



Jennings Aldas (2019) Limited
1 Alvin Road
Gloucester GL1 3EJ



Airtightness Testing Report

Prepared for:

Spelthorne Leisure Centre
Knowle Green, Staines-upon-Thames, Surrey TW18 1AJ

On behalf of:

Graham Thompson, Willmott Dixon

Author:

Paul Jennings

Paul Jennings, Aldas

Date:

27th August 2024

Reference:

P3958-05

DOCUMENT HISTORY

Role	Name	Date
Author	Paul Jennings	27 th August 2024
Checked & authorised	Duncan Jennings	27 th August 2024

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.

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EXECUTIVE SUMMARY



The results achieved in the acceptance Airtightness Testing of the Spelthorne Leisure Centre, in Knowle Green, Staines-upon-Thames, Surrey, which was carried out on the 10th of August 2024, are detailed in the table below:

Testing carried out by:	Test Engineers: Paul Jennings & Mischa Hewitt
Target Air Permeability, m ³ /hr/m ² @ 50Pa:	≤0.4 (Passivhaus)
Achieved Air Permeability, m ³ /hr/m ² @ 50Pa:	0.40
Achieved Air Changes, AC/hr @ 50 Pa:	0.12
Data consistency, r ² (requirement, r ² > 0.98):	0.998
Slope, n (requirement, 0.5 < n < 1.0):	0.62

This result demonstrates that the new Spelthorne Leisure Centre meets the Passivhaus airtightness target for this project. Because of the scale and nature of the building, the airtightness target ($\leq 0.4 \text{ m}^3/\text{hr}/\text{m}^2 @ 50\text{Pa}$) is much more onerous than the usual newbuild Passivhaus airtightness target of $\leq 0.6 \text{ AC}/\text{hr} @ 50\text{Pa}$.

No significant areas of air leakage were identified during 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 and III. An Air Leakage Certificate is included as the final appendix.

1.0 INTRODUCTION

This report documents acceptance air leakage testing undertaken by Aldas for Willmott Dixon at the new Spelthorne Leisure Centre in Knowle Green, Staines-upon-Thames, on the 10th of August 2024. We present direct observations from what was noted during our attendance on site, together with recommendations for what to do next, in terms of both investigative and/or remedial work, if required.

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 was undertaken by Aldas for Willmott Dixon at the new Spelthorne Leisure Centre in Knowle Green, Staines-upon-Thames, on the 10th of August 2024. Testing was carried out using a Retrotec 3000SR. This was mounted in a flexible “Bag door” system in an external door near the main entrance. Testing was carried out in accordance with the requirements of BS EN 13829 and the ATTMA Quality Procedure, in conformance with the standards CIBSE TM23 (2022) and ATTMA TSL4 (2021), 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 were kept open during testing so free movement of air within the building was assured.

2.2 Measurement procedures

Test procedures in accordance with the following standards: CIBSE TM23, 2022 and ATTMA TSL4, 2021, Method A. After a preliminary single-point depressurisation test and an initial leakage check of the building to confirm that all doors and windows were closed, 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 air volume

As a very large and complex building, the new Spelthorne Leisure Centre was modelled by Josh Wardle of GT3 Architects in the Sketch-up computer program. This was used to generate the requisite envelope area to enable the air permeability of the final building to be calculated (Illustration 3). The Sketch-up model was also used to generate the PHI-compliant room-by-room volume, used to calculate the air change rate (Illustration 1). These are included as Appendix IV.

Volume under test	Volume (m ³)	Envelope area (m ²)
	PHI conventions	PHI conventions
Spelthorne Leisure Centre Knowle Green, Staines-upon-Thames, Surrey TW18 1AJ	50,787.9	15,031.5

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
Testo 511 Digital Barometer	Serial No: 39118203/909	Expires 16 th May 2025
Retrotec DM32 Digital Gauge	Serial No: 413167	Expires 15 th May 2025
Digitron K-type Temperature Probe	Serial No: 34850785/1220	Expires 16 th May 2025
Testo 925 Digital Thermometer	Serial No: 34850785/1220	Expires 16 th May 2025
Retrotec 3000SR High-Power Fan	Serial No: PH002309	Expires 16 th May 2025

3.0 LEAKAGE OBSERVATIONS

Following the detailed thermographic leakage inspection carried out in the early hours of Friday 6th August (detailed in our earlier report Aldas P3958-04), extensive remedial sealing works were undertaken to key leakage sites identified, prior to the acceptance airtightness test. Some leakage sites, notably to the parapet and the tops of the pods on the roof, could not be addressed in the time available. Hence the marginally satisfactory airtightness acceptance result achieved.

APPENDIX I - Set-up images

Site Address: Spelthorne Leisure Centre

Knowle Green, Staines-upon-Thames, Surrey TW18 1AJ



A1.1) External view of test equipment mounted in open door near main entrance



A1.2) Internal view of test equipment mounted in open door near main entrance



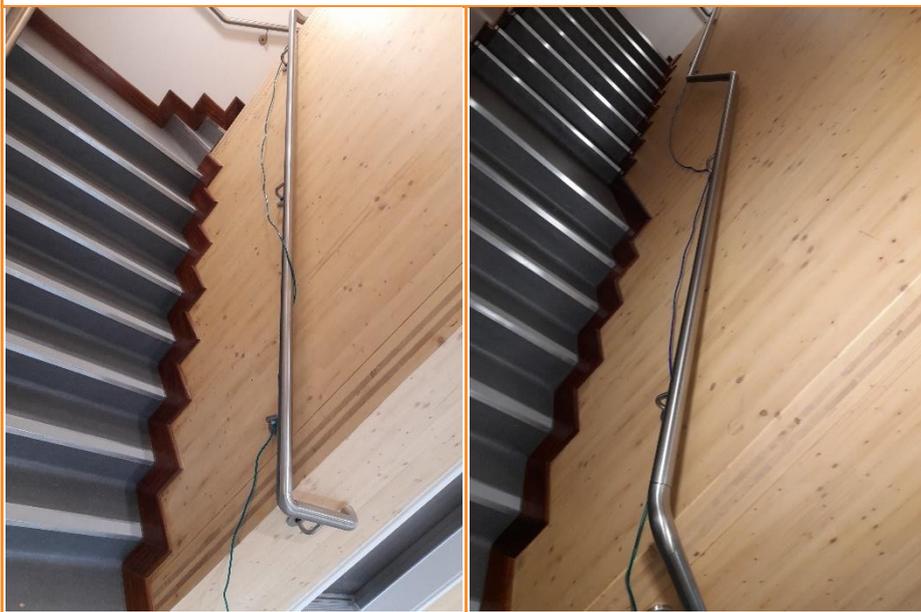
A1.3) Temporary seal around door closer at top of bag door system



A1.4) External pressure tap (red tube) extended away from the fan mounted in the doorway and secured in a sheltered position



A1.5) Internal pressure tap (blue tube) extended away from fan and digital manometer across lobby to base of stairs



A1.6) Internal pressure tap (blue tube) extended up the stairs to the first floor (approximately the centre of the building)



A1.7) Internal pressure tap (blue tube) further extended up the stairs and secured on the first floor beside lift



A1.8) Large AHU that operates 24/7 temporarily sealed on outlet dampers

A1.9) Large AHU that operates 24/7 temporarily sealed on inlet dampers





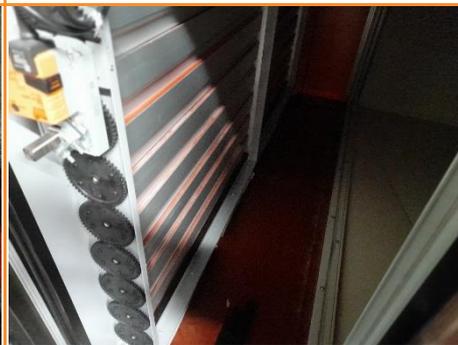
A1.10) Large AHU that operates 24/7 temporarily sealed on external inlet ductwork



A1.11) Large AHU that operates 24/7 temporarily sealed on external outlet ductwork



A1.12) Large AHU that operates 24/7 temporarily sealed over inlet grille



A1.13) Large AHU that operates 24/7 temporarily sealed on outside of supply dampers

APPENDIX II – Negative Pressure Differential vs Airflow Data Set

Site Address: Spelthorne Leisure Centre, Knowle Green, Staines-upon-Thames

Date: 10th August 2024 Time: 10:25 to 10:55

Environmental Conditions:

Barometric Pressure:	102.0	kPa	Wind speed:	2.2	m/s	
Temperatures, initial:	Indoors:	26.3	°C	Outdoors:	19.1	°C
Temperatures, final:	Indoors:	26.3	°C	Outdoors:	19.1	°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]	1.5	-1.0	-1.1	-2.2	-2.4	-2.3	-3.6	-3.5	-3.6	-3.0
Baseline, final [Pa]	-2.2	-3.1	-2.7	-1.7	-1.6	-2.5	-2.1	-3.4	-3.1	-2.9

Static Pressure Averages:	initial [Pa]	ΔP_{01}	-2.12	ΔP_{01-ve}	-2.52	ΔP_{01+ve}	1.50
	final [Pa]	ΔP_{02}	-2.53	ΔP_{02-ve}	-2.53	ΔP_{02+ve}	0.00

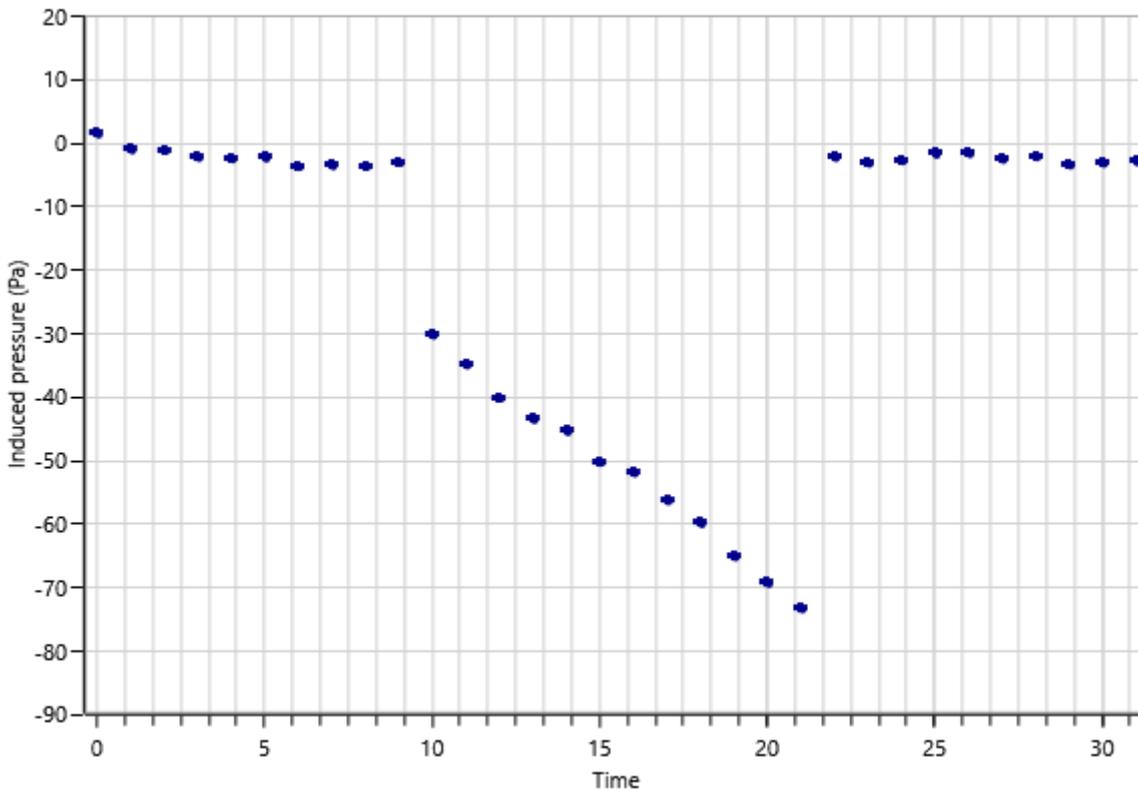
Results:

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).

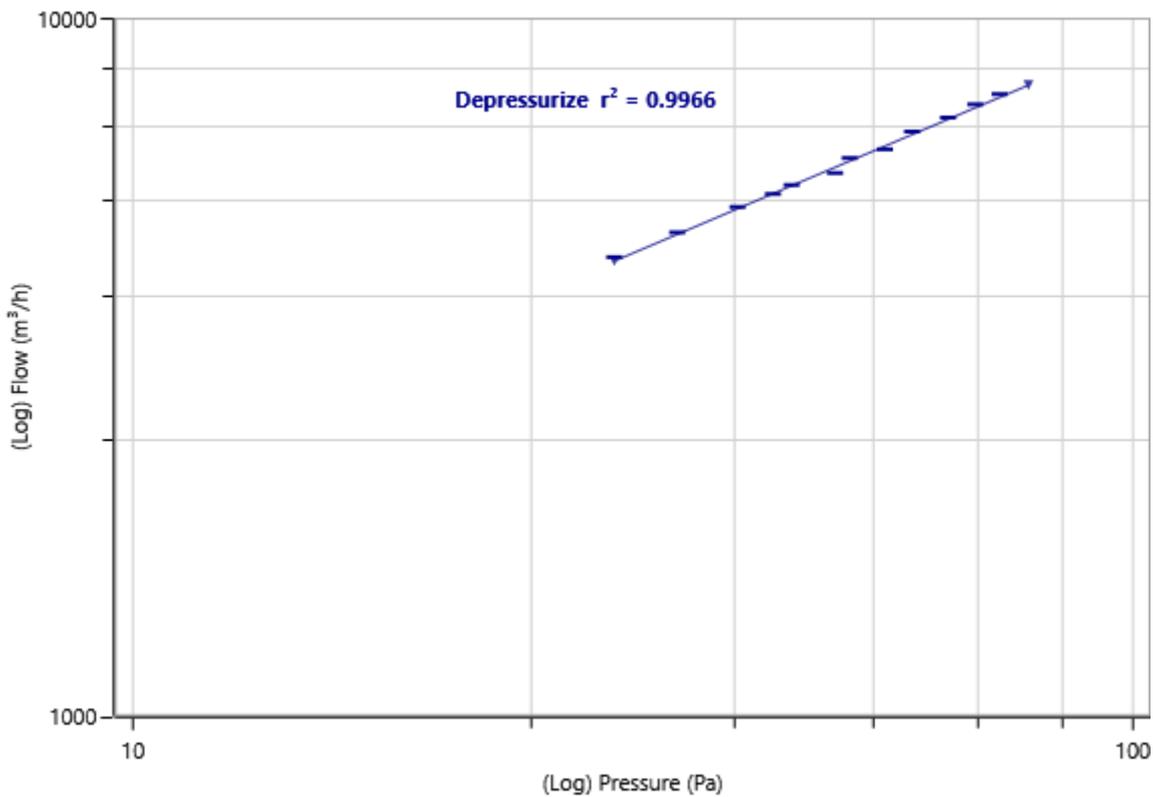
Readings collected are detailed below:

Reading	1	2	3	4	5	6	7	8	9	10	11	12
Induced Pressure [Pa]	-32.5	-37.2	-42.4	-45.8	-47.7	-52.5	-54.2	-58.6	-62.2	-67.4	-71.6	-75.6
Total flow, Q_r [m ³ /h]	4602.4	4992.4	5432.7	5667.8	5837.3	6073.2	6384.3	6566.6	6961.7	7290.3	7617.5	7876.7
Corrected flow, Q_{env} [m ³ /h]	4557.1	4943.2	5379.2	5611.9	5779.8	6013.4	6321.4	6501.9	6893.1	7218.4	7542.4	7799.0
Error [%]	0.9%	0.2%	0.2%	-0.5%	-0.1%	-2.3%	0.7%	-1.4%	0.6%	0.2%	0.8%	0.7%

G1: Graph of imposed pressure differentials, Depressurisation, Spelthorne Leisure Centre:



G2: Graph of imposed pressure differential against airflow, Depressurisation, Spelthorne Leisure Centre:



Depressurisation Test Results – Spelthorne Leisure Centre Knowle Green, Staines-upon-Thames, Surrey TW18 1AJ						
	Results				Results	Uncertainty
Correlation, r^2	0.997	95% confidence limits		Air flow at 50 Pa, Q_{50} [m ³ /h]	6163.1	+/-0.7%
Intercept, C_{env} [m ³ /h.Pa ⁿ]	569.1	516.0	627.4	Permeability at 50 Pa, AP_{50} [m ³ /h.m ²]	0.410	+/-0.8%
Slope, n	0.61	0.58	0.63	Equivalent leakage area at 50 Pa [cm ²]	1906	+/-0.7%
				Air changes, n_{50}	0.121	+/-0.8%

APPENDIX III - Positive Pressure Differential vs Airflow Data Set

Site Address: Spelthorne Leisure Centre, Knowle Green, Staines-upon-Thames

Date: 10th August 2024 Time: 11:00 to 11:23

Environmental Conditions:

Barometric Pressure:	102.0	kPa	Wind speed:	2.7	m/s
Temperatures, initial:	Indoors: 26.6	°C	Outdoors: 20.2		°C
Temperatures, final:	Indoors: 26.5	°C	Outdoors: 21.4		°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]	-2.2	-3.1	-2.7	-1.7	-1.6	-2.5	-2.1	-3.4	-3.1	-2.9
Baseline, final [Pa]	-4.5	-4.6	-3.1	-2.5	-3.1	-2.3	0.6	-0.1	-1.0	-2.3

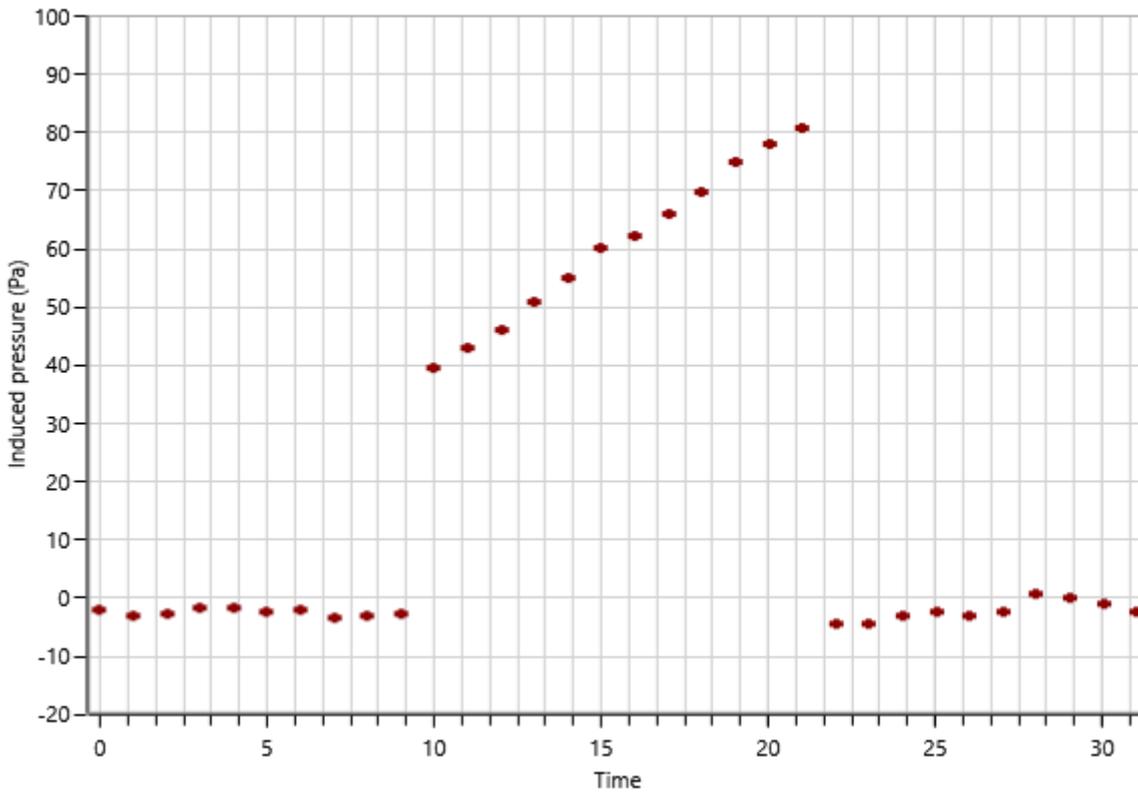
Static Pressure Averages:	initial [Pa]	ΔP_{01}	-2.53	ΔP_{01-ve}	-2.53	ΔP_{01+ve}	0.00
	final [Pa]	ΔP_{02}	-2.29	ΔP_{02-ve}	-2.61	ΔP_{02+ve}	0.60

Results:

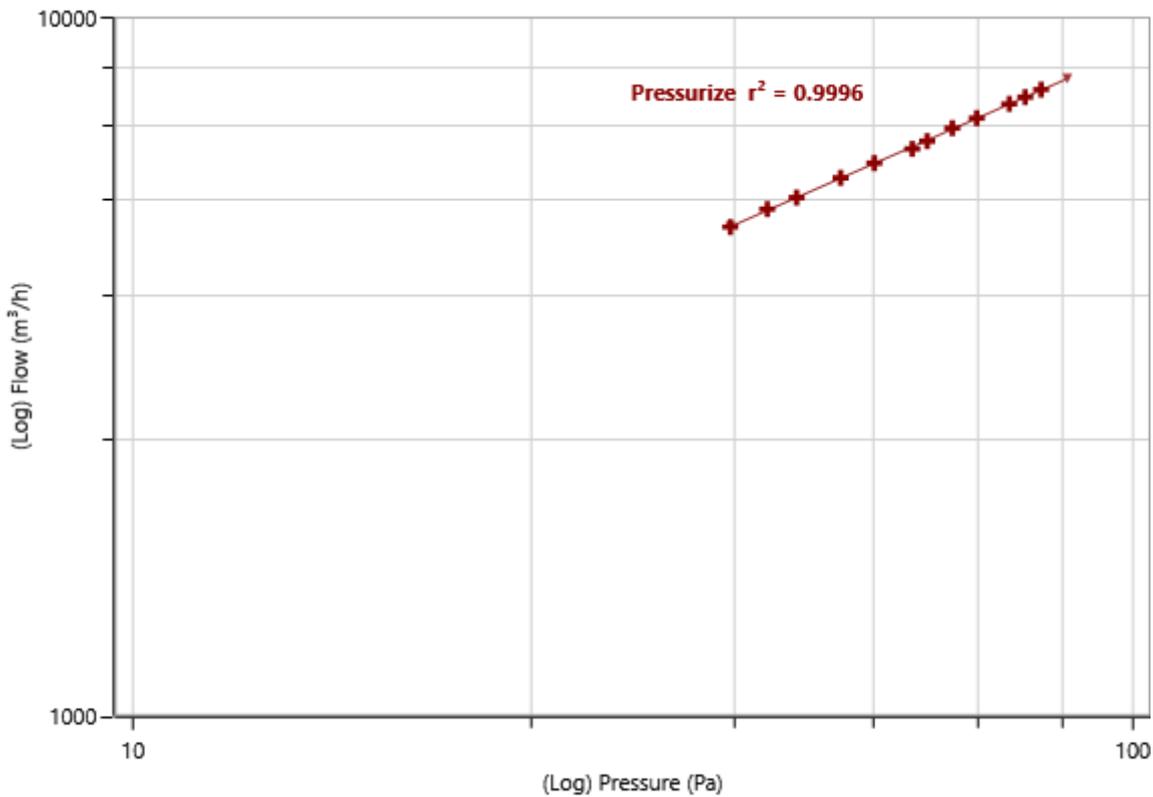
All results are compared to the standards set in Building Regulations ‘Approved Document L1A – Conservation of fuel and power in new dwellings (2010)’. Results are calculated using the formulae set out in ATTMA TSL1 (Appendix A). Readings collected are detailed below:

Reading	1	2	3	4	5	6	7	8	9	10	11	12
Induced Pressure [Pa]	37.0	40.5	43.5	48.4	52.5	57.5	59.6	63.3	67.1	72.5	75.3	78.2
Total flow, Q_r [m ³ /h]	4948.3	5248.9	5452.7	5818.7	6108.6	6401.1	6566.6	6853.6	7083.1	7420.2	7589.6	7782.3
Corrected flow, Q_{env} [m ³ /h]	5035.9	5341.9	5549.3	5921.8	6216.8	6514.5	6682.9	6974.9	7208.5	7551.6	7724.0	7920.0
Error [%]	-0.1%	0.4%	0.0%	0.1%	0.1%	-0.0%	-0.3%	0.3%	0.1%	0.0%	0.0%	0.2%

G3: Graph of imposed pressure differentials, Pressurisation, Spelthorne Leisure Centre:



G4: Graph of imposed pressure differential against airflow, Pressurisation, Spelthorne Leisure Centre:



Pressurisation Test Results – Spelthorne Leisure Centre Knowle Green, Staines-upon-Thames, Surrey TW18 1AJ						
	Results				Results	Uncertainty
Correlation, r^2	1.000	95% confidence limits		Air flow at 50 Pa, Q_{50} [m^3/h]	5818.4	+/-0.2%
Intercept, C_{env} [$m^3/h.Pa^n$]	501.9	484.4	520.0	Permeability at 50 Pa, AP_{50} [$m^3/h.m^2$]	0.39	+/-0.6%
Slope, n	0.63	0.62	0.64	Equivalent leakage area at 50 Pa [cm^2]	1646	+/-0.2%
				Air changes, n_{50}	0.11	+/-0.6%

APPENDIX IV- Sketch-up models underlying envelope and volume calculations

As a very large and complex building, the new Spelthorne Leisure Centre was modelled by Josh Wardle of GT3 Architects in the Sketch-up computer program. This was used to generate the requisite envelope area to enable the air permeability of the final building to be calculated (Illustration 3). The Sketch-up model was also used to generate the PHI-compliant room-by-room volume, used to calculate the air change rate (Illustration 1).

Illustration 1): Sketch-up model of Spelthorne with internal room volumes shown & summed to give overall PHI-compliant volume

Illustration 2): Sketch-up model of Spelthorne with building model turned off and one sample volume (learner pool and splashpad) selected to give reported volume

Illustration 3): Sketch-up model of Spelthorne giving the envelope area, as modified to give the overall surface used in the final air permeability calculation

Illustration 1): Sketch-up model of Spelthorne with internal room volumes shown & summed to give overall PHI-compliant volume

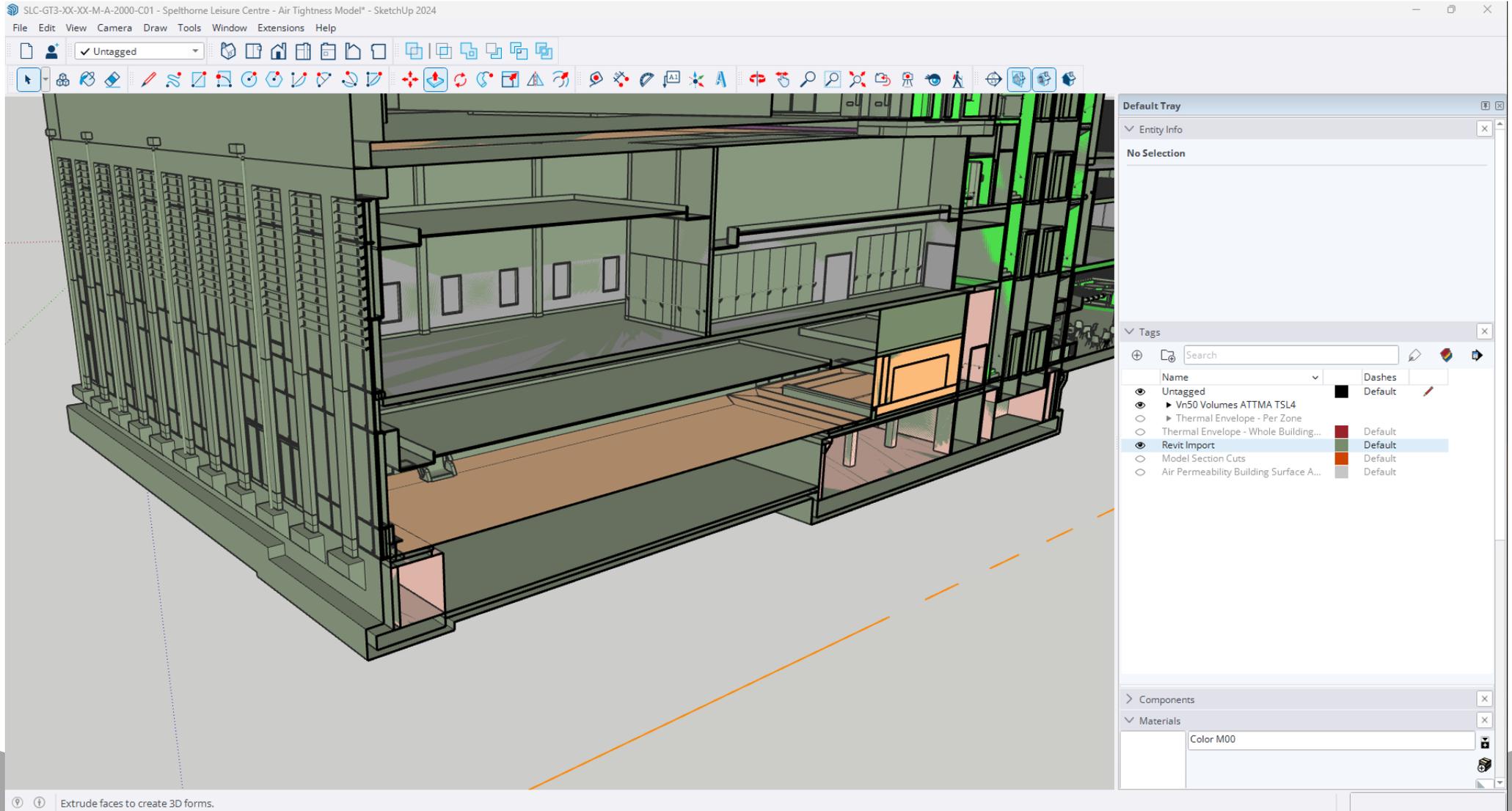


Illustration 2): Sketch-up model of Spelthorne with building model turned off and one sample volume (learner pool and splashpad) selected to give reported volume

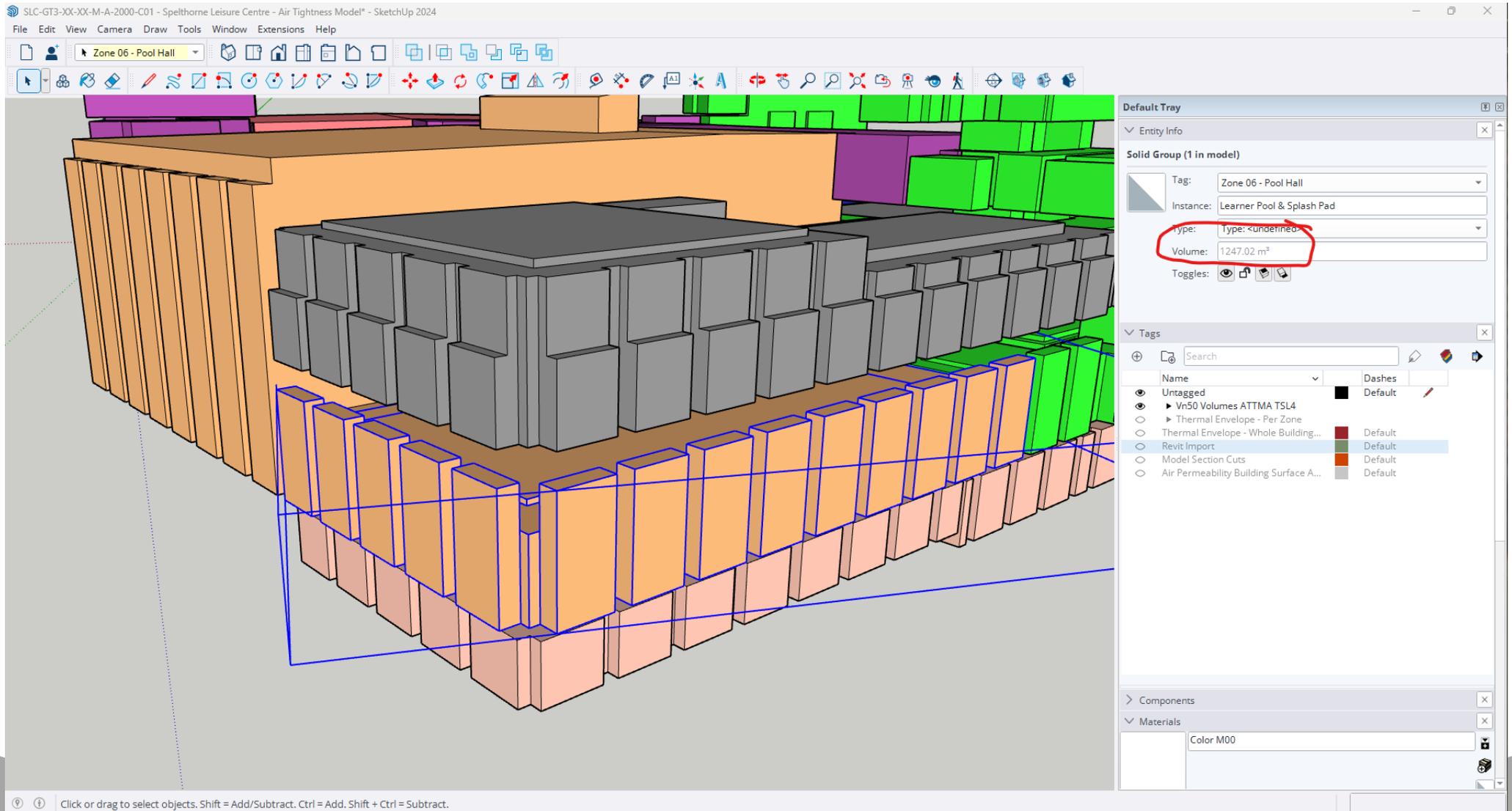
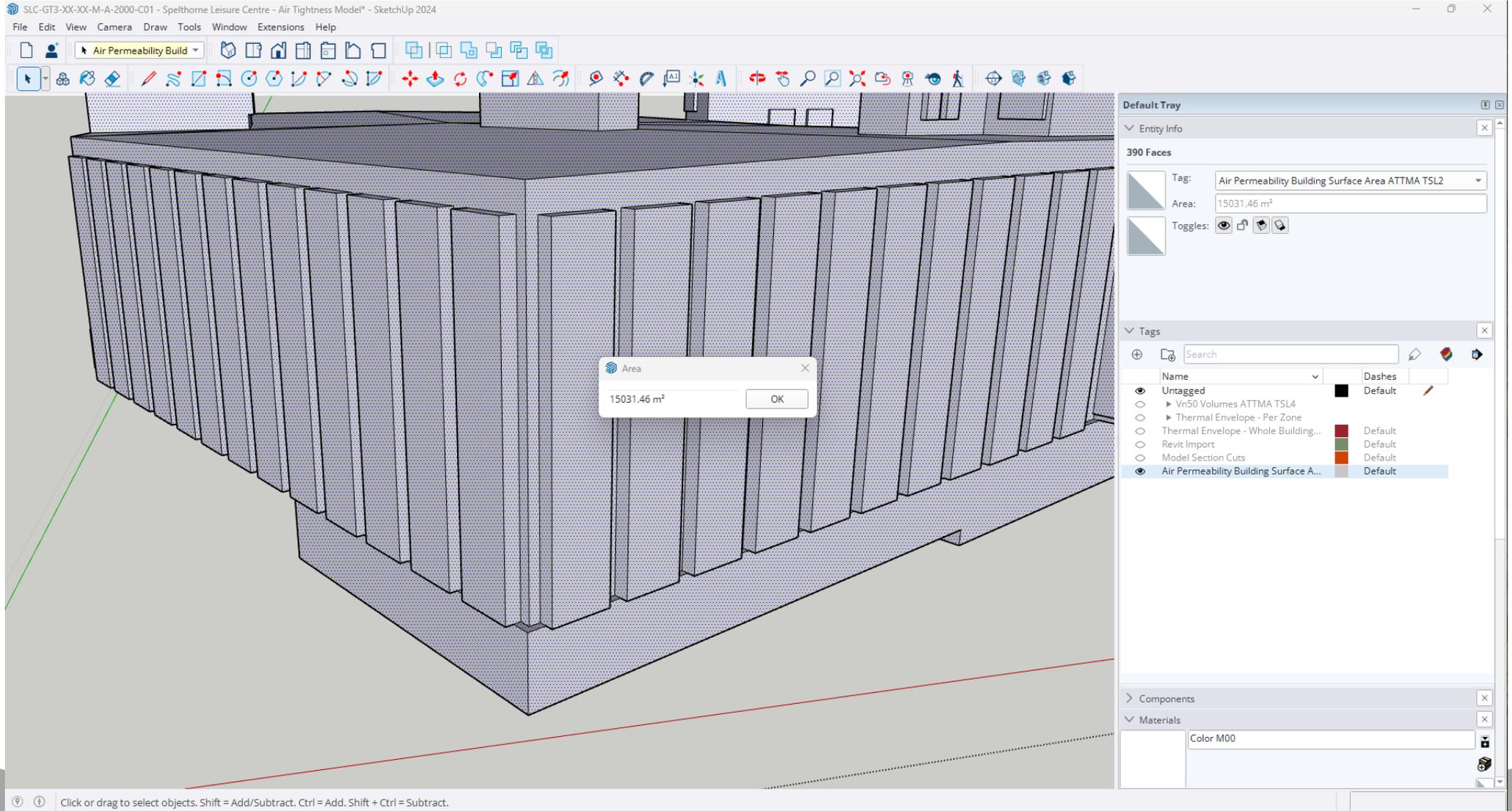


Illustration 3): Sketch-up model of Spelthorne giving the envelope area, as modified to give the overall surface used in the final air permeability calculation



APPENDIX V - Air Leakage Certificate



Air Leakage Certificate

In accordance with BS EN 13829, ATTMA TSL4
(2021) & CIBSE TM23 (2022)

Building Tested:		Spelthorne Leisure Centre Knowle Green, Staines-upon-Thames, Surrey TW18 1AJ
Test Date:		10 th August 2024
Test Engineer:		Paul Jennings, & Mischa Hewitt, Aldas
Certificate No:		P3958-C01

This is to certify that the above-named building has been tested for air leakage in accordance with the BS EN 13829:2001 methodology and the requirements of ATTMA as specified in TSL4 (2021) and CIBSE as specified in TM23 (2022). 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:		5991.0 m ³ /hr	
Air Permeability @ 50 Pa:		0.40 m ³ / (hr.m ²)	
Air Change Rate @ 50 Pa:		0.12 AC/hr	
Data consistency, r ² (requirement, r ² > 0.98):		0.998	
Slope, n (requirement, 0.5 < n < 1.0):		0.62	
Intercept, C _{env} :		535.5 m ³ / (hr.Pa ⁿ)	
Test Parameters			
Envelope, A _E :		15,031.5 m ²	
Volume, V:		50,787.9 m ³	
Env. Calc. prepared by:		Josh Wardle, GT3 Architects	
Initial Offset Pressure	-2.12 Pa	Final Offset Pressure:	-2.29 Pa
Initial Inside Temperature:	26.3°C	Final Inside Temperature:	26.5°C
Average Outside Temperature:	20.0°C	Barometric Pressure:	102.0 kPa

This certificate should be read in conjunction with the full airtightness test report P3958-05 and associated test method statement.

Signed: _____ Name: Paul Jennings Date Issued: 11th August 2024

Position: Air Leakage Specialist

Deviations from ATTMA TSL4 (2021) & CIBSE TM23 (2022) methodology: None