

Report Date: 10-Feb-2025 12:30 PM

FR Ref: YI159/10/02/2025/SCT/FROO

Revision 0

FINAL REPORT

SITE CHAMBER TEST – AIR, WATER & STRUCTURAL

Test Undertaken for:

Metalo Aluminium
Wally Complex-Abu Rawash,
October 6th City, Egypt
Tel: 01223187137

Project:

Testing of Sliding Door Unit-Slim X Ultra

File: YI159

File Name: YI159 Metalo Aluminium- Sliding Door Unit-Slim X Ultra FROO

Thomas Bell-Wright International Consultants (Dubai Branch)
Plot 599 8987, Corner 46 & 47 Streets, Jebel Ali Industrial Area 1, Dubai, U.A.E
T: +971 4 8215777 | enquiries@bell-wright.com | www.bell-wright.com

UAE • KSA • QATAR • UK



Accreditation

ISO 17025 General requirements for the competence of testing and calibrating laboratories by

1. United Kingdom Accreditation Service (UKAS) – 4439
www.ukas.com
2. Emirates International Accreditation Centre – LB-TEST-188
www.eiac.gov.ae



Memberships

Member of Centre for Window and Cladding Technology
www.cwct.co.uk



Member of Council on Tall Buildings and Urban Habitat
www.ctbuh.org



The work included in this document falls wholly or partly under the accreditation checked below

ISO 17025	UKAS	☐
ISO 17025	EIAC	☐

It is a non-accredited test ☒



Table of Contents

Testing of Sliding Door Unit-Slim X Ultra	1
1. GENERAL PARAMETERS	4
2. SAMPLING PROCEDURE	4
3. METHOD OF TEST.....	4
3.1. Air Infiltration Test ASTM E283/E283M-19.....	4
3.2. Static Water Penetration Test ASTM E 331-00 Reapproved: 2016.....	5
3.3. Structural Performance Test Method A, ASTM E 330-14	5
3.4. Structural Proof Load Test 1.5 X, Method A, ASTM E330-14.....	6
4. TEST CRITERIA	6
5. TEST SUMMARY	7
5.1. Physical Condition of Test Specimen.....	8
5.2. Description of the Sample.....	8
5.3. Ambient Test Conditions.....	8
5.4. Test Results	8
5.5. Description of Modification or Rectification (By Contractor)	10
5.6. Description of Adjustment or Exclusion of Test Area.....	10
5.7. Deviation from Standard	10
5.8. Status of Internal Finishes	10
5.9. Test Equipment Details	10
6. COMPLIANCE STATEMENT.....	11
7. CONCLUSION.....	11
8. LIMITATIONS	11
9. REVISION HISTORY	12
10. TEST SHEETS.....	13
11. FIGURES.....	14
12. DRAWINGS	15
13. PHOTOGRAPHS	16
14. TEST WITNESS FORM	20

SITE CHAMBER TEST - FINAL REPORT

TESTING OF SLIDING DOOR UNIT SLIM X ULTRA

PROJECT INFORMATION	
Client/Owner	Metalo Aluminium
Main Contractor	-
Alum. Contractor	-
Consultant	-

MOCKUP/SAMPLE INFORMATION	
Specimen Type	SLIDING DOOR UNIT
Specimen Size	3.57 meters x 3.2 meters
Orientation	Flat
Test Location	Metalo Aluminium - Factory
Manufacturer	Please refer section 11
Model	
Material	

1. GENERAL PARAMETERS

TEST SEQUENCE			
TEST NO.	TEST DESCRIPTION	TEST STANDARD	PROJECT SPECS REF.
Test 1	Air infiltration Test	ASTM E283/E283M-19	Client email dated 24/04/2024 & AAMA-WDMA-CSA - I.S.2 -A440 -17
Test 2	Static Water Penetration Test	ASTM E331-00 (2016)	
Test 3	Structural Performance Test	ASTM E330-14	
Test 4	Structural Performance at 150% positive and negative wind load design pressures	ASTM E331-00 (2016)	

2. SAMPLING PROCEDURE

The test specimens were tested in different locations as selected by the Consultant/Client. M/s. TBWIC was not responsible in the selection of the test location.

3. METHOD OF TEST

3.1. Air Infiltration Test ASTM E283/E283M-19

1. Ambient conditions such as barometric pressure, temperature, wind speed and direction were recorded at or near the exposed surface of the test specimen during the test.

2. The vents were opened, closed and locked five times.
3. The specimen was sealed with non-permeable tape, checking visually that proper sealing was achieved.
4. Negative chamber pressure was applied and flow rate was recorded. Since the standards do not mention the test duration, approximately 1 minute the peak pressure was held and then initial reading were taken and continued to take four more readings to get the average leakage.
5. Without opening the chamber door or disturbing any other seals, the temporary sealing from the specimen was removed.
6. Negative chamber pressure was applied and read flow rate as mentioned above to record the specimen & chamber leakage together.
7. The specimen leakage was recorded by obtaining the difference between Specimen plus chamber leakage & Chamber leakage only.

3.2. Static Water Penetration Test ASTM E 331-00 Reapproved: 2016

1. Ambient conditions such as barometric pressure, temperature, wind speed and direction were recorded at or near the exposed surface of the test specimen during the test.
2. A spray rack consisting of header pipe attached to an arrangement of drop pipes with nozzles uniformly spaced, distanced and angled to achieve uniformity of water spray was installed near the exterior surface of the specimen.
3. The water spray was started and adjusted to the correct flow and pressure as per the in-house verification of the spray rack.
4. Flow rate and corresponding pressure during the test were recorded.
5. Chamber pressure to was adjusted to required pressure and test start time was recorded.
6. After 15 minutes, the pressure was returned to zero in one step, and water spray system was turned off.
7. During the test, test witnesses stayed inside the chamber during the test to look for the leak and to locate the source of the leak.

3.3. Structural Performance Test Method A, ASTM E 330-14

1. Ambient conditions such as barometric pressure, temperature, wind speed and direction were recorded at or near the exposed surface of the test specimen during the test.
2. 09 linear transducers were installed on the interior of the specimen. Three was fixed near two successive anchorages of a typical mullion and one in between, another three located on a transom center and at both ends followed by three on the glass center.
3. For the mullion and the transom, the distance between the outermost transducers was measured and recorded. This distance was divided by allowable deflection to arrive at the permitted deflection.
4. The pressure in the chamber was decreased to 960 Pascals, 50% of the positive test load to set the anchorages, held for 10 seconds and returned to zero. (Positive test load = the pressure on the external side or exposed to the weather is higher than pressure along the internal side of the specimen).
5. After waiting for one minute, the reading of the transducer was set to zero at the computer read program.
6. Pressure was slowly decreased to 1920 Pascals, 100% of the positive design load, and held for 10 seconds, the maximum reading of the transducers was recorded.
7. The pressure is returned to zero after waiting for one minute, and the residual readings on the transducers was recorded.

8. The pressure in the chamber was increased to 960 Pascals, 50% of the negative design load to set the anchorages, and the maximum reading of the transducers was read. (Negative test load = the pressure on the external side or exposed to the weather is lesser than pressure along the internal side of the specimen).
9. After waiting for one minute, the reading at the data acquisition software will be set to zero.
10. Pressure was slowly increased to 1920 Pascals, 100% of the Negative design load, held for 10 seconds, and the deflection recorded.
11. Return the pressure to zero after waiting for one minute, the residual readings on the transducers will be recorded.

3.4. Structural Proof Load Test 1.5 X, Method A, ASTM E330-14

1. Ambient conditions such as barometric pressure, temperature, wind speed and direction were recorded at or near the exposed surface of the test specimen during the test.
2. The same Linear Displacement Transducers installed was kept in place on the interior of the specimen for this test.
3. The distance between the outermost transducers, if moved was measured and recorded as the L, length. This distance L was divided by the allowable deformation to arrive at the permitted value.
4. The pressure in the chamber was then be decreased to 1440 Pascals, 75% of the Negative test load to set the anchorages, held for ten seconds and return to zero pressure. (Negative test load = the pressure on the external side or exposed to weather is lesser than pressure along internal side of the specimen).
5. After waiting for one minute, the reading of the transducer was set to zero at the computer read program.
6. Pressure was slowly decreased to 2880 Pascals, 150% of the Positive test load and held for 10 seconds.
7. The pressure then was returned to zero and after one minute at least, the residual readings of the transducers was recorded to constitute the net deformation.
8. The pressure in the chamber was increased to 1440 Pascals, 75% of the Negative test load to set the anchorages, held for ten seconds and return to zero pressure. (Negative test load = the pressure on the external side or exposed to weather is lesser than pressure along internal side of the specimen).
9. After waiting for one minute, the reading at the data acquisition software was set to zero.
10. Pressure was slowly increased to 2880 Pascals, 150% of the Negative test load, held for 10 seconds, and the maximum and net deflections recorded for information.
11. Return the pressure to zero and after waiting for one minute at least, the residual readings of the transducers were recorded to constitute the net deformation.
12. For more detailed information, please refer to the submitted method statement reference YI159/06/11/2024/MS00/SCT

4. TEST CRITERIA

The following values were mentioned in the approved MS no: YI159/06/11/2024/MS00/SCT

TEST		CRITERIA	REFERENCE
A.	Test Briefing		
B.	Visual Inspection		

1. Air Infiltration Test	ASTM E283/E283M-19	Client email dated 24/04/2024
Test pressure	300 Pa	AAMA-WDMA-CSA - I.S.2 -A440 -17
Permitted Leakage	5.4 m ³ /hr./ m ² for specimen	
2. Static Water Penetration Test	ASTM E 331-00 (2016)	Client email dated 24/04/2024
Test Pressure	500 Pa	AAMA-WDMA-CSA - I.S.2 -A440 -17
Leakage details	There shall be no water penetration inside the test specimen.	
3. Structural Performance Test	ASTM E 330-14	Client email dated 24/04/2024
Test Pressure (inward and outward directions)	1920 Pa inward & 1920 Pa outward pressures	AAMA-WDMA-CSA - I.S.2 -A440 -17
Acceptable Deflection	L/ 175 (distance between end gauges)	
6. Structural Proof Load Test 1.5 X, Method A	ASTM E 330-14	Client email dated 24/04/2024
Test Pressure (inward and outward directions)	2880 Pa inward & 2880 Pa outward pressures	AAMA-WDMA-CSA - I.S.2 -A440 -17
Acceptable Deflection	L/ 500 (distance between end gauges)	

Performance Class - AAMA-WDMA-CSA -I.S.2 -A440 -17		
Class R-PG15-HS		
Class LC-PG25-HS		
Class CW-PG30-HS		
Class AW-PG40-HS		
Legend:		
R: Residential	C: Commercial	AW: Architectural
LC: Light Commercial	HC: Heavy Commercial	

5. TEST SUMMARY

This is the final report of site chamber testing at site for the project Bi-Folding Door Test at Guggenheim Abu Dhabi. The testing was done under the supervision of the Testing Engineer

and assisted by the testing aid of this firm as witnessed by the respective representative from the Consultants and Contractors.

5.1. Physical Condition of Test Specimen

The test specimen was completed during the tests.

5.2. Description of the Sample

Please refer section 11 for sample description.

5.3. Ambient Test Conditions

Indoor Temperature:	20 °C
Outdoor Temperature:	19 °C
Wind Speed:	1.0 m/s
Wind Direction:	South-East
Humidity:	50.8 %
Barometric pressure:	1003 mbar

5.4. Test Results

No.	TEST	DATE & TIME	RESULT
1	Air Infiltration Test, ASTM E283/E283M-19	05-Feb-2025 02:00 PM	PASS
Maximum differential test pressure =300 Pascal Permitted/ allowable leakage rate at 300 Pa for specimen=5.4 m³/hr./m² Specimen Area = 11.4 m² <u>Air leakage of fixed area:</u> The achieved leakage for the chamber and the specimen listed below are as follows: - Extraneous air leakage (specimen sealed with tape) at 300 Pa, (Q_E) =86.91 m³/hr. - Total leakage (chamber plus specimen) at 300 Pa, (Q_T) = 90.14 m³/hr. - Specimen air leakage (SL= Q_T - Q_E) at 300 Pa = 3.22 m³/hr. at standard condition. UOM: - Total Permitted Leakage (TPL) at 300 Pa = 61.69 m³/hr. - Expanded Uncertainty 95% Confidence (EUC95) = 3.02 m³/hr. - Specimen Leakage (SL) = 3.22 m³/hr. 3.22+ 3.02 = 6.24 m³/hr. 3.22- 3.02 = 0.2 m³/hr. Decision Rule:			

- SL $\pm$ EUC95 < TPL, then result of the test will be pass
- SL - EUC95 < TPL & SL < TPL but SL + EUC95 > TPL, then result of the test will be conditional pass
- SL - EUC95 < TPL but SL + EUC95 > TPL & SL > TPL, then result of the test will be conditional fail
- SL > TPL $\pm$ EUC95, then result of the test will be fail

No.	TEST	DATE & TIME	RESULT
2	Static Water Penetration Test, ASTM E 331-00 (2016)	05-Feb-202 04:00 PM	PASS

The spray rack was positioned in accordance with standard requirements and rotameter gauges that control the water volume flow were adjusted and set to the required rate. The entire specimen was covered with 30 nozzles, each nozzle producing 1.26 liters per minute of water flow, thus producing total of 38 liter per minute (LPM) of water spray applied to the entire specimen during the test.

- Minimum required water flow rate per specimen area as per ASTM E 331-00 (2016) = 3.4 L/min/m²
- Test Pressure = 500 Pa
- Test Duration = 15 minutes
- Measured water flow during the test: 38 LPM
- Specimen Area: 11.4 m²
- Recorded water flow rate per specimen area: 3.4 L/min/m²
- Recorded water pressure during the test: 2 Bar
- The pressure recorded during the spray rack calibration: 2 Bar

During the test, no water leakage was found from the tested areas. Hence, the test was recorded as Pass.

No.	TEST	DATE & TIME	RESULT
3	Structural Performance Test, ASTM E 330-14	05-Feb-2025 05:45 PM	PASS

The table below shows the net calculated deflections, in mm, for gauge nos. 2 which show the net deflection measurements for the mullion.

Both the positive and negative peak load deflections were within the allowable limits.

See Figure 1 in Section 10 for the gauge locations.

Gauge no.	Allowable	+ve peak	+ve residual	-ve peak	-ve residual
2* - mullion	19.2	7.6	0.45	8.8	0.15

No.	TEST	DATE & TIME	RESULT
4	Structural Proof Load Test 1.5 X, Method A ASTM E 330-14	05-Feb-2025 06:05 PM	PASS

The table below shows the net calculated residual deflections, in mm, for gauge 2, which show the net residual deflection measurements for the mullion.

No damage to the sample was visible.

Both the positive and negative residual deflections were within the allowable limits.

See Figure 1 in Section 10 for the gauge locations.

Gauge no.	Allowable	+ve residual	-ve residual
2* - mullion	6.74	2.05	1.55

5.5. Description of Modification or Rectification (By Contractor)

No modification or adjustment was done to the test specimen by the contractor

5.6. Description of Adjustment or Exclusion of Test Area

No modification or adjustment was done to the test specimen by the contractor

5.7. Deviation from Standard

Test has been performed as per the standard test procedure with no deviation unless otherwise specified.

5.8. Status of Internal Finishes

This is PMU test and hence this not applicable.

5.9. Test Equipment Details

The following equipment were employed for performing the test.

Sr. No.	Equipment Details	Asset Code	Calibration Due Date
1	Manometer-1	ARE-A-21-06-STD-0063	25-Jun-2025
2	Manometer-2	ARE-A-23-01-STD-0080	10-Jun-2025
3	Thermohydrometer	ARE-A-21-05-STD-0060	10-Jun-2025
4	Barometer	ARE-A-19-10-STD-0086	14-May-2025
5	Stopwatch	ARE-E-17-11-STD-0018	24-May-2025
6	Measuring Tape	ARE-E-18-02-STD-0020	25-May-2025
7	Anemometer	ARE-A-23-08-STD-0119	23-Sep-2025
8	Rotameter	ARE-E-21-03-STD-0041	24-May-2025
9	Pressure gauge	ARE-A-20-02-STD-0110	27-Jul-2025

10	LDTs/Dial Gauge 1	ARE-A-23-08-STD-0123	24-May-2025
11	LDTs/Dial Gauge 2	ARE-A-23-08-STD-0122	24-May-2025
12	LDTs/Dial Gauge 3	ARE-A-23-01-STD-0077	11-Jun-2025

The copies of calibration certificates will be issued upon request.

6. COMPLIANCE STATEMENT

The specimen was tested as per the procedure described in section 3 of this document in conformance with project requirements and corresponding test standards with corresponding test results as mentioned in section 5.4

7. CONCLUSION

The tests were conducted according to the procedure mentioned and project specification requirements.

And sample achieved Performance Class:

Class AW-PG40-HS

Test sequence no.	Test	Result	Observation
1	Air Infiltration Test ASTM E283/E283M-19 Test Pressure: 300 Pa	PASS	The specimen air leakage was within the allowable limit.
2	Static Water Penetration Test ASTM E 331-00 (2016) Test Pressure: 500 Pa	PASS	No water leakage was found in the tested areas.
3	Structural Performance Test ASTM E 330-14 Test Pressure: +/- 1920 Pa	PASS	Both the positive and negative peak load deflections were within the allowable limits.
4	Structural Proof Load Test 1.5 X, Method A ASTM E 330-14 Test Pressure: +/- 2880 Pa	PASS	Residual deflections recorded for information. No damage to the sample was visible.

Refer to the decision rule provided in the method statement.

8. LIMITATIONS

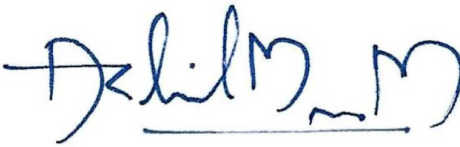
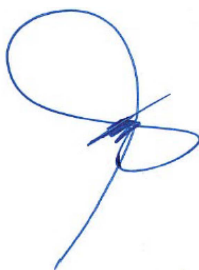
The test results are valid only for the specific tested locations during the time of test mentioned herein.

9. REVISION HISTORY

Revision No.	Description
00	Initial Issue

This Final Report is respectfully submitted by:

Thomas Bell-Wright International Consultants

Test Conducted by & Report Prepared by:	Reviewed & authorized by:
 Akhil Mohan Site Testing Engineer	 Clarence Facun Façade Testing Manager

10. TEST SHEETS

1

Air Infiltration Test ASTM E283:2004 (2012)

This is the first test in sequence, and the initial running of this test

Project Name: **Slim-X Ultra**

Client: **Metalo Egypt**

File: **YI159**

TEST CRITERIA

Specimen height	3.57 m
Specimen width	3.20 m
Specimen area	11.42 m²
Length of opening joint	0.00 m
Permitted leakage, area	5.40 m³/hr/m²
Permitted leakage, opening joint	0.00 m³/hr/m

INSTANTANEOUS VALUES

Ambient Temperature	20 °C
Barometric Pressure	1003 mb
Relative Humidity	0.49
Chamber Pressure	304 Pa
Nozzle Pressure	74 Pa
Input Data Check	1

MEAN LEAKAGE AT AMBIENT CONDITIONS

Extraneous leakage at ambient conditions	86.91 m³/hr
Uncertainty of Extraneous Leakage	± 1.11 m³/hr
Total leakage at ambient conditions	90.14 m³/hr
Uncertainty of Total Leakage	± 1.07 m³/hr
Specimen leakage at ambient conditions	3.23 m³/hr

AIR INFILTRATION TEST RESULT

Specimen Leakage at Standard Conditions	3.22 m³/hr
Standard Uncertainty (68% confidence)	± 1.54 m³/hr
Expanded Uncertainty (95% confidence)	± 3.02 m³/hr

MEAN LEAKAGE DATA

	Readings	Temp	Bar	RH	Dia	Chamber	Nozzle	Air Flow	Adjusted	Uncerty	Time	Date
Extraneous	5	20 °C	1003 mb	0.49	55.91 mm	301 Pa	66 Pa	86.91 m³/hr	86.91 m³/hr	± 1.11 m³/hr	4:20 PM	5-Feb-25
Total	5	20 °C	1003 mb	0.49	55.91 mm	301 Pa	71 Pa	90.14 m³/hr	90.14 m³/hr	± 1.07 m³/hr	4:26 PM	5-Feb-25

Thomas Bell-Wright International Consultants, Dubai

PRESSURE & FLOW

Test pressure	300 Pa
Total permitted leakage	61.69 m³/hr
Required accuracy (5%)	± 3.08 m³/hr

CALCULATED VALUES

Ambient Air Density	1.19 kg/m³
Standard Air Density	1.20 kg/m³
Reynolds Number	37,879
Check Value	91.39 m³/hr
Air Flow at ambient conditions	92.23 m³/hr
Adjust to exact Test Pressure	91.62 m³/hr
Uncertainty	± 1.05 m³/hr

After completion of the testing, the data was saved at 16:26, in C:\Users\Tayib\Desktop\Jobs-2025\Metalo Aluminium - Egtpt\ASTM E783-Sliding door-Slim-X-SCT05.02.2025.xls\Air (Fixed)

INPUT CONNECTION

Conical Inlet Nozzle Dia.	55.91 mm
Pressure Tdr. Range	500 Pa
Pressure Tdr. Uncertainty	2.8 Pa
Chamber Connection	LDT 2
Nozzle Connection	LDT 1

UNCERTAINTY

Method, from BS848	0.4227 m³/hr
Nozzle pressure	1.7334 m³/hr
Nozzle diameter	0.1836 m³/hr
Barometric pressure	0.1831 m³/hr
Temperature	0.1660 m³/hr
Relative Humidity	0.0124 m³/hr
Total uncertainty	1.0454 m³/hr

Testing Engineer

Akhil Mohan

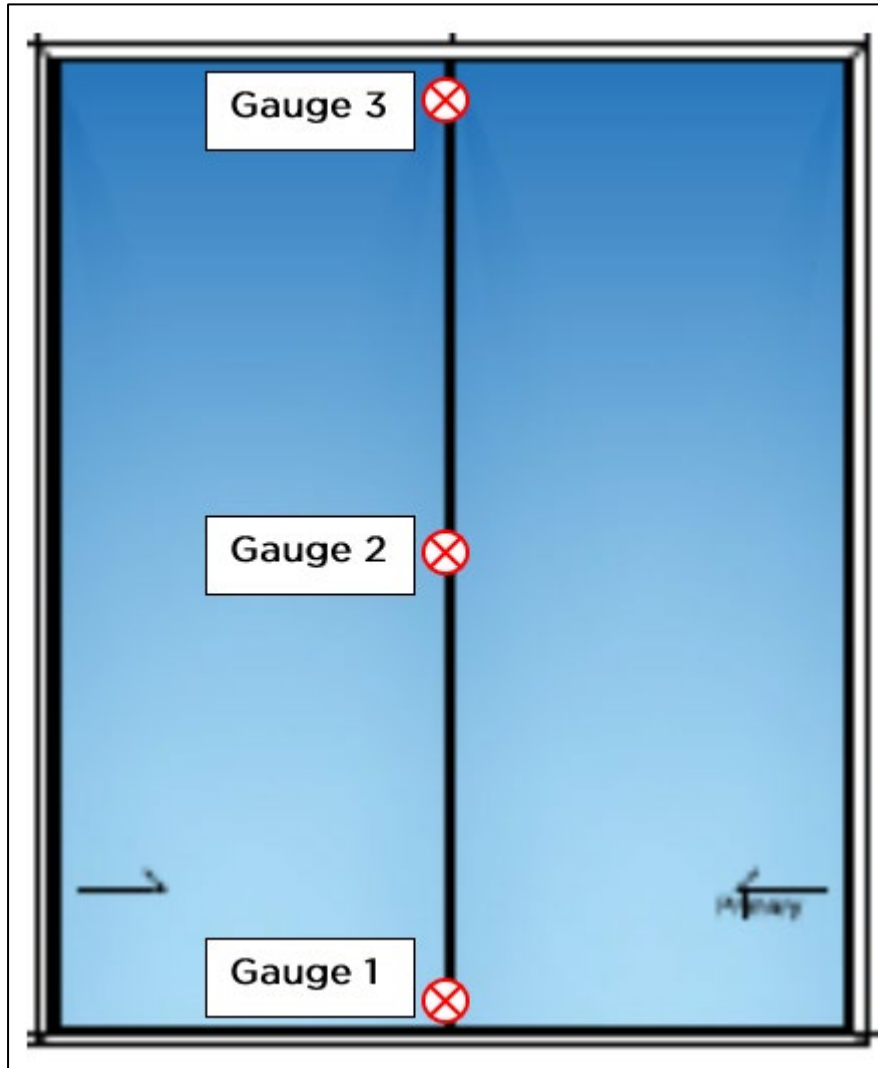
Date: **5-Feb-25**

TBW-CW-28 - Issue1 - Issue Date - March 2022

11. FIGURES

Please see below figures for locations for transducers for structural performance test;

Figure 1:



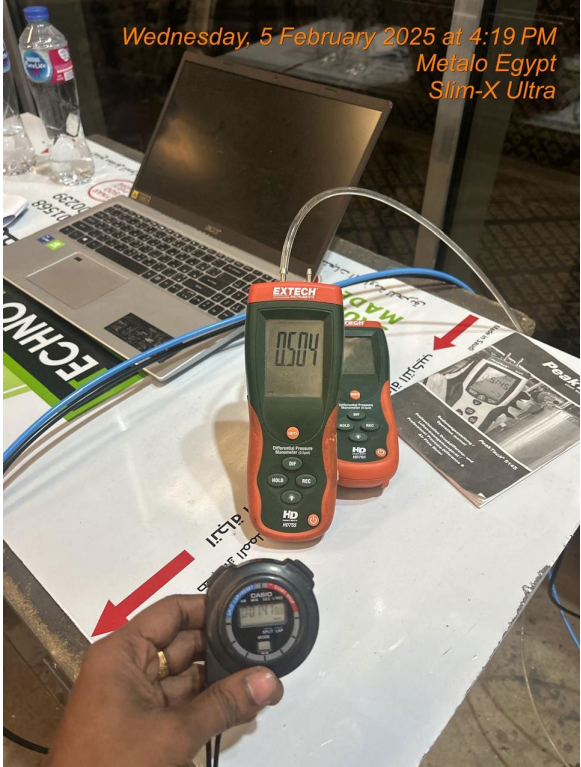
12. DRAWINGS

[illegible]

13. PHOTOGRAPHS

Photo No.	Description	Photograph
1	External View of test specimen	 Wednesday, 5 February 2025 at 4:19 PM Metalco Egypt Slim-X Ultra
2	Site chamber test set-up Manometer and controller to regulate and monitor test pressure	 Wednesday, 5 February 2025 at 2:18 PM Metalco Egypt Slim-X Ultra

3	Test in progress - Air infiltration test	 Wednesday, 5 February 2025 at 2:17 PM Metalo, Egypt Slim-X Ultra
4	Spray bar set-up for static water penetration	 Wednesday, 5 February 2025 at 4:19 PM Metalo, Egypt Slim-X Ultra

5	Test in progress – Static water penetration	 Wednesday, 5 February 2025 at 4:19 PM Metalo Egypt Slim-X Ultra
6	Water flow regulated by rotameter	 Wednesday, 5 February 2025 at 4:20 PM Metalo Egypt Slim-X Ultra

7	Dial gauge set-up to record deflection of framing member	
---	--	---

14. TEST WITNESS FORM

SI No.	Name	Company
1	Sherif Zohny (CEO)	Metalo Aluminium
2	George Wadie (Finance Manager)	Metalo Aluminium
3	Kareem Esawy (Technical Office Manager)	Metalo Aluminium
4	Mostafa Abu-Elkhier (Operation Manager)	Metalo Aluminium

---End of Report---