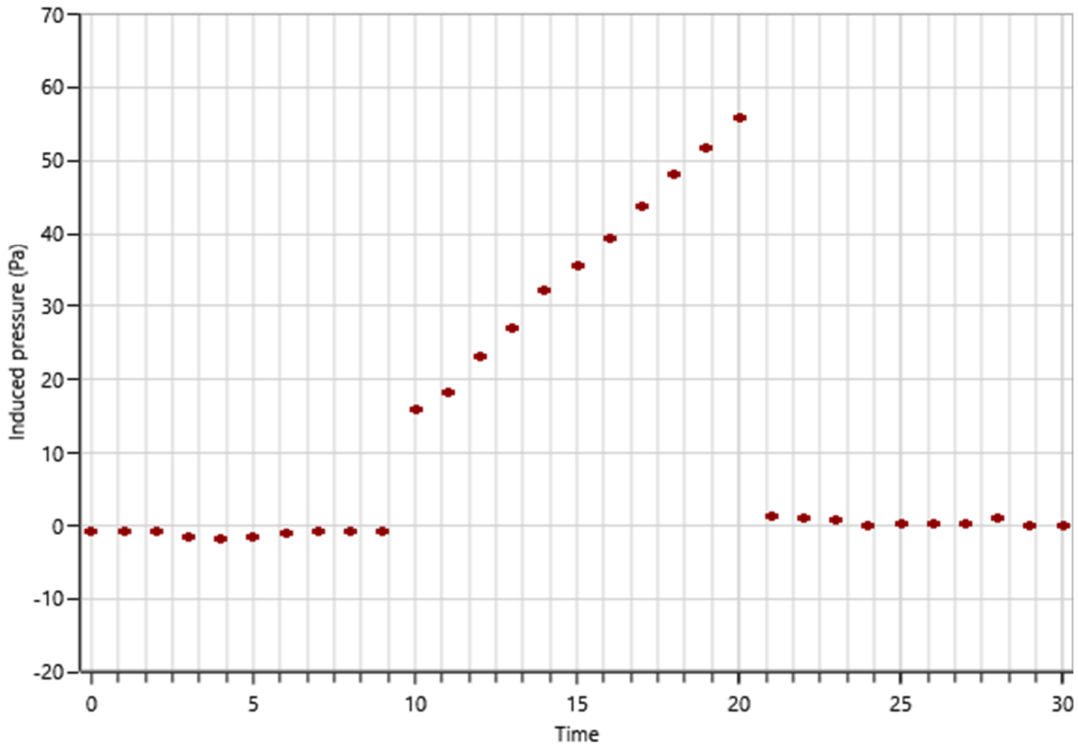
Static Pressure Averages:	**initial [Pa]**	ΔP_{01}	**-1.22**	$\Delta P_{01\text{-ve}}$	**-1.22**	ΔP_{01+ve}	**0.00**
	final[Pa]	ΔP_{02}	**0.39**	$\Delta P_{02\text{-ve}}$	**-0.10**	ΔP_{02+ve}	**0.44**

Results:

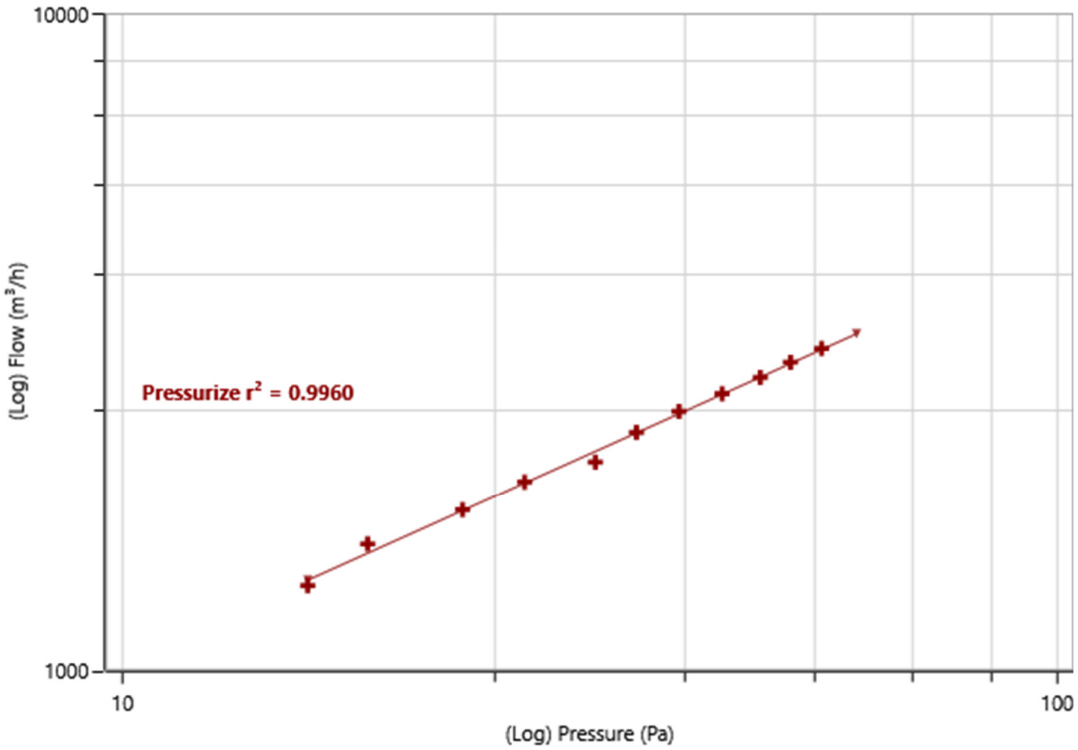
All results are compared to the standards set in Building Regulations 'Approved Document L2A – Conservation of fuel and power in new buildings other than dwellings (2010)'. Results are calculated using the formulae set out in ATTMA TSL2 (Appendix A). Readings collected are detailed below:

Reading	1	2	3	4	5	6	7	8	9	10	11
Induced Pressure [Pa]	**15.3**	**17.8**	**22.6**	**26.4**	**31.5**	**34.9**	**38.8**	**43.2**	**47.5**	**51.2**	**55.3**
Total flow, Q_r [m^3/h]	**1384.1**	**1600.6**	**1804.4**	**1992.0**	**2135.4**	**2369.0**	**2549.0**	**2710.9**	**2869.7**	**3025.8**	**3174.1**
Corrected flow, Q_{env} [m^3/h]	**1353.9**	**1565.7**	**1765.1**	**1948.6**	**2088.9**	**2317.5**	**2493.5**	**2651.9**	**2807.2**	**2960.0**	**3105.0**
Error [%]	**-1.9%**	**3.2%**	**0.3%**	**0.4%**	**-3.7%**	**0.2%**	**0.8%**	**0.2%**	**-0.1%**	**0.4%**	**0.3%**

G3: Graph of imposed pressure differentials, Pressurisation, St Sidwell's Point:



G4: Graph of imposed pressure differential against airflow, Pressurisation, St Sidwell's Point:



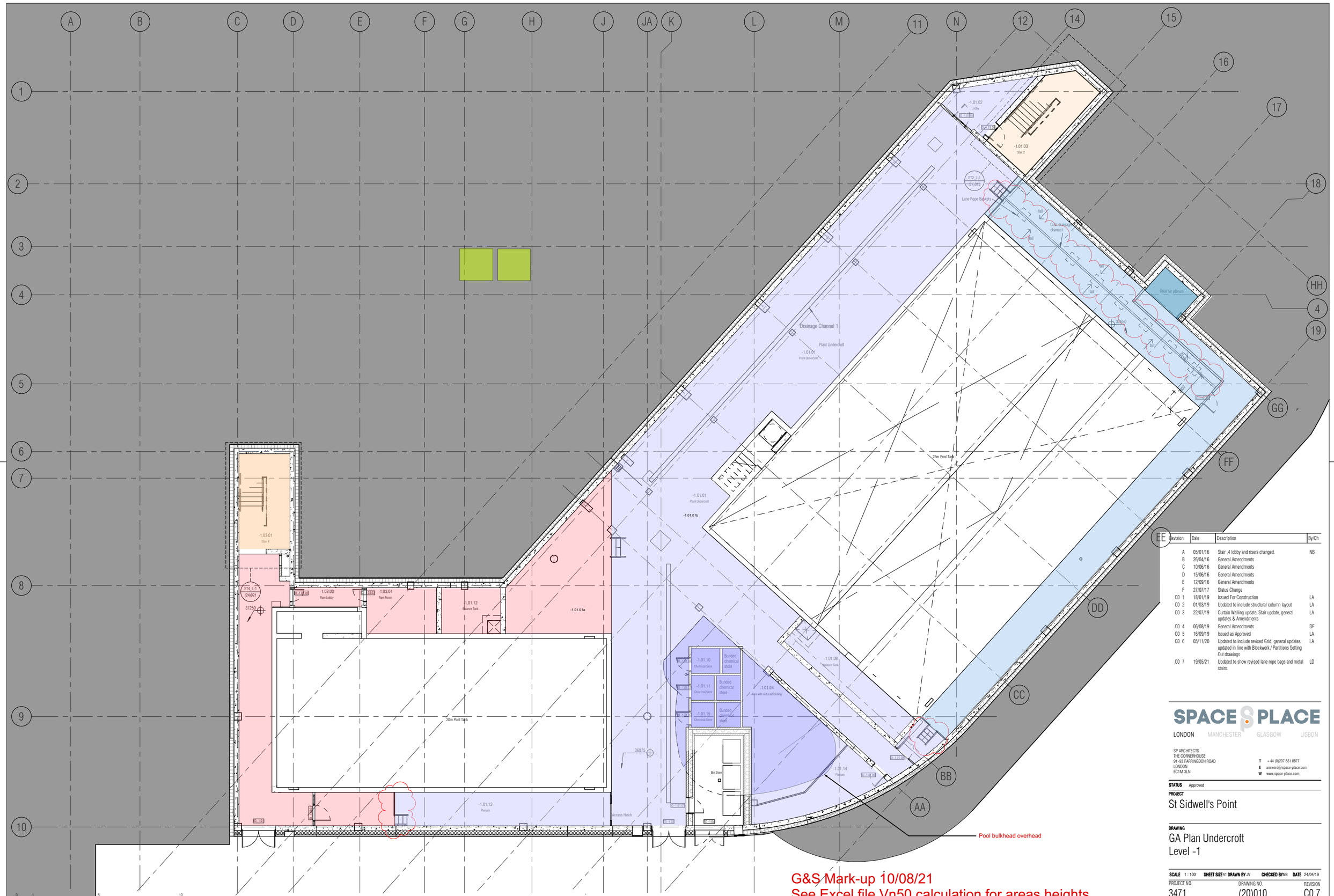
Pressurisation Test Results – St Sidwell's Point Paris Street, Exeter, Devon EX1 2JB						
	Results				Results	Uncertainty
Correlation, r^2	**0.996**	95% confidence limits		Air flow at 50 Pa, Q_{50} [m^3/h]	**2911**	**+/-1.8%**
Intercept, C_{env} [$m^3/h.Pa^n$]	**238.1**	**214.0**	**264.9**	Permeability at 50 Pa, AP_{50} [$m^3/h.m^2$]	**0.30**	**+/-1.8%**
Slope, n	**0.64**	**0.61**	**0.67**	Equivalent leakage area at 50 Pa [cm^2]	**788.4**	**+/-1.8%**
				Air changes, n_{50}	**0.10**	**+/-1.8%**

APPENDIX IV- Dimensioned drawings & envelope and volume calculations

SSP Ceiling Height Reference Sheets (5 pages)

SSP Envelope Area and Volume Model & Calculation Spreadsheet (8 pages)

SSP Ceiling Height Reference Sheets (5 pages)



G&S Mark-up 10/08/21
See Excel file Vn50 calculation for areas heights

Revision	Date	Description	By/Ch
A	05/01/16	Stair .4 lobby and risers changed.	NB
B	26/04/16	General Amendments	
C	10/06/16	General Amendments	
D	15/06/16	General Amendments	
E	12/09/16	General Amendments	
F	27/07/17	Status Change	
C0 1	18/01/19	Issued For Construction	LA
C0 2	01/03/19	Updated to include structural column layout	LA
C0 3	22/07/19	Curtain Walling update. Stair update, general updates & Amendments	LA
C0 4	06/08/19	General Amendments	DF
C0 5	16/09/19	Issued as Approved	LA
C0 6	05/11/20	Updated to include revised Grid, general updates, updated in line with Blockwork / Partitions Setting Out drawings	LA
C0 7	19/05/21	Updated to show revised lane rope bags and metal stairs.	LD

SPACE PLACE
LONDON MANCHESTER GLASGOW LISBON

SP ARCHITECTS
THE CORNERHOUSE
91-93 FARRINGDON ROAD
LONDON
EC1M 3LN

T +44 (0)207 831 8877
E answers@space-place.com
W www.space-place.com

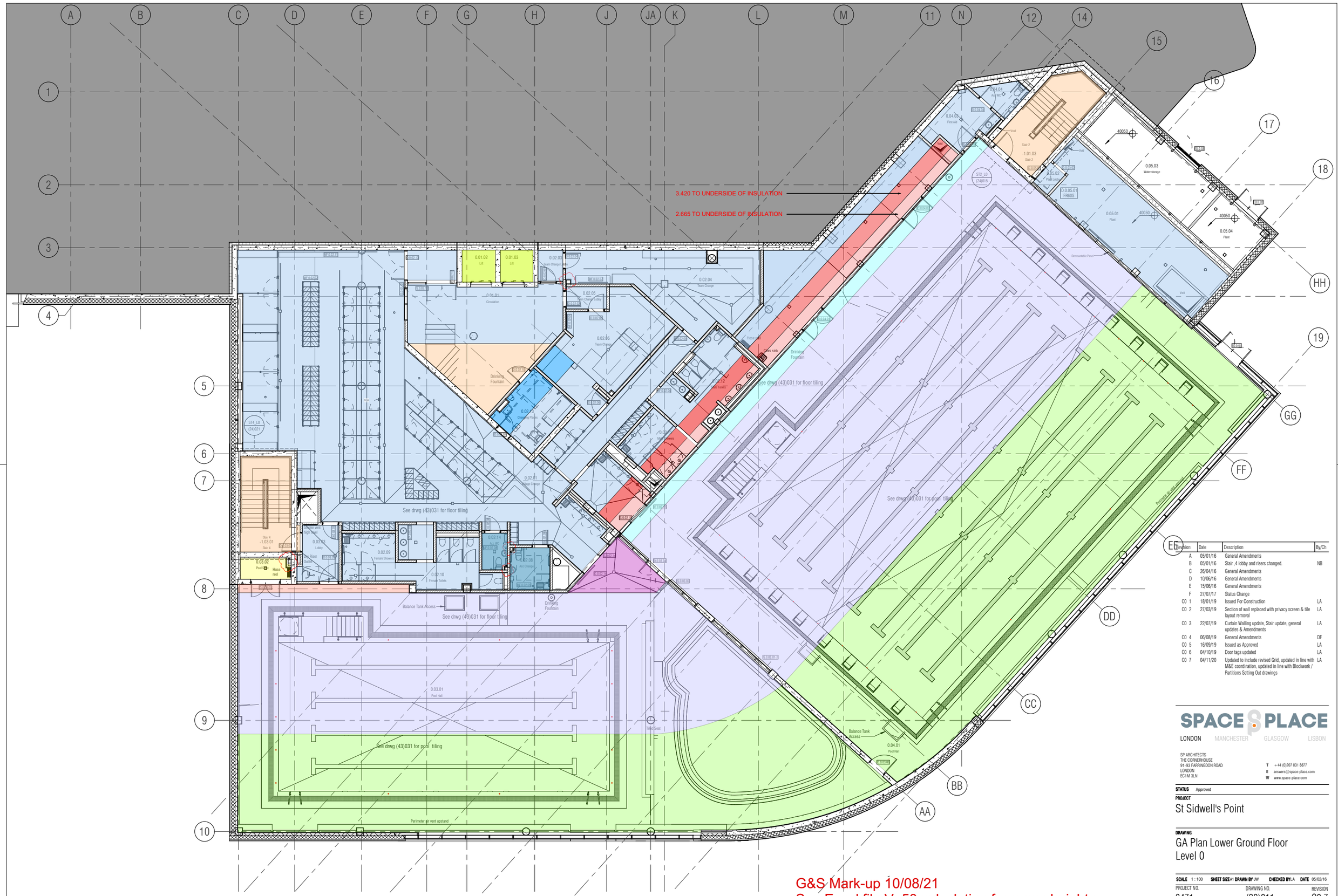
STATUS Approved

PROJECT
St Sidwell's Point

DRAWING
GA Plan Undercroft
Level -1

SCALE 1 : 100 **SHEET SIZE** A1 **DRAWN BY** JV **CHECKED BY** NB **DATE** 24/04/19

PROJECT NO. 3471 | DRAWING NO. (20)010 | REVISION C0 7



Revision	Date	Description	By/Ch
A	05/01/16	General Amendments	
B	05/01/16	Stair ,4 lobby and risers changed.	NB
C	26/04/16	General Amendments	
D	10/06/16	General Amendments	
E	15/06/16	General Amendments	
F	27/07/17	Status Change	
C0 1	18/01/19	Issued For Construction	LA
C0 2	27/03/19	Section of wall replaced with privacy screen & tile layout removal	LA
C0 3	22/07/19	Curtain Walling update, Stair update, general updates & Amendments	LA
C0 4	06/08/19	General Amendments	DF
C0 5	16/09/19	Issued as Approved	LA
C0 6	04/10/19	Door tags updated	LA
C0 7	04/11/20	Updated to include revised Grid, updated in line with M&E coordination, updated in line with Blockwork / Partitions Setting Out drawings	LA

G&S Mark-up 10/08/21
See Excel file Vn50 calculation for areas heights

0 1 5 10
Scale in Meters

SPACE PLACE
LONDON MANCHESTER GLASGOW LISBON
SP ARCHITECTS
THE CORNERHOUSE
91-93 FARRINGDON ROAD
LONDON
EC1M 3LN
T +44 (0)207 831 8877
E answers@space-place.com
W www.space-place.com

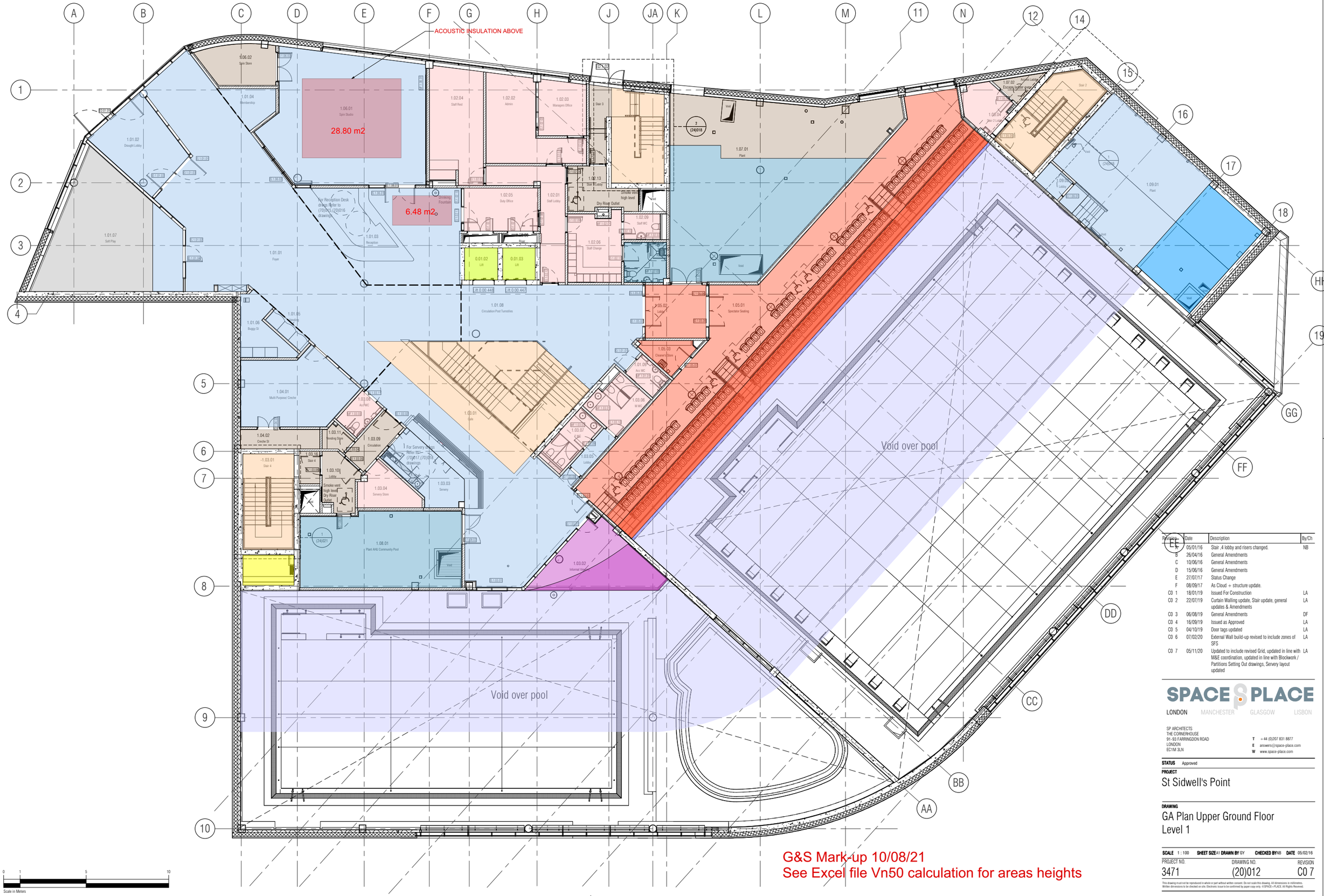
STATUS Approved

PROJECT
St Sidwell's Point

DRAWING
GA Plan Lower Ground Floor
Level 0

SCALE 1 : 100 **SHEET SIZE** A1 **DRAWN BY** JW **CHECKED BY** LA **DATE** 05/02/16

PROJECT NO. 3471 | DRAWING NO. (20)011 | REVISION C0 7



Revision	Date	Description	By/Ch
	05/01/16	Stair ,4 lobby and risers changed.	NB
B	26/04/16	General Amendments	
C	10/06/16	General Amendments	
D	15/06/16	General Amendments	
E	27/07/17	Status Change	
F	08/09/17	As Cloud + structure update.	
C0 1	18/01/19	Issued For Construction	LA
C0 2	22/07/19	Curtain Walling update, Stair update, general updates & Amendments	LA
C0 3	06/08/19	General Amendments	DF
C0 4	16/09/19	Issued as Approved	LA
C0 5	04/10/19	Door tags updated	LA
C0 6	07/02/20	External Wall build-up revised to include zones of SFS	LA
C0 7	05/11/20	Updated to include revised Grid, updated in line with M&E coordination, updated in line with Blockwork / Partitions Setting Out drawings, Servery layout updated	LA

SPACE PLACE
LONDON MANCHESTER GLASGOW LISBON

SP ARCHITECTS
THE CORNERHOUSE
91-93 FARRINGDON ROAD
LONDON
EC1M 3LN

T +44 (0)207 831 8877
E answers@space-place.com
W www.space-place.com

STATUS Approved

PROJECT
St Sidwell's Point

DRAWING
GA Plan Upper Ground Floor
Level 1

SCALE 1 : 100 **SHEET SIZE** A1 **DRAWN BY** GY **CHECKED BY** NB **DATE** 05/02/16

PROJECT NO. 3471 | DRAWING NO. (20)012 | REVISION C0 7

STEP IN FLOOR SLAB ABOVE

STEP IN FLOOR SLAB ABOVE

34.5 m2

30.378 m2

20.64 m2

25.562 m2

21.340 m2

16.139 m2

7.8 m2

6.576 m2

9.6 m2

1.8 m2

7.506 m2

2.01.06a

2.01.06b

2.01.06d

2.01.01 General Circulation

2.01.02 Lift

2.01.03 Lift

2.01.03 Bar Fridge

2.03.01 F Change Lobby

2.03.02 F Fitness Change

2.03.03 F Change Toilets

2.03.04 F Fitness Showers

2.01.04 Acc Change

2.04.01 M Change Lobby

2.04.02 M Fitness Change

2.04.03 M Change Toilets

2.02.04 Cleaner's Store 4.4 m²

2.06.01 Hydro Plant

2.05.01 Plant

2.05.02 External stair

2.05.03 Accessible Lobby

2.02.16 Stair 4 Lobby

-1.03.01 Stair 4

Void

Void over 25m pool

Weight Area

Fire service access only

Smoke vent

Dry Riser Outlet

Drinking Fountain

Maintenance access to roof

1:40

1:20

Scale in Meters 0 1 5 10

G&S Mark-up 10/08/21
See Excel file Vn50 calculation for areas heights

Revision	Date	Description	By/Ch
A	05/01/16	General Amendments	
B	05/01/16	Stair ,4 lobby and risers changed.	NB
C	26/04/16	General Amendments	
D	10/06/16	General Amendments	
E	15/06/16	General Amendments	
F	27/07/17	Status Change	
C0 1	27/03/19	Wall and door update, tile layout removal & general amendments	LA
C0 2	22/07/19	Curtain Walling update, Stair update, general updates & Amendments	LA
C0 3	06/08/19	General Amendments	DF
C0 4	16/09/19	Issued as Approved	LA
C0 5	04/10/19	Door tags updated	LA
C0 6	07/02/20	External Wall build-up revised to include zones of SFS	LA
C0 7	05/11/20	Updated to include revised Grid, updated in line with M&E coordination, updated in line with Blockwork / Partitions Setting Out drawings. hydroplant/cleaners store amended to create 2 spaces	LA
C0 8	23/03/21	Updated to accommodate the raised access floor and ramps.	LD

SPACE PLACE
LONDON MANCHESTER GLASGOW LISBON

SP ARCHITECTS
THE CORNERHOUSE
91-93 FARRINGDON ROAD
LONDON
EC1M 3LN

T +44 (0)207 831 8877
E answers@space-place.com
W www.space-place.com

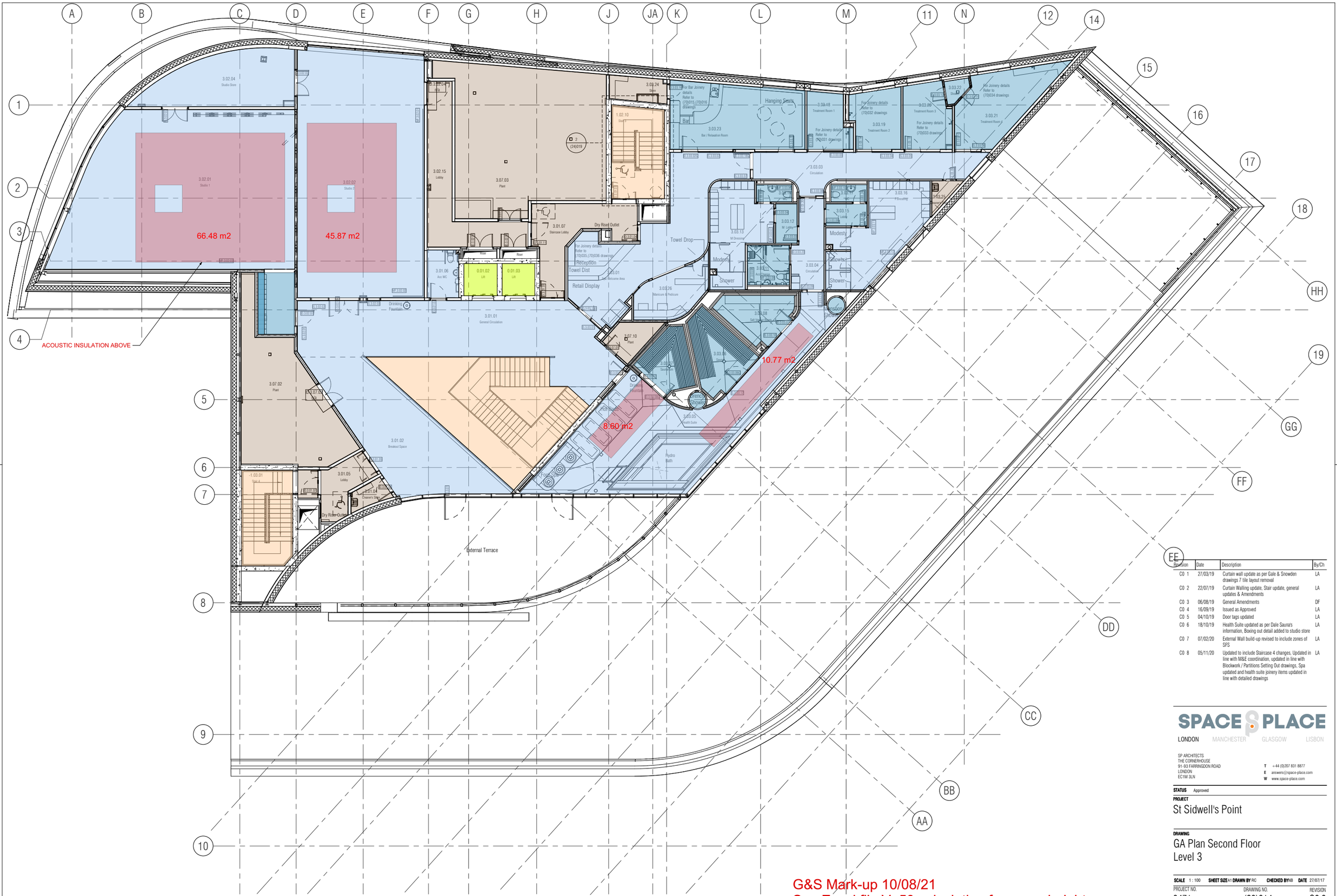
STATUS Approved

PROJECT
St Sidwell's Point

DRAWING
GA Plan First Floor
Level 2

SCALE 1 : 100 **SHEET SIZE** A1 **DRAWN BY** GY **CHECKED BY** NB **DATE** 05/02/16

PROJECT NO. 3471 | DRAWING NO. (20)013 | REVISION C0 8



G&S Mark-up 10/08/21
See Excel file Vn50 calculation for areas heights

Revision	Date	Description	By/Ch
C0 1	27/03/19	Curtain wall update as per Gale & Snowden drawings 7 tile layout removal	LA
C0 2	22/07/19	Curtain Walling update, Stair update, general updates & Amendments	LA
C0 3	06/08/19	General Amendments	DF
C0 4	16/09/19	Issued as Approved	LA
C0 5	04/10/19	Door tags updated	LA
C0 6	18/10/19	Health Suite updated as per Dale Sauna's information, Boxing out detail added to studio store	LA
C0 7	07/02/20	External Wall build-up revised to include zones of SFS	LA
C0 8	05/11/20	Updated to include Staircase 4 changes, Updated in line with M&E coordination, updated in line with Blockwork / Partitions Setting Out drawings, Spa updated and health suite joinery items updated in line with detailed drawings	LA

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EC1M 3LN

T +44 (0)207 831 8877
E answers@space-place.com
W www.space-place.com

STATUS Approved

PROJECT
St Sidwell's Point

DRAWING
GA Plan Second Floor
Level 3

SCALE 1 : 100 **SHEET SIZE** A1 **DRAWN BY** RC **CHECKED BY** NB **DATE** 27/07/17

PROJECT NO. 3471 | DRAWING NO. (20)014 | REVISION C0 8

SSP Envelope Area and Volume Model & Calculation Spreadsheet (8 pages)

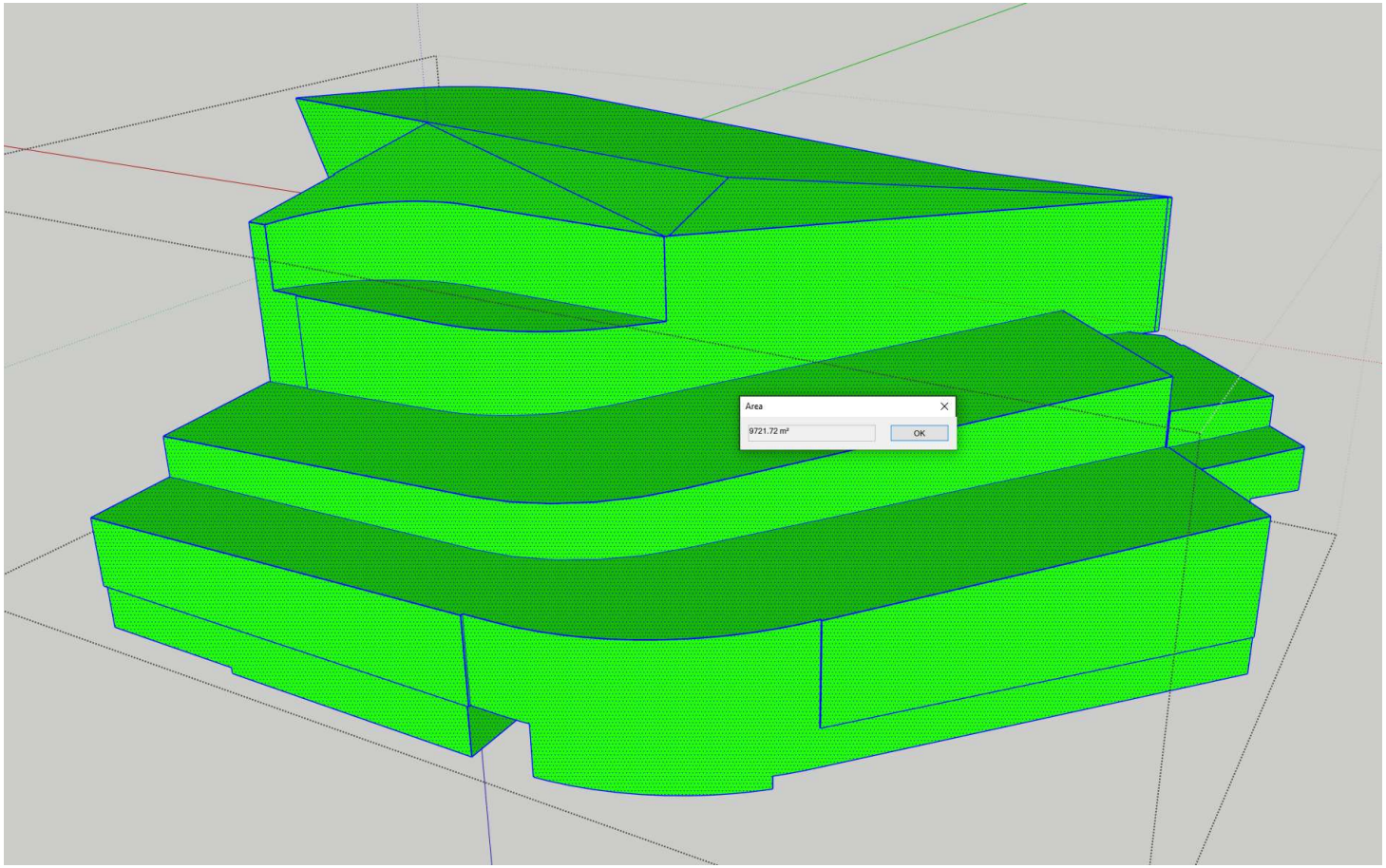
Project No.	E1901				
Project Name	St Sidwells Point				
Client	Kier				
Schedule Reference	EXA-GSA-ZZ-ZZ-A2-0001			Author	AS
Schedule Name	Envelope Area and Vn50 Calculations			Checked	GB
Issue	01			Date	17/09/2021

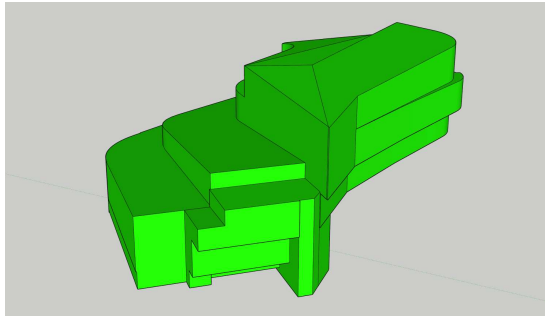
GALE & SNOWDEN

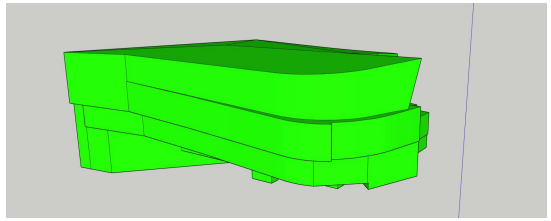
Envelope Area Calculation

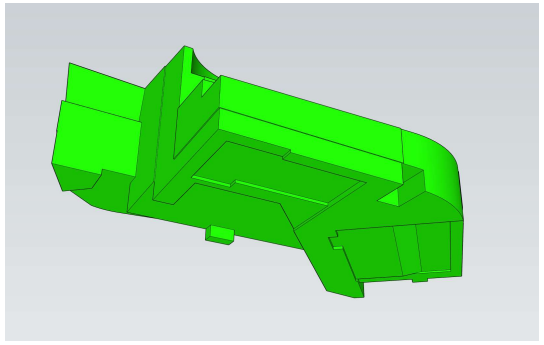
Total Envelope Area **9721.72 m2**

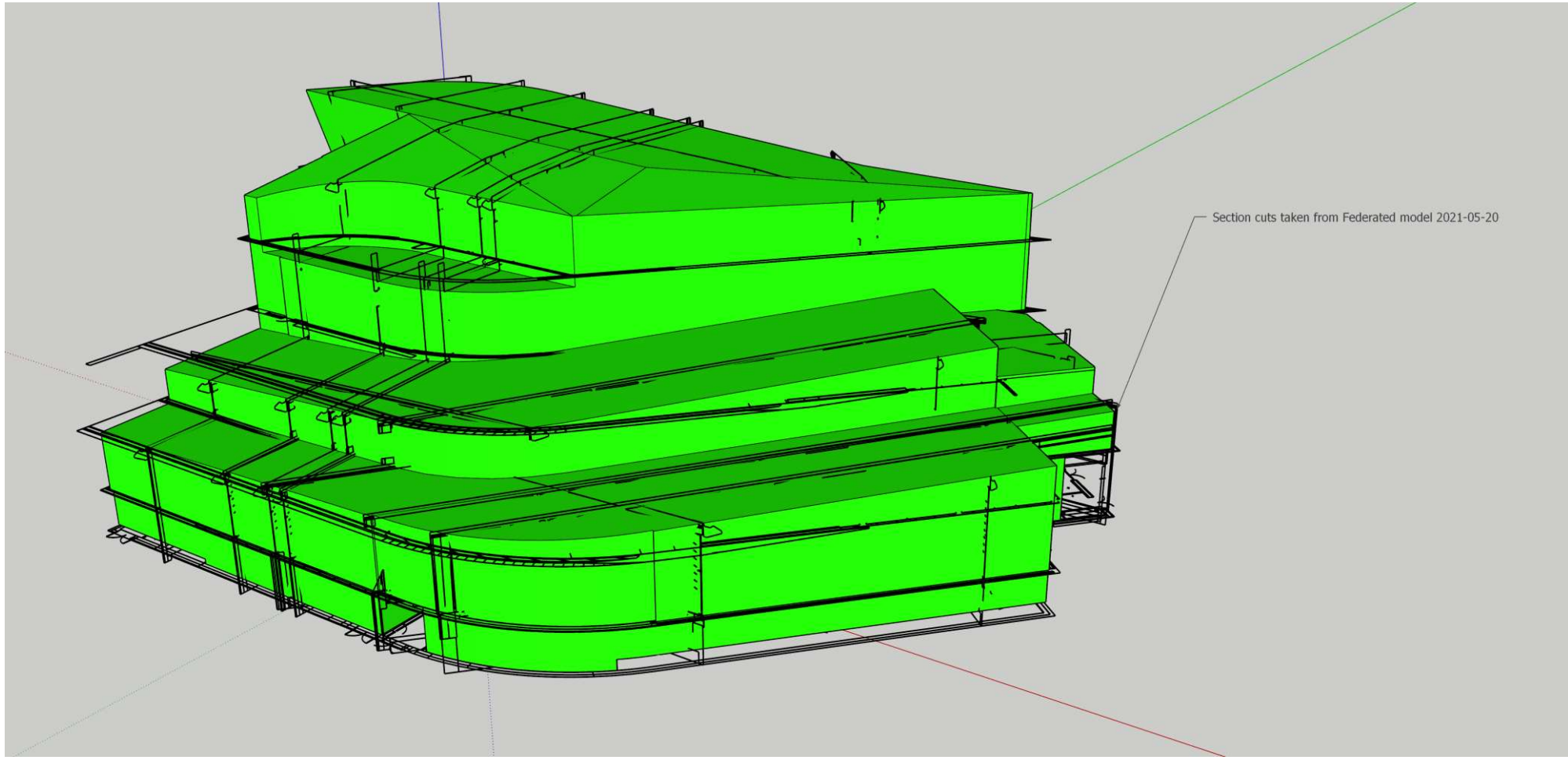
The following images are taken from our Sketchup model of the envelope area. Please refer to this model for the detailed area calculations.










Section cuts taken from Federated model 2021-05-20

Vn50 Calculation

Refer to GSA mark-ups for height references (colour co-ordinated)

Level -1 **FFL** **36.875**

Room No.	Space	-	Base Area (m²)	Clear Height	Vn50	Height reference
-1.01.01a	Plant Undercroft: Raised Floor		41.06	2.34	96.08	FFL to underside of concrete floor slab
-1.01.01b	Plant Undercroft: Lower Floor		316.42	2.73	862.25	FFL to underside of concrete floor slab
-1.01.02	Lobby		10.06	2.73	27.41	FFL to underside of concrete floor slab
-1.01.03	Stair core 2		20.89	3.18	66.33	FFL to FFL (floor above)
-1.01.04	Area with Reduced Ceiling		27.10	2.45	66.40	FFL to underside of concrete (average height)
-1.01.08	Balance Tank		16.08	2.34	37.63	FFL to underside of concrete
-1.01.09	Plenum (Main Pool)		109.60	1.95	213.72	FFL to underside of concrete
-1.01.09	Plenum (open riser)		4.97	2.40	11.93	FFL to FFL (floor above)
-1.01.10	Chemical Store 1		4.29	2.45	10.51	FFL to underside of concrete (average height)
-1.01.11	Chemical Store 2		4.29	2.45	10.51	FFL to underside of concrete (average height)
-1.01.12	Balance Tank		10.07	2.34	23.56	FFL to underside of concrete
-1.01.12	Chemical Store 3		4.29	2.45	10.51	FFL to underside of concrete (average height)
-1.01.13	Plenum (Learner Pool), Upper level		13.93	2.34	32.60	FFL to underside of concrete
-1.01.13	Plenum (Learner Pool), low level		26.62	2.73	72.54	FFL to underside of concrete
-1.01.14	Plenum (Toddler Pool)		17.43	2.73	47.50	FFL to underside of concrete
-1.03.01	Stair core 4		17.98	3.18	393.81	FFL to FFL (floor above)
	Plenum (Learner Pool)		40.44	2.34	94.62	FFL to underside of concrete
-1.03.03	Ram Lobby		4.77	2.34	11.16	FFL to underside of concrete
-1.03.04	Ram Room		11.90	2.34	27.85	FFL to underside of concrete
0.01.02	Lift Shaft		4.95	3.18	15.72	FFL to FFL (floor above)
0.01.03	Lift Shaft		4.95	3.18	15.72	FFL to FFL (floor above)
		Net FA (m²)	**712.10**	**Vn50 (m3)**	**2148.36**	

Level 0 **FFL** **40.050**

Room No.	Space	-	Base Area (m²)	Clear Height	Vn50	Height reference
0.01.01	Circulation: Base of Stairwell 1		32.90	4.51	148.37	FFL to underside of insulation (perforated /open ceiling)
0.01.01	Stair 1 Core		18.42	4.95	91.16	FFL to FFL (floor above)
0.01.01	Circulation: Stairwell Lobby to Village Change		5.32	4.51	23.98	FFL to underside of insulation (perforated /open ceiling)
0.01.02	Lift Shaft		3.89	4.95	19.27	FFL to FFL (floor above)
0.01.03	Lift Shaft		3.82	4.95	18.91	FFL to FFL (floor above)
-1.01.03	Stair 2 Core		20.89	4.95	103.42	FFL to FFL (floor above)
0.02.01	Village Change		221.33	4.51	998.20	FFL to underside of insulation (perforated /open ceiling)
0.02.03	Team Change Lobby		2.75	4.51	12.42	FFL to underside of insulation (perforated /open ceiling)
0.02.04	Team Change		39.14	4.51	176.52	FFL to underside of insulation (perforated /open ceiling)
0.02.05	Team Change Lobby		3.20	4.51	14.45	FFL to underside of insulation (perforated /open ceiling)
0.02.06/07	Team Change & Team Change Lobby		29.87	4.51	134.71	FFL to underside of insulation (perforated /open ceiling)
0.02.06/07	Team Change Lobby (under stair slope)		2.67	4.95	13.22	FFL to FFL (floor above)

0.02.08	Accessible Change	6.00	2.40	14.40	FFL to ceiling
0.02.09/10	Female Showers & Toilets	21.94	4.51	98.95	FFL to underside of insulation (perforated /open ceiling)
0.02.09a	Female Shower lobby	4.43	4.51	19.98	FFL to underside of insulation (perforated /open ceiling)
	Corridor between Male showers and Team change	21.95	4.51	98.99	FFL to underside of insulation (perforated /open ceiling)
0.02.11	Male Showers	6.17	4.51	27.83	FFL to underside of insulation (perforated /open ceiling)
0.02.11	Male Showers	2.72	3.42	9.30	FFL to underside of insulation to stepped slab above (perforated /open ceiling)
0.02.11	Male Showers	1.62	2.67	4.32	FFL to underside of insulation to stepped slab above (perforated /open ceiling)
	Room adjacent to Male Showers	8.01	4.51	36.13	FFL to underside of insulation (perforated /open ceiling)
	Room adjacent to Male Showers	3.03	3.42	10.36	FFL to underside of insulation to stepped slab above (perforated /open ceiling)
	Room adjacent to Male Showers	2.44	2.67	6.50	FFL to underside of insulation to stepped slab above (perforated /open ceiling)
0.02.12	Male Toilets	13.30	4.51	59.98	FFL to underside of insulation (perforated /open ceiling)
0.02.12	Male Toilets	5.27	3.42	18.02	FFL to underside of insulation to stepped slab above (perforated /open ceiling)
0.02.12	Male Toilets	2.41	2.67	6.42	FFL to underside of insulation to stepped slab above (perforated /open ceiling)
0.02.13a	Changing Places	7.06	4.51	31.83	FFL to underside of insulation (perforated /open ceiling)
0.02.13b	Changing Places (under stair slope)	6.02	4.95	29.81	FFL to FFL (floor above)
0.02.14	Accessible WC	3.24	2.40	7.78	FFL to ceiling
0.03.01a	Pool Hall with Higher Ceiling (slice at level 0 only)	255.23	4.95	1263.39	FFL to FFL (refer to SU model if unclear)
0.03.01b	Pool Hall with Reduced Ceiling (entire volume)	233.47		**1182.68**	**FFL to ceiling - See Sketchup model for calculation**
0.03.01d	Pool Hall Entrance Area	10.63	4.64	49.27	FFL to underside of concrete of floor above (perforated /open ceiling)
0.03.01e	Pool hall under bulkhead (adjacent to Pool store)	5.01	3.15	15.76	FFL to ceiling
0.03.02	Pool Store	3.77	3.54	13.33	FFL to top of wall inside riser
-1.03.01	Stair 4 Core	17.98	4.95	89.00	FFL to FFL (floor above)
0.03.03a	Space next to Lobby	0.37	4.51	1.67	FFL to underside of insulation (perforated /open ceiling)
0.03.03	Lobby	7.85	4.51	35.40	FFL to underside of insulation (perforated /open ceiling)
0.04.01a	Pool Hall with Heigher Ceiling (slice at level 0 only)	410.34	4.95	2031.18	FFL to FFL (floor above)
0.04.01b	Space under spectator seating	20.54	2.79	57.20	FFL to underside of concrete of floor above (perforated /open ceiling)
0.04.01c	Pool Hall with Reduced Ceiling	319.44		**2075.52**	**FFL to ceiling - See Sketchup model for calculation**
0.04.02	Cleaner's Room / Pool Store	22.59	4.51	101.88	FFL to underside of insulation (perforated /open ceiling)
0.04.03	Cleaner's Room / Pool Store	15.09	3.42	51.61	FFL to underside of insulation to stepped slab above (perforated /open ceiling)
0.04.04	Cleaner's Room / Pool Store	10.17	2.67	27.10	FFL to underside of insulation to stepped slab above (perforated /open ceiling)
0.04.03	First Aid	8.44	4.51	38.06	FFL to underside of insulation (perforated /open ceiling)
0.04.04	Accessible WC	4.09	4.51	18.45	FFL to underside of insulation (perforated /open ceiling)
0.05.01	Plant	44.39	3.75	166.46	FFL to ceiling
0.05.02	Plant Lobby	1.82	3.75	6.83	FFL to ceiling
	Net FA (m²)	**1891.03**	**Vn50 (m3)**	**9460.01**	

Level 01		**FFL**	**45.000**		
Room No.	**Space**	**-**	**Base Area (m²)**	**Clear Height**	**Vn50**	**Height reference**
0.01.02	Lift Shaft	3.89	4.50	17.52	FFL to FFL (floor above)
0.01.03	Lift Shaft	3.82	4.50	17.19	FFL to FFL (floor above)
1.01.01	Foyer	135.31	4.10	554.76	FFL to underside of floor slab above (perforated /open ceiling)

	Stair 1 Core	20.74	4.50	93.34	FFL to FFL (floor above)
1.01.02	Draught Lobby	19.35	4.10	79.31	FFL to underside of floor slab above (perforated /open ceiling)
1.01.03a	Reception	40.08	4.10	164.32	FFL to underside of floor slab above (perforated /open ceiling)
1.01.03b	Reception (acoustic ceiling)	6.48	4.05	26.24	FFL to underside of acoustic insulation (perforated /open ceiling)
1.01.04	Membership	5.37	4.10	22.03	FFL to underside of floor slab above (perforated /open ceiling)
1.01.05	Vending	2.63	4.10	10.80	FFL to underside of floor slab above (perforated /open ceiling)
1.01.06	Buggy St	8.18	4.10	33.52	FFL to underside of floor slab above (perforated /open ceiling)
1.01.07a	Soft Play: Lower Floor	45.01	5.10	229.54	FFL to underside of floor slab (no ceiling)
1.01.07b	Soft Play: Level Floor	8.43	4.10	34.57	FFL to underside of floor slab above (perforated /open ceiling)
1.01.08	Circulation Post Turnstiles	47.73	4.10	195.70	FFL to underside of floor slab above (perforated /open ceiling)
1.01.09	Accessible WC	3.39	4.10	13.88	FFL to underside of floor slab (perforated inlay/ceiling grid)
1.02.01	Staff Lobby	14.41	4.10	59.07	FFL to underside of floor slab (perforated inlay/ceiling grid)
1.02.02	Admin	20.48	4.10	83.95	FFL to underside of floor slab (perforated inlay/ceiling grid)
1.02.03	Manager's Office	9.34	4.10	38.27	FFL to underside of floor slab (perforated inlay/ceiling grid)
1.02.04	Staff Rest	23.06	4.10	94.55	FFL to underside of floor slab (perforated inlay/ceiling grid)
1.02.05	Duty Office	11.58	4.10	47.48	FFL to underside of floor slab (perforated inlay/ceiling grid)
1.02.06	Staff Change	13.31	4.10	54.55	FFL to underside of floor slab (perforated inlay/ceiling grid)
1.02.07	Accessible Staff Change	6.15	3.98	24.43	FFL to underside of insulation (no ceiling)
1.02.09	Staff WC	3.99	4.10	16.38	FFL to underside of floor slab (perforated inlay/ceiling grid)
1.02.11	Stair 3 Core	17.74	4.50	79.83	FFL to FFL (floor above)
1.02.12a	Stair 3 Entrance Area	3.22	4.44	14.31	FFL to underside of floor slab (no ceiling)
1.02.12b	Stair 3 Step	0.29	4.27	1.26	FFL to underside of floor slab (no ceiling)
1.02.12c	Stair 3 space adjacent to lobby	1.89	4.10	7.75	FFL to underside of floor slab (no ceiling)
1.02.13	Stair 3 Lobby	8.74	4.10	35.82	FFL to underside of floor slab (no ceiling)
0.03.01f	Pool Hall with Higher Ceiling (slice at level 01 only)	254.58		**834.80**	**FFL to ceiling - See Sketchup model for calculation**
0.04.01e	Pool Hall with Heigher Ceiling (slice at level 01 only)	400.33		**2180.09**	**FFL to ceiling - See Sketchup model for calculation**
-1.03.01	Stair 4 Core	17.91	4.50	80.58	FFL to FFL (floor above)
1.03.01	Café	62.79	2.80	175.80	FFL to underside of floor slab (perforated inlay/ceiling grid)
1.03.02a	Informal Viewing	10.96	4.10	44.92	FFL to ceiling
1.03.02a	Informal Viewing higher ceiling	10.80		**43.22**	**FFL to ceiling - See Sketchup model for calculation**
	Pool Store (rise from floor below)	5.68	10.58	60.07	Top of wall inside riser (where width increases)
1.03.03	Servery	12.75	4.10	52.27	FFL to underside of floor slab above (solid ceiling but open to perforated ceiling adjacent)
1.03.04	Servery Store	6.68	4.10	27.38	FFL to underside of floor slab (perforated inlay/ceiling grid)
1.03.05	Toilet Lobby	2.68	2.80	7.51	FFL to ceiling
1.03.06	Male WC	7.96	4.10	32.62	FFL to underside of floor slab (perforated inlay/ceiling grid)
1.03.07	Female WC	6.00	4.10	24.58	FFL to underside of floor slab (perforated inlay/ceiling grid)
1.03.08	Accessible WC	3.79	4.10	15.54	FFL to underside of floor slab (perforated inlay/ceiling grid)
1.03.09	Circulation	5.65	4.10	23.17	FFL to underside of floor slab (no ceiling)
1.03.10	Servery Lobby	6.73	4.10	27.58	FFL to underside of floor slab (no ceiling)
1.03.11	Vending Store	2.24	4.10	9.18	FFL to underside of floor slab (no ceiling)
1.03.16	Stair 4 Lobby	2.45	4.10	10.04	FFL to underside of floor slab (no ceiling)

1.04.01	Multi Purpose / Creche		25.89	4.10	106.13	FFL to underside of floor slab (perforated inlay/ceiling grid)
1.04.02	Creche Store		5.61	4.10	23.00	FFL to underside of floor slab (no ceiling)
1.05.01a	Spectator Seating Rear Row and Behind		88.31	3.94	347.95	FFL to underside of insulation (perforated /open ceiling)
1.05.01b	Spectator Seating Middle Row		29.64	5.07	150.13	FFL to underside of insulation (adjacent to perforated /open ceiling)
1.05.01c	Spectator Seating Front Row		37.01	5.83	215.61	FFL to underside of insulation (adjacent to perforated /open ceiling)
1.05.01d	Spectator bulkhead projection		5.03	3.94	19.83	FFL to underside of insulation (adjacent to perforated /open ceiling)
1.05.02	Spectator Lobby		11.77	3.98	46.80	FFL to underside of insulation (adjacent to perforated /open ceiling)
1.05.03	Cleaner's Store		4.55	3.98	18.08	FFL to underside of insulation (adjacent to perforated /open ceiling)
1.05.04	Stair 2 Lobby		6.41	4.22	27.01	FFL to underside of floor slab (perforated inlay/ceiling grid)
1.05.05	Stair 2 Core		20.89	2.50	52.23	FFL to ceiling
1.06.01a	Spin Studio		42.60	4.10	174.67	FFL to underside of floor slab (perforated inlay/ceiling grid)
1.06.01b	Spin Studio (acoustic ceiling)		28.80	3.98	114.48	FFL to underside of acoustic insulation (perforated /open ceiling)
1.06.02	Spin Store		10.34	4.10	42.38	FFL to underside of floor slab (no ceiling)
1.07.01a	Plant		44.24	4.10	181.38	FFL to underside of floor slab (no ceiling)
1.07.01b	Plant (insulated ceiling)		66.78	3.98	265.45	FFL to underside of insulation (no ceiling)
1.07.02	Escape Ladder		2.71	4.10	11.09	FFL to underside of floor slab (no ceiling)
1.08.01	Plant AHU Community Pool		44.08	3.98	175.23	FFL to underside of insulation (no ceiling)
1.09.01.a	Plant landing		1.66	4.70	7.80	FFL to underside of floor slab (no ceiling)
1.09.01b	Plant (Higher Ceiling)		52.34	5.60	293.10	FFL to underside of floor slab (no ceiling)
1.09.01	Plant (Lower Ceiling)		28.45	3.27	93.03	FFL to underside of floor slab (no ceiling)
1.09.02	Plant Lobby		2.63	2.50	6.59	FFL to ceiling
		Net FA (m²)	**1864.30**	**Vn50 (m3)**	**8071.69**	

Level 02 **FFL** **49.500**

Room No.	**Space**	-	**Base Area (m²)**	**Clear Height**	**Vn50**	**Height reference**
2.01.01	General Circulation		49.32	5.15	253.99	FFL to underside of floor slab above (perforated /open ceiling)
0.01.02	Lift Shaft		3.89	5.55	21.61	FFL to FFL (floor above)
0.01.03	Lift Shaft		3.82	5.55	21.20	FFL to FFL (floor above)
	Stair 1 Core		56.06	5.55	311.14	FFL to FFL (floor above)
	Stair 3 Core		17.74	5.55	98.46	FFL to FFL (floor above)
	Stair 4 Core		17.91	5.55	99.38	FFL to FFL (floor above)
2.01.02	Accessible Change		5.96	2.40	14.31	FFL to ceiling
2.01.03a	Stair 3 Lobby		10.67	5.11	54.51	FFL to underside of insulation (no ceiling)
2.01.03b	Space between lobby and Stair 3		0.41	5.24	2.15	FFL to underside of floor slab (no ceiling)
2.02.04	Cleaner's Store		6.14	4.98	30.55	FFL to underside of insulation (no ceiling)
2.02.16a	Stair 4 Lobby		7.73	4.66	36.02	FFL to underside of floor slab (no ceiling)
2.02.16a	Stair 4 Lobby		0.47	5.24	2.45	FFL to underside of floor slab (no ceiling)
2.03.01	F Change Lobby		6.40	5.11	32.72	FFL to underside of floor slab (no ceiling)
2.03.02	F Fitness Change		55.76	4.98	277.42	FFL to underside of insulation (perforated /open ceiling)
2.03.04	F Fitness Showers		25.10	4.98	124.89	FFL to underside of insulation (perforated /open ceiling)
2.04.01	M Change Lobby		5.74	2.70	15.51	FFL to ceiling

2.04.02a	M Fitness Change		49.84	4.98	247.95	FFL to underside of insulation (perforated /open ceiling)
2.04.02b	M Fitness Change		0.60	3.93	2.36	FFL to underside of insulation (perforated /open ceiling)
2.04.03	M Change Toilets		41.39	3.93	162.47	FFL to underside of insulation (perforated /open ceiling)
	M Fitness Showers		16.03	3.93	62.93	FFL to underside of insulation (perforated /open ceiling)
	M Fitness Showers		1.90	4.98	9.45	FFL to underside of insulation (perforated /open ceiling)
	M Fitness Showers		2.39	4.54	10.86	FFL to underside of insulation (perforated /open ceiling)
2.05.01a	Plant		105.79	5.24	553.78	FFL to underside of floor slab (no ceiling)
2.05.01b	Plant (raised floor)		2.50	4.19	10.46	FFL to underside of insulation (no ceiling)
2.05.01b	Plant (stepped floor above)		2.76	5.11	14.08	FFL to underside of floor slab (no ceiling)
2.05.03	Access Ladder		5.79	5.24	30.29	FFL to underside of floor slab (no ceiling)
2.06.01a	Hydro Plant		10.71	4.66	49.91	FFL to underside of floor slab (no ceiling)
2.06.01b	Hydro Plant		0.70	3.93	2.75	FFL to underside of insulation (no ceiling)
2.06.01c	Hydro Plant		2.07	4.98	10.29	FFL to underside of insulation (no ceiling)
2.01.04a	Gymnasium		223.52	5.15	1151.15	FFL to underside of floor slab above (perforated /open ceiling)
2.01.04a	Gymnasum (acoustic insulation)		119.61	5.10	610.03	FFL to underside of insulation (perforated /open ceiling)
2.01.04b	Gymnasium		215.41	5.15	1109.38	FFL to underside of floor slab above (perforated /open ceiling)
2.01.04b	Gymnasum (acoustic insulation)		51.78	5.10	264.06	FFL to underside of insulation (perforated /open ceiling)
2.01.04c	Gymnasium		80.14	5.15	412.70	FFL to underside of floor slab above (perforated /open ceiling)
2.01.04c	Gymnasium (acoustic insulation)		9.31	5.10	47.46	FFL to underside of insulation (perforated /open ceiling)
2.06.02	Unnamed room		8.66	4.66	40.36	FFL to underside of floor slab above (perforated /open ceiling)
		Net FA (m²)	**1224.03**	**Vn50 (m3)**	**6199.04**	

Level 03 **FFL** **55.050**

Room No.	Space	-	Base Area (m²)	Clear Height	Vn50	Height reference
0.01.02	Lift Shaft		3.89		**20.60**	**FFL to underside of roof (no ceiling) - See Sketchup model for calculation**
0.01.03	Lift Shaft		3.82		**21.41**	**FFL to underside of roof (no ceiling) - See Sketchup model for calculation**
	Stair 1 Core		56.06		**283.83**	**FFL to underside of roof (perforated /open ceiling) - See Sketchup model for calculation**
	Stair 3 Core		17.74		**86.25**	**FFL to underside of roof (no ceiling) - See Sketchup model for calculation**
	Stair 4 Core		17.91		**73.04**	**FFL to underside of roof (no ceiling) - See Sketchup model for calculation**
3.01.01	General Circulation and Breakout Space		116.64		**607.78**	**FFL to underside of roof (perforated /open ceiling) - See Sketchup model for calculation**
3.01.04	Cleaner's Store		2.92		**12.56**	**FFL to underside of roof (no ceiling) - See Sketchup model for calculation**
3.01.05	Lobby (inc space between lobby and stairs)		9.80		**43.20**	**FFL to underside of roof (no ceiling) - See Sketchup model for calculation**
3.07.02	Plant		44.10		**230.75**	**FFL to underside of roof (no ceiling) - See Sketchup model for calculation**
3.02.01a	Studio 1 lobby		6.74	2.40	16.18	FFL to underside of ceiling
3.02.01b	Studio 1 lobby lockers		1.43	2.10	3.00	FFL to underside of bulkhead
3.02.01b	Studio 1 (volume excludes acoustic insulation)		125.21		**783.13**	**FFL to underside of roof (perforated /open ceiling) - See Sketchup model for calculation**
3.02.02	Studio 2 (volume excludes acoustic insulation)		113.64		**634.55**	**FFL to underside of roof (perforated /open ceiling) - See Sketchup model for calculation**
3.02.04	Studio Store		26.44		152.27	**FFL to underside of roof (no ceiling) - See Sketchup model for calculation**
3.02.15	Studio Lobby		21.76		**117.91**	**FFL to underside of roof (no ceiling) - See Sketchup model for calculation**
3.07.03	Plant		78.97		**391.34**	**FFL to underside of roof (no ceiling) - See Sketchup model for calculation**
3.01.06	Accessible WC		5.42	2.40	13.00	FFL to underside of ceiling

3.01.07	Staircase Lobby	18.25		**94.37**	**FFL to underside of roof (no ceiling) - See Sketchup model for calculation**
3.03.01	Spa Welcome Area and Circulation	68.17		**219.24**	**FFL to underside of roof (perforated /open ceiling) - See Sketchup model for calculation**
3.03.26	Manicure & Pedicure	10.83		**53.81**	**FFL to underside of roof (perforated /open ceiling) - See Sketchup model for calculation**
3.07.10	Plant	5.04		**25.17**	**FFL to underside of roof (no ceiling) - See Sketchup model for calculation**
3.03.24	Store	5.02		**20.56**	**FFL to underside of roof (no ceiling) - See Sketchup model for calculation**
3.03.23	Bar / Relaxation Room	31.51	2.50	78.77	FFL to underside of ceiling
3.03.18	Treatment Room 1	8.05		**20.92**	**FFL to underside of ceiling - See Sketchup model for calculation**
3.03.19	Treatment Room 2	10.41		**28.11**	**FFL to underside of ceiling - See Sketchup model for calculation**
3.03.20	Treatment Room 3	11.16		**29.12**	**FFL to underside of ceiling - See Sketchup model for calculation**
3.03.21	Treatment Room 4	20.19		**52.33**	**FFL to underside of ceiling - See Sketchup model for calculation**
3.03.22	Shower	1.70	2.40	4.08	FFL to underside of ceiling
3.03.14	WC	2.18	2.40	5.23	FFL to underside of ceiling
3.03.12	M Lobby	2.98	2.40	7.15	FFL to underside of ceiling
3.03.13	M Dressing	18.32		**86.52**	**FFL to underside of roof (perforated /open ceiling) - See Sketchup model for calculation**
3.03.11	Accessible Change	6.71	2.40	16.10	FFL to underside of ceiling
3.03.17	WC	2.21	2.40	5.31	FFL to underside of ceiling
3.03.15	F Lobby	3.20	2.40	7.68	FFL to underside of ceiling
3.03.16	F Dressing	24.84		**101.01**	**FFL to underside of roof (perforated /open ceiling) - See Sketchup model for calculation**
3.03.25	Cleaner's Store	1.98		**7.81**	**FFL to underside of roof (no ceiling) - See Sketchup model for calculation**
3.03.05	Health Suite and Circulation (volume excludes acoustic insulation)	84.42		**323.60**	**FFL to underside of roof (perforated /open ceiling) - See Sketchup model for calculation**
3.03.06	Sauna	12.77	2.30	29.36	FFL to underside of ceiling
3.03.07	Sauna	9.55	2.30	21.96	FFL to underside of ceiling
3.03.08	Salt Vapour Room	10.31	2.30	23.72	FFL to underside of ceiling
	Net FA (m²)	**1022.26**	**Vn50 (m3)**	**4752.72**	

Total Net FA (m2)	**6713.72**	**Total Vn50 (m3)**	**28483.47**

APPENDIX V - Air Leakage Certificate

Jennings Aldas (2019) Limited
97 Innsworth Lane
Gloucester GL2 0TT

Air Leakage Certificate

In accordance with BS EN 13829 and ATTMA TSL2 (2010) & TSL4 (2018)

Building Tested:		**St Sidwell's Point Paris Street, Exeter, Devon EX1 2JB**
Test Date:		**17th December 2021**
Test Engineer:		**Paul Jennings, Aldas**
Certificate No:		**P3819-C01**

This is to certify that the above-named dwelling has been tested for air leakage in accordance with the BS EN 13829:2001 methodology and the requirements of ATTMA as specified in TSL2 (2010) & TSL4 (2018). The additional requirements of the Passivhaus Institute when Passivhaus Certification is required were also met. The average Leakage Characteristics of the building were recorded as follows:

Airflow @ 50 Pa:		**2921.5 m^3/hr**
Air Permeability @ 50 Pa:		**0.30 m^3/ ($hr.m^2$)**
Air Change Rate @ 50 Pa:		**0.10 AC/hr**
Data consistency, r^2 (requirement, $r^2 > 0.98$):		**0.998**
Slope, n (requirement, $0.5 < n < 1.0$):		**0.64**
Intercept, C_{env}:		**232.3 m^3/ ($hr.Pa^n$)**
Test Parameters		
Envelope, A_E:		**9,721.7 m^2**
Volume, V:		**28,483.5 m^3**
Env. Calc. prepared by:		**Adam Scott of Gale & Snowden, Architects**

Initial Offset Pressure	**-1.8 Pa**	**Final Offset Pressure:**	**0.39 Pa**
Initial Inside Temperature:	**18.6°C**	**Final Inside Temperature:**	**19.8°C**
Average Outside Temperature:	**8.2°C**	**Barometric Pressure:**	**103.4 kPa**

This certificate should be read in conjunction with the full airtightness test report P3819-11 and associated test method statement.

Signed: Paul Jennings **Name:** Paul Jennings **Date Issued:** 7th February 2022

Position: Air Leakage Specialist

Deviations from TSL2 & TSL4 methodology: None