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Mississauga Fire Station 125
Whole Building Airtightness Report No.2

Test Date: May 13, 2024
Report Date: May 27, 2024

Mr. Martin,

Building Enclosure Lab Inc (BELi) is pleased to provide you with this report regarding the whole building airtightness testing at the Fire Station 125, located at 6627 Tenth Line West, Mississauga, Ontario. BELi previously tested the building at 50% completion and documented the results in a report dated January 3, 2024. The final airtightness test was done at 100% completion of the enclosure components and this report outlines the results of the final test.

BELi performed the airtightness test of the whole building on May 13, 2024 in general accordance with *ASTM E3158-18 Standard Test Method for Measuring the Air Leakage Rate of a Large or Multi-Zone Building.* The purpose of the test was to measure and report the airtightness of the building enclosure following the100% installation of all enclosure components. The construction of Fire Station 125 has been designed to meet Level 3 of the Mississauga Corporate Green Standard and it is the first project to target Net-Zero energy, and as per project specification section 07 27 10, a pass would be achieved if the air leakage of the building was less than 1.5 L/s/m^2 of enclosure area at 75 Pa.

1. Building Description

Fire Station 125 is a 1-storey fire station with two main areas: living quarters and the truck bay. These areas both have a concrete floor slab and low-slope roofs, however, the truck bay low slope roof is higher than the low slope roof above the living quarters. The truck bay also has 4 large four-fold doors for easy drive-in and drive-out access for the trucks. Punch windows exist through CMU block walls and large curtain walls exist at the 3 Captain's Rooms at the front of the building. The air barrier system includes the concrete floor slab, liquid applied air barrier and closed-cell spray foam over the CMU walls and a sheet air barrier at the roof levels. The windows are tied into the wall air barrier with sheet air barrier membranes. The windows and curtain walls are fixed IGUs and do not have operable components.

2. Key Building Parameters

Building measurements were based on the Architectural drawings by Hossack Architects, dated March 17, 2023. The air barrier, interior wall finishes, cladding, and roof system was fully installed. The four-fold doors in the apparatus bay were fully installed and therefore included in the testing area. The calculations for the building parameters were completed by BELi (Tristan Rouse).

Table 1: Building Parameter Summary

Building Elevation Above Sea Level	211 m (692 ft)
Building Height	At the truck bay: 6 m (19.5 ft) All other areas: 4.7 m (15.5 ft)
Conditioned Floor Area	958 m^2 (10,311.8 ft^2)
Envelope Surface Area	2,729 m^2 (29,374.7 ft^2)
Year Built	2024
Allowable Air Leakage at 75Pa	4,094 L/s

3. Air Leakage Test Procedure

The building was prepared as outlined in Section 9 of the ASTM E3158 test standard. A computer-controlled fan system was used to pressurize and depressurize the building while measuring and collecting air flow and pressure data. The airtightness test was carried out for the whole building and it was tested as a single zone. A test plan was created by BELi that included an estimated number of fans required to reach the target pressure (75Pa).The airtightness tests were carried out as follows:

Stage 1: Building Envelope Test, Depressurize and Pressurize
Stage 2: Operational Test, Depressurize

The whole building airtightness tests were all carried out using the multi-point regression method outlined in Section 10.1 of ASTM E3158.

4.1Blower Door Setup and Pressure Tap Locations

One single-fan blower door with one fan opening was installed in the truck bay rear entrance door (Refer to Figure 1). Two digital manometers (DG-1000) were used to measure the pressurization & depressurization, one at either end of the building. Exterior pressure delta was electronically averaged from two locations at ground level on the North and South of the building (Refer to Figure 1). The pressure taps were run along the side of the building and terminated along the side of the wall.

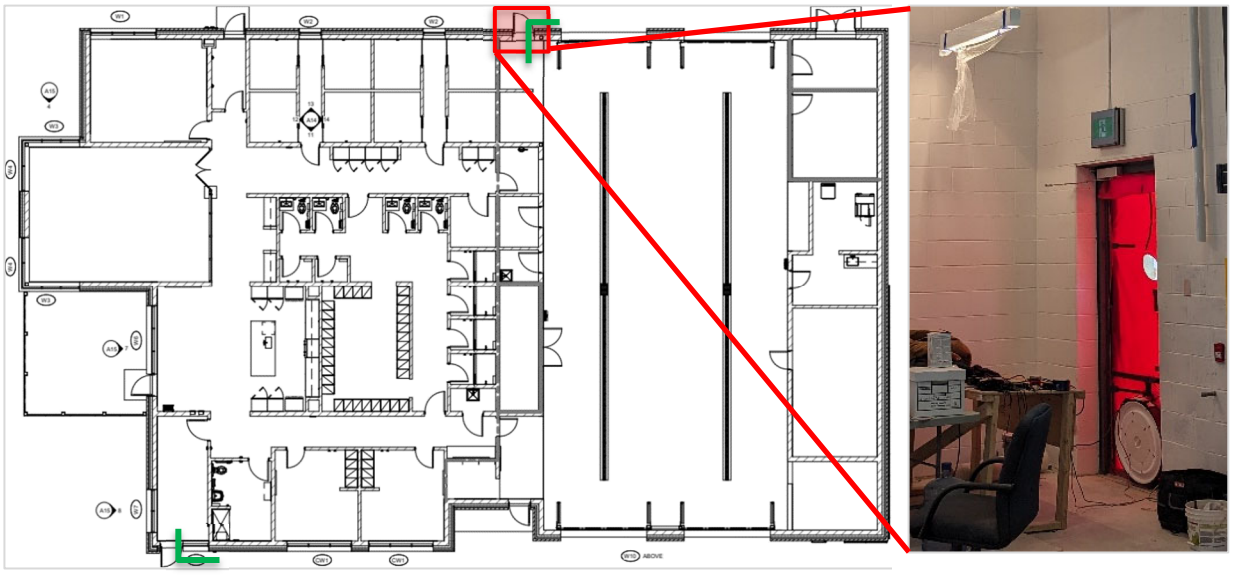

Figure 1: Floor plan (by HOSSACK) with blower door location (red) and pressure tap locations (green)

Initially, 2 fans were set up at opposite sides of the building. During the field-check to reach the building target pressures, it was found that only 1 fan was required to reach the target pressure. The second fan was closed and sealed and the DG-1000 used at this location was only used to determine exterior enclosure pressure at this part of the building.

4.2 Building Test Preparation

Stage 1 included temporary sealing at the mechanical penetrations through the enclosure from the exterior (Refer to Figure 2), exterior doors were closed and interior doors were opened. All plumbing penetrations were filled with water and all mechanical penetrations were sealed—including dampers. Following this for Stage 2 testing, the temporary seals at the mechanical penetrations were removed, while exterior and interior door configurations remained unchanged from Stage 1. Throughout both stages, the HVAC system remained switched off. A summary of openings and their condition for both stages are outlined below:

Table 2: Summary of Penetration Configuration

Intentional Opening	Building Envelope Test	Operational Test
Interior Doors	Open	As found*
Fire Dampers	Open	As found*
Windows, Doors, and Roof Hatches	Closed and latched	Closed and latched
Dryer doors	Not installed	Not installed
Clothes Dryer Vent	Sealed	Open
Air Inlet with dampers	Sealed	As found*
Exhaust with dampers	Sealed	As found*
Make-up air	Sealed	As found*
Floor drains and plumbing	Traps filled	Traps filled
Kitchen Exhaust	Open	As found*

* As found means that temporary air seals were removed and left as BELi found them prior to air sealing was carried out.

Figure 2: Example of exterior penetration sealing at make-up air unit

Figure 3: Example of exterior penetration sealing at exhaust ducts

Temporary air sealing was carried out by the Contractor (Gateman Milloy) and BELi prior to the test. This temporary air sealing was removed by BELi for the Operational Test.

4.3 Equipment List

The following equipment was used during the test. Calibration certificates are available upon request.

Table 3: Summary of Equipment Used

Item	Model	Serial Number(s)
Blower Door Fan	Model 3 fan	31278
Digital Manometer	DG-1000 by The Energy Conservatory (TEC)	10497
Digital Manometer	DG-1000 by The Energy Conservatory (TEC)	2119
Digital temperature/ RH meter	Kestrel Professional	2595720

TECLOG 4 (version 4.2.0.37) software was used to analyze and collect pressure and airflow data, and to operate the fans.

4.4 Deviations from the Test Standard

There were no deviations from the ASTM E3158 standard during the test.

4. Air Tightness Test Results

The following section provides the results for the whole building airtightness test on May 13, 2024. Refer to Appendix A for the full measured results. Note that the allowable airflow at 75 Pa for the size of the building is 4093.5 L/s (or 1.5 L/s/m^2).

4.1 Test Conditions

The following environmental and building conditions were determined on site using a Kestrel Professional device:

Table 4: Test Information: Building Envelope Test - Depressurize

Indoor Temperature (Start – End)	21-22 °C
Outdoor Temperature (Start – End)	23 - 23°C
Wind Speed and Direction	0.7 m/s WSW
Exterior Air Pressure	988 hPa

Table 5: Test Information: Building Envelope Test - Pressurize

Indoor Temperature	21-23°C
Outdoor Temperature	23 - 23°C
Wind Speed and Direction	0.8 m/s WSW
Exterior Air Pressure	988 hPa

Table 6: Test Information: Operational Test - Depressurize

Indoor Temperature	23-23°C
Outdoor Temperature	23-23°C
Wind Speed and Direction	0.9 m/s WSW
Exterior Air Pressure	988 hPa

4.2 Result Summary

Table 7: Summary of Results (Building Envelope Test)

Test Condition	**Depressurize**	**Pressurize**
Air Leakage Coefficient, C	84.0 +/- 7.2%	238.9 +/- 23.1%
Pressure Exponent, n	0.68 +/- 0.039	0.46 +/- 0.1
Correlation Coefficient, r	0.996	0.989
Airflow at 75 PA (L/s)	1603 +/- 1.3%	1743 L/s +/- 1.6%
Airflow at 75 PA (L/s/m^2) – calculated	0.58	0.64
Effective Leakage Area (cm^2 @ 4 Pa)	840.2 +/- 16.1%	1754.4 +/- 15.4%

Overall Result: PASS

Table 8: Summary of Results (Operational Test)

Test Condition	Depressurize
Air Leakage Coefficient, C	146.4 +/- 8.1%
Pressure Exponent, n	0.601 +/- 0.019
Correlation Coefficient, r	0.998
Airflow at 75 PA (L/s)	1956 +/- 0.7%
Airflow at 75 PA (L/s/m^2) – calculated	0.72
Effective Leakage Area (cm^2 @ 4 Pa)	1305.6 +/- 5.4%

Overall Result: PASS

4.3 Deviation Statement

The following outlines whether procedure items in ASTM E3158 were followed.

Table 9: Deviation Summary

Fans sealed prior to pre-test baseline measurement (30 seconds)	Yes
Pre-test baseline measurement taken for 120 seconds	Yes
Pressure difference no more than +/-10% of induced pressure	Yes
Post-test baseline measurement taken for 120 seconds	Yes
Pressure exponent (n) is > 0.45 and < 1.05	Yes
Correlation coefficient squared $r^2 > 0.98$	Yes
Building air flow exceeds target test pressure	Yes
Minimum test pressure above 10 Pa	Yes
Maximum test pressure below 100 Pa	Yes
Each envelope pressure and flow taken within 20 seconds	Yes

5. Discussion and Closure

The maximum normalized air leakage rate for the operational test was measured to be 0.72 L/sm^2 at 75 Pa. This result confirms that building meets and exceeds the airtightness target and achieves a pass.

The air leakage rate for the operational test is greater than the building envelope test. This is due to the removal of the temporary air seals, meaning the intentional openings were included in the overall air leakage result.

Kindest regards,

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Project Manager
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289 795 8863

Jayna Joachim, B.E.Sc.
Project Manager
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APPENDIX A

Full Air Tightness Testing Results:

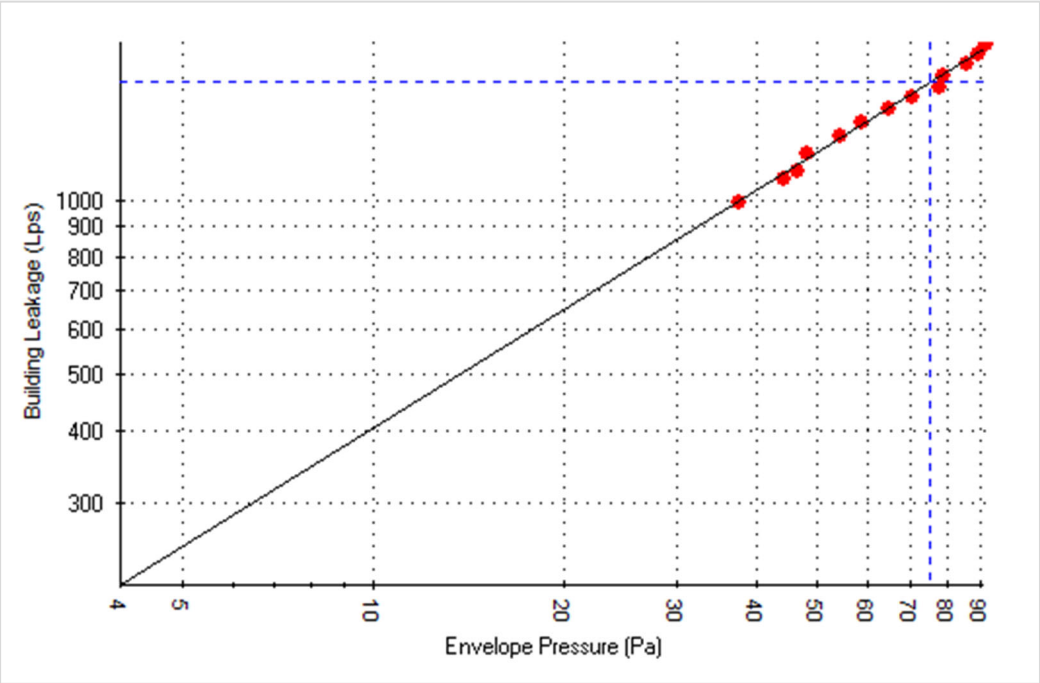
Testing Organization Information:	
Name: Tristan Rouse	
Phone: 289-795-8863	**email**: tristan@beli-eng.com
Company: Building Enclosure Labs Inc. (BELi)	
Address: 71 Wellington Street, London, ON, N6B 2K4	

TEST No.1: Depressurization		
Test Pressure (Pa)	Flow Rate (L/s)	Ring
-91.34	1849.713	Open
-88.98	1781.739	Open
-85.39	1709.383	Open
-78.43	1639.146	Open
-76.85	1564.147	Open
-69.66	1496.371	Open
-64.1	1426.87	Open
-57.94	1354.072	Open
-53.97	1285.965	Open
-47.76	1197.829	Ring A
-43.94	1080.666	Ring A
-37.29	983.199	Ring A
Wind Speed (m/s)[Direction]: 0.7 [WSW]		
Temperature(C): Pre: 21.1 Post:21.8		
Baseline Pressure (Pa): Pre: 1.2 Post: -0.9		
Time: Start: 2:06 pm end: 3:05pm		

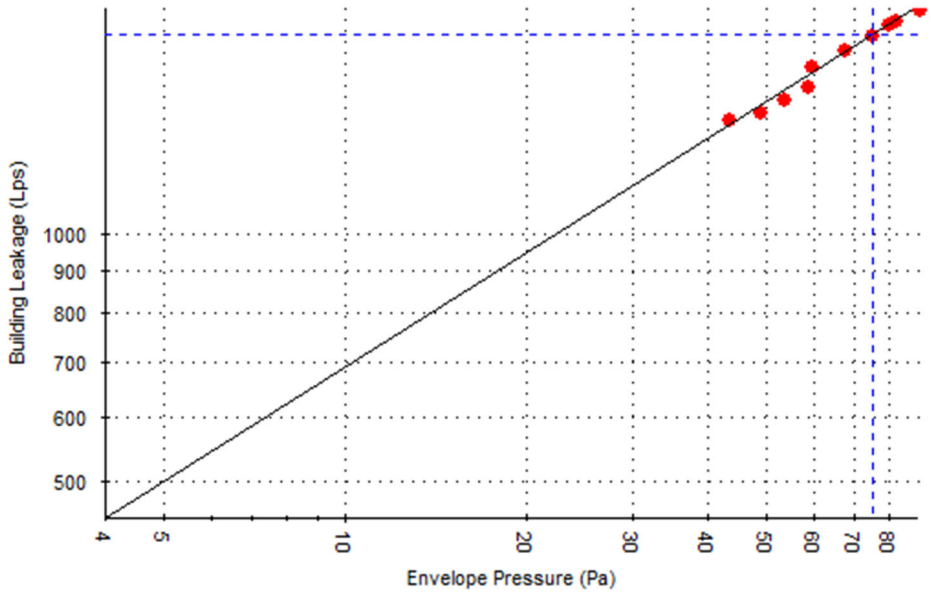
TEST No.2: Pressurization		
Test Pressure (Pa)	Flow Rate (L/s)	Ring
91.02	1880.288	Open
83.4	1827.404	Open
81.06	1802.75	Open
76.18	1754.798	Open
68.63	1677.632	Open
59.99	1517.226	Open
54.81	1464.121	Open
63.91	1498.313	Open
50.15	1415.101	Open
44.76	1384.532	Open
39.99	1095.987	Ring A
34.61	982.422	Ring A
Wind Speed (m/s)[Direction]:0.8 (WSW)		
Temperature(C): Pre:21.4 Post: 23.1		
Baseline Pressure (Pa): Pre:0.4 Post: 2.6		
Time: Start: 3:35pm end: 4:28pm		

TEST No.3: Operational Depressurization		
Test Pressure (Pa)	Flow Rate (L/s)	Ring
29	-89.71	Open
30	-88.71	Open
29	-83.96	Open
29	-79.79	Open
28	-72.63	Open
28	-68.04	Open
30	-63.44	Open
30	-57.58	Open
29	-50.73	Open
29	-47.85	Ring A
30	-41.25	Ring A
29	-35.97	Ring A
Wind Speed (m/s)[Direction]: 0.7 [WSW]		
Temperature(C): Pre: 21.1 Post:21.8		
Baseline Pressure (Pa): Pre: 1.2 Post: -0.9		

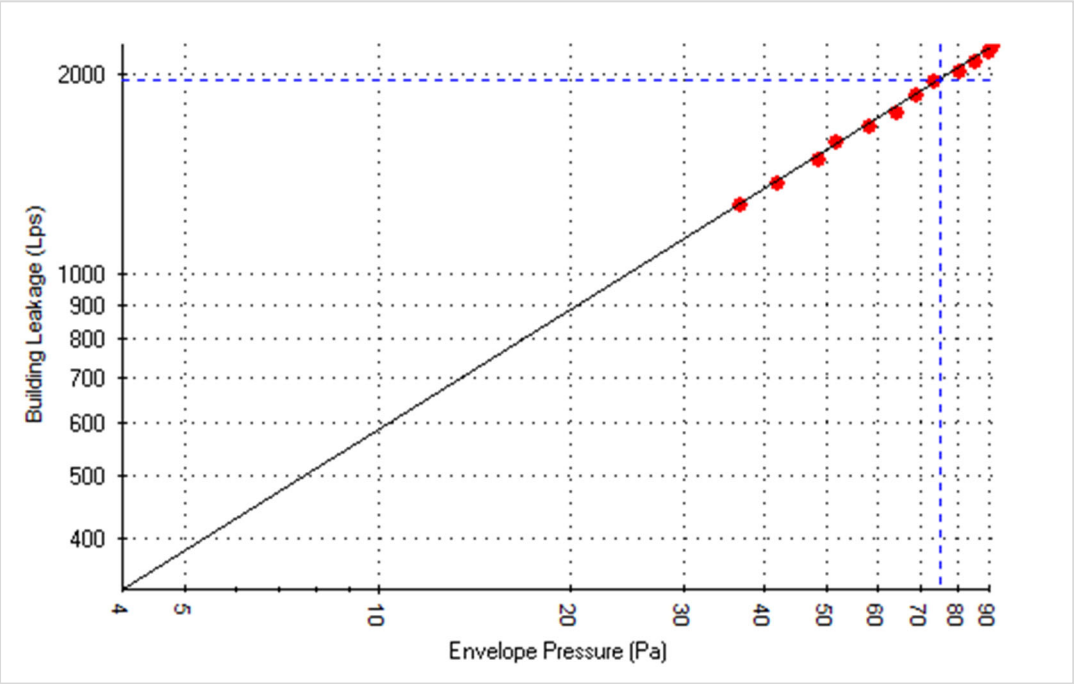
Time: Start: 2:06 pm end: 3:05pm



Depressurization Test



Pressurization Test



Operational Depressurization Test

APPENDIX B

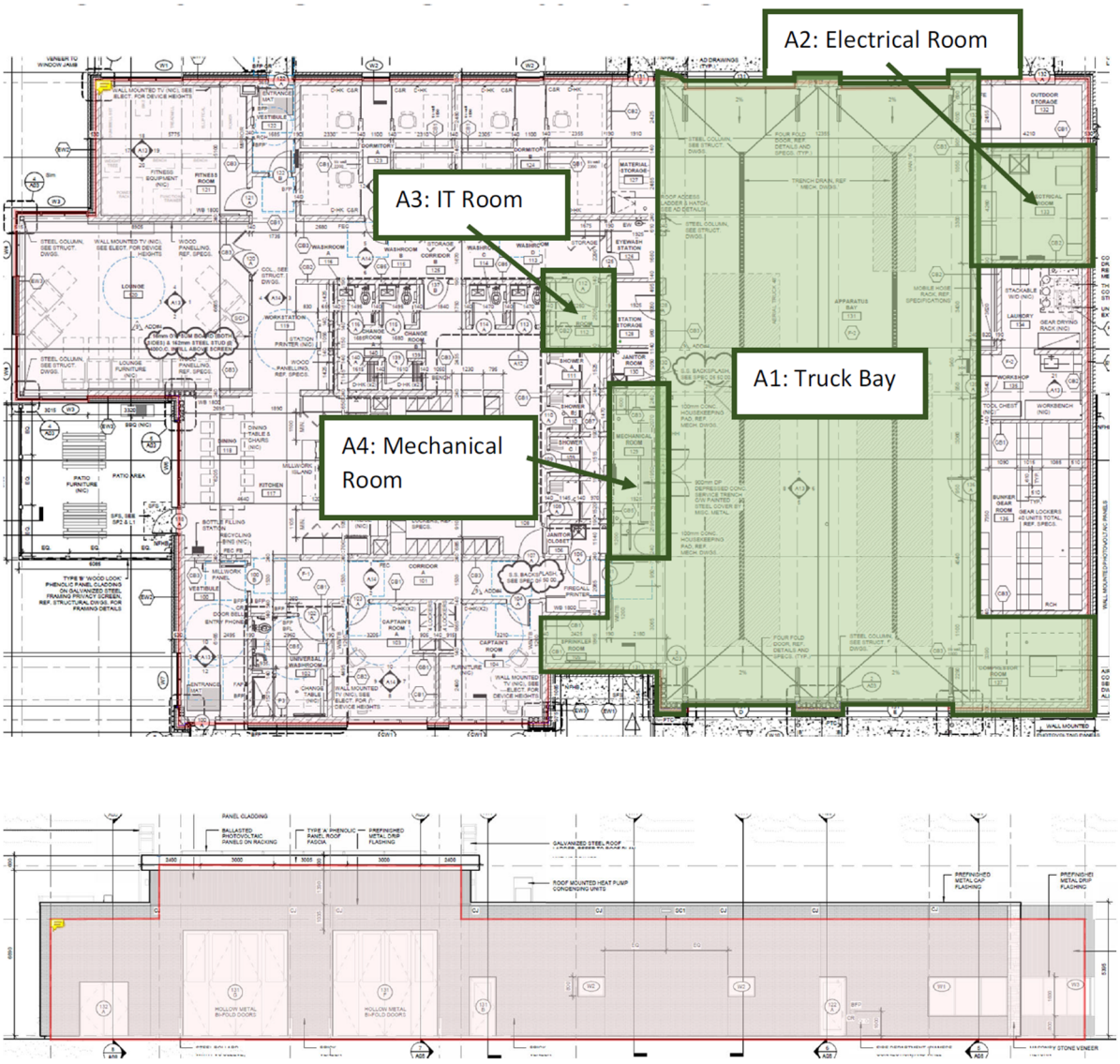


Figure 4: Building enclosure drawings identifying test boundary and auxiliary spaces included in the test