November 22, 2014

Toro Glass Wall Inc
300 Edgeley Boulevard, Concord
Ontario, Canada L4K-3Y3

Attn.: Carlo Iannessa

Project: TGW Series PMU PO 3493-MOK-TGW

Subject: Performance Testing

Mr. Iannessa,

At your request, Smith-Emery Laboratories has provided testing at the above mentioned project. The accompanying report number CW14-633 presents a description of the tests performed, the results of our testing, and our conclusions.

We appreciate this opportunity to be of service to you. If you have any questions regarding this report, please do not hesitate to contact us at your convenience.

Respectfully Submitted,
SMITH-EMERY LABORATORIES, INC.

Dana Nelson
Curtain/Window Wall Manager
Attachment: Report No.CW14-633
cc: File
EVALUATION OF  Toro Glass Wall PMU Mockup

PREPARED FOR  Toro Glass Wall Inc
300 Edgeley Boulevard, Concord
Ontario, Canada L4K-3Y3

TESTING LOCATION  SMITH-EMERY LABORATORIES
781 E WASHINGTON BLVD
LOS ANGELES, CA 90021

PROJECT NUMBER:  42409-3
REPORT NUMBER:  CW14-633
REPORT DATE:  NOVEMBER 22, 2014
TEST COMPLETION DATE:  NOVEMBER 19, 2014
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## 1.00 INTRODUCTION

### 1.01 Purpose

The purpose of our testing was to evaluate the installed conditions of the test specimen.

### 1.02 Scope of Testing

The general scope of this testing program included the following:

- Perform testing in accordance with the ASTM and AAMA specifications.
- Preparation of this report providing descriptions and results of the above testing and our conclusions.

### 1.03 Specimen Description

TORO Glass Wall Unitized Curtain Wall System See attached drawings provided by TGW
Weather conditions: Sunny with temps ranging from (22.7 c) 73 F to (26.6 c) 80 F degrees.

2.00 Final Test Results and Finding.

Tests Performed                              Results.

OPERATE VENT ASSEMBLY.                      Pass.
2. PRELOAD                                   Pass.
3. AIR INFILTRATION TEST.                   Pass.
4. WATER PENETRATION UNDER STATIC PRESSURE  Pass.
5. WATER PENETRATION UNDER DYNAMIC PRESSURE  Pass.
6. STRUCTURAL TEST AT 50% & 100% OF INWARD DESIGN PRESSURE. Pass.
7. STRUCTURAL TEST AT 50% & 100% OF OUTWARD DESIGN PRESSURE Pass.
8. AIR INFILTRATION TEST.                   Pass.
9. WATER PENETRATION UNDER STATIC PRESSURE. Pass.
10. SEISMIC HORIZONTAL DISPLACEMENT PARALLEL. Pass.
11. AIR INFILTRATION TEST.                   Pass.
12. WATER PENETRATION UNDER STATIC PRESSURE. Pass.
13. WATER PENETRATION UNDER DYNAMIC PRESSURE. Pass.
14. STRUCTURAL TEST AT 75%, & 150% OF INWARD DESIGN PRESSURE. Pass.
15. STRUCTURAL TEST AT 75%, & 150% OF OUTWARD DESIGN PRESSURE. Pass.
16. SEISMIC HORIZONTAL DISPLACEMENT PARALLEL 1.5 X DESIGN. Pass.

3. AIR INFILTRATION TEST

19.3 c 66.9 F 28% H 9:00 am
Fixed Area allowable 78.44 cubic m/hr 46.17 CFM
Total measured 8.66 cubic m/hr 5.1 CFM
Operable vent allowable 4.84 cubic m/hr 2.85 CFM
Total measured .339 cubic m/hr 0.2 CFM

6. STRUCTURAL TEST AT 50% & 100% OF INWARD DESIGN PRESSURE.

<table>
<thead>
<tr>
<th>Glass adjacent to corner</th>
<th>Allowable</th>
<th>Net deflection measured</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20.32 mm 0.800”</td>
<td></td>
</tr>
<tr>
<td>Typical glass</td>
<td>20.06 mm 0.790”</td>
<td></td>
</tr>
<tr>
<td>Corner mullion</td>
<td>19.05 mm 0.750”</td>
<td></td>
</tr>
<tr>
<td>Typical mullion</td>
<td>19.05 mm 0.750”</td>
<td></td>
</tr>
<tr>
<td>Typical horizontal mullion</td>
<td>7.92 mm 0.312”</td>
<td></td>
</tr>
</tbody>
</table>

7. STRUCTURAL TEST AT 50% & 100% OF OUTWARD DESIGN PRESSURE

<table>
<thead>
<tr>
<th>Glass adjacent to corner</th>
<th>Allowable</th>
<th>Net deflection measured</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20.32 mm 0.800”</td>
<td></td>
</tr>
<tr>
<td>Typical glass</td>
<td>20.82 mm 0.820”</td>
<td></td>
</tr>
<tr>
<td>Corner mullion</td>
<td>19.05 mm 0.750”</td>
<td></td>
</tr>
<tr>
<td>Typical mullion</td>
<td>19.05 mm 0.750”</td>
<td></td>
</tr>
<tr>
<td>Typical horizontal mullion</td>
<td>7.92 mm 0.312”</td>
<td></td>
</tr>
</tbody>
</table>

8. AIR INFIILTRATION TEST
Fixed Area allowable 78.44 cubic m/hr 46.17 CFM
Operable vent allowable 4.84 cubic m/hr 2.85 CFM
Total measured for total mockup 7.64 cubic m/hr 4.5 CFM

11. AIR INFIILTRATION TEST
Fixed Area allowable 78.44 cubic m/hr 46.17 CFM
Operable vent allowable 4.84 cubic m/hr 2.85 CFM
Total measured for total mockup 7.64 cubic m/hr 4.5 CFM

14. STRUCTURAL TEST AT 75%, & 150% OF INWARD DESIGN PRESSURE

<table>
<thead>
<tr>
<th>Glass adjacent to corner</th>
<th>Allowable</th>
<th>Net deflection measured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corner mullion</td>
<td>3.17 mm 0.125”</td>
<td></td>
</tr>
<tr>
<td>Typical mullion</td>
<td>3.17 mm 0.125”</td>
<td></td>
</tr>
<tr>
<td>Typical horizontal mullion</td>
<td>1.57 mm 0.062”</td>
<td></td>
</tr>
</tbody>
</table>

15. STRUCTURAL TEST AT 75%, & 150% OF OUTWARD DESIGN PRESSURE

<table>
<thead>
<tr>
<th>Glass adjacent to corner</th>
<th>Allowable</th>
<th>Net deflection measured</th>
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<tbody>
<tr>
<td>Corner mullion</td>
<td>3.17 mm 0.125”</td>
<td></td>
</tr>
<tr>
<td>Typical mullion</td>
<td>3.17 mm 0.125”</td>
<td></td>
</tr>
</tbody>
</table>
Typical horizontal 1.57 mm 0.062” .050 mm 0.002”

2.01 Test Witness List

Name Company
Carlo Lannessa TGW
Zygmunt Zuchelkowski Toro Aluminum
Jacob Sliwinski TGW
John Barkovich Toro Aluminum
Dana Nelson SEL
Juan Silva SEL

2.02 Test Methods

Description of test methods performed

1. OPERATE VENT ASSEMBLY.
TEST PROCEDURE
Unlock and completely open and close and lock perform this 5 times on each.

ACCEPTANCE CRITERIA:
Perform a visual inspection of all components note any findings.

2. PRELOAD
(Ref.: ASTM E330)
TEST PROCEDURE
Preload at 50% of the inward design wind pressure 1436.4 pa 30.0 PSF.

ACCEPTANCE CRITERIA:
Visually inspect the assembly for any detrimental affects.

3. AIR INFILTRATION TEST
(Ref: ASTM E 283)
TEST PROCEDURE
Cover and seal the mockup completely with polyethylene sheeting while leaving the chamber uncovered. Develop a positive differential pressure of 298.7 pa 6.24 PSF on the chamber. Record the airflow required to maintain this pressure. This number represents the airflow through the chamber. Remove the sheeting and reestablish the positive pressure of 298.7 pa 6.24 PSF. Record the airflow required to maintain this pressure. This number is the airflow through the mockup and chamber. The difference between the two-recorded airflows is the airflow through the mockup.

ACCEPTANCE CRITERIA:
.1019 cubic m/hr 0.06 CFM per square foot of exterior surface, exclusive of any operating window and
door areas. Mockup area x.06 = S.F. .509 cubic m/hr 0.3CFM/ft² for any vent assembly.

4. WATER PENETRATION UNDER STATIC PRESSURE  
(Ref. ASTM E 331)  
TEST PROCEDURE  
Establish a positive test pressure of 718.2 pa 15.0 PSF on the mockup. Apply water to the exterior of the mockup at a rate of 5 gallons per hour per square foot for a period of fifteen minutes while maintaining the differential pressure of 718.2 pa 15.0 PSF. During this period, visually inspect the interior of the mockup for water penetration.

ACCEPTANCE CRITERIA:  
There shall be no unacceptable water leakage, defined as follows:  
The occurrence of condensation during water infiltration tests is acceptable. Other water leakage is acceptable only if all of the following conditions are satisfied: (a) the water is contained and drained to the exterior; (b) there would be no staining or other damage to any part of the completed building or its furnishings (c) No water beyond a plane parallel to the vertical plane intersecting the innermost projection of the test specimen.

5. WATER PENETRATION UNDER DYNAMIC PRESSURE  
(Ref.: AAMA 501.1)  
TEST PROCEDURE  
Apply an air stream equivalent to a static differential air pressure of 718.2 pas 15.0 PSF (123.9 km/h 77 mph, 152.8 km/h 95 mph and 180.2 km/h 112 mph) to the mockup. Apply water to the mockup at a rate of five gallons per hour per square foot for a period of fifteen minutes. During this period visually inspect the interior of the mockup for water penetration.

ACCEPTANCE CRITERIA:  
There shall be no unacceptable water leakage, defined as follows:  
The occurrence of condensation during water infiltration tests is acceptable. Other water leakage is acceptable only if all of the following conditions are satisfied: (a) the water is contained and drained to the exterior: (b) there would be no staining or other damage to any part of the completed building or its furnishings: (c) No water beyond a plane parallel to the vertical plane intersecting the innermost projection of the test specimen.

6. STRUCTURAL TEST AT 50% & 100% OF INWARD DESIGN PRESSURE  
(Ref.: ASTM E330)  
TEST PROCEDURE  
Apply positive pressure to the mockup of 1436.4 pa 30.0 PSF and hold for 10 seconds. Release the pressure difference across the mockup. After a recovery period of not less than 1 minute or more than 5 minutes at zero loads, record initial readings. Increase positive pressure to 2872.8 pa 60.0 PSF and hold for 10 seconds. Record deflection readings. Reduce pressure to zero. After a recovery period of not less than 1 minute nor more than 5 minutes zero load measuring devices.

ACCEPTANCE CRITERIA:  
Net deflection of any framing members shall not exceed L/175 of the clear span or 19.05 mm 3/4"
whichever is less for spans less than 4114.8 mm 13'-6" For spans over 4114.8 mm 13'-6" Net deflection of any framing members shall not exceed L240 + 6.95 mm ¼" of the clear span.

7. STRUCTURAL TEST AT 50% & 100% OF OUTWARD DESIGN PRESSURE (Ref.: ASTM E330)

TEST PROCEDURE
Apply negative pressure to the mockup of 1436.4 pa 30.0 PSF and hold for 10 seconds. Release the pressure difference across the mockup. After a recovery period of not less than 1 minute nor more than 5 minutes at zero load, record initial readings. Increase negative pressure to 2872.8 pa 60.0 PSF and hold for 10 seconds. Record deflection readings. Reduce pressure to zero. After a recovery period of not less than 1 minute nor more than 5 minutes zero load measuring devices.

ACCEPTANCE CRITERIA:
Same as procedure (6)

8. AIR INFILTRATION TEST (Ref: ASTM E 283)

TEST PROCEDURE
Cover and seal the mockup completely with polyethylene sheeting while leaving the chamber uncovered. Develop a positive differential pressure of 298.7 pa 6.24 PSF on the chamber. Record the airflow required to maintain this pressure. This number represents the airflow through the chamber. Remove the sheeting and reestablish the positive pressure of 298.7 pa 6.24 PSF. Record the airflow required to maintain this pressure. This number is the airflow through the mockup and chamber. The difference between the two-recorded airflows is the airflow through the mockup.

ACCEPTANCE CRITERIA:
.1019 cubic m/hr 0.06 CFM per square foot of exterior surface, exclusive of any operating window and door areas. Mockup area x.06 = S.F. .509 cubic m/hr 0.3CFM/ft² for any vent assembly.

9. WATER PENETRATION UNDER STATIC PRESSURE (Ref: ASTM E 331)

TEST PROCEDURE
Establish a positive test pressure of 718.2 pa 15.0 PSF on the mockup. Apply water to the exterior of the mockup at a rate of 5 gallons per hour per square foot for a period of fifteen minutes while maintaining the differential pressure of 718.2 pa 15.0 PSF. During this period, visually inspect the interior of the mockup for water penetration.

ACCEPTANCE CRITERIA:
There shall be no unacceptable water leakage, defined as follows:
The occurrence of condensation during water infiltration tests is acceptable. Other water leakage is acceptable only if all of the following conditions are satisfied: (a) the water is contained and drained to the exterior; (b) there would be no staining or other damage to any part of the completed building or its furnishings (c) No water beyond a plane parallel to the vertical plane intersecting the innermost projection of the test specimen.
10. **SEISMIC HORIZONTAL DISPLACEMENT PARALLEL AT 63.5 mm 2.5".**  
(Ref AAMA 501.4)  
**TEST PROCEDURE**  
Using a hydraulic system the intermediate floor level will be moved to the left of center and then to the right of center this shall be repeated for three cycles.

**ACCEPTANCE CRITERIA**  
Project specifications shall state detailed pass/fail criteria for façade systems if not provided Refer to AAMA 501.4 section 11.0 for applicable performance level based on occupancy level groups I, II, and III. The system shall remain water tight without repair no structural damage or disengagement of trim or snap on members glazing gaskets or sealant, no breakage of glass shall occur.

11. **AIR INFILTRATION TEST**  
(Ref: ASTM E 283)  
**TEST PROCEDURE**  
Cover and seal the mockup completely with polyethylene sheeting while leaving the chamber uncovered. Develop a positive differential pressure of 298.7 pa 6.24 PSF on the chamber. Record the airflow required to maintain this pressure. This number represents the airflow through the chamber. Remove the sheeting and reestablish the positive pressure of 298.7 pa 6.24 PSF. Record the airflow required to maintain this pressure. This number is the airflow through the mockup and chamber. The difference between the two-recorded airflows is the airflow through the mockup.

**ACCEPTANCE CRITERIA:**  
.1019 cubic m/hr 0.06 CFM per square foot of exterior surface, exclusive of any operating window and door areas. Mockup area x.06 = S.F. .509 cubic m/hr 0.3CFM/ft 2 for any vent assembly.

12. **WATER PENETRATION UNDER STATIC PRESSURE**  
(Ref. ASTM E 331)  
**TEST PROCEDURE**  
Establish a positive test pressure of 718.2 pa 15.0 PSF on the mockup. Apply water to the exterior of the mockup at a rate of 5 gallons per hour per square foot for a period of fifteen minutes while maintaining the differential pressure of 718.2 pa 15.0 PSF. During this period, visually inspect the interior of the mockup for water penetration.

**ACCEPTANCE CRITERIA:**  
There shall be no unacceptable water leakage, defined as follows: The occurrence of condensation during water infiltration tests is acceptable. Other water leakage is acceptable only if all of the following conditions are satisfied: (a) the water is contained and drained to the exterior; (b) there would be no staining or other damage to any part of the completed building or its furnishings (c) No water beyond a plane parallel to the vertical plane intersecting the innermost projection of the test specimen.

13. **WATER PENETRATION UNDER DYNAMIC PRESSURE**  
(Ref.: AAMA 501.1)
TEST PROCEDURE
Apply an air stream equivalent to a static differential air pressure of 718.2 pa 15.0 PSF 123.9 km/h (77mph) to the mockup. Apply water to the mockup at a rate of five gallons per hour per square foot for a period of fifteen minutes. During this period visually inspect the interior of the mockup for water penetration.

ACCEPTANCE CRITERIA:
There shall be no unacceptable water leakage, defined as follows:
The occurrence of condensation during water infiltration tests is acceptable. Other water leakage is acceptable only if all of the following conditions are satisfied: (a) the water is contained and drained to the exterior; (b) there would be no staining or other damage to any part of the completed building or its furnishings; (c) No water beyond a plane parallel to the vertical plane intersecting the innermost projection of the test specimen.

14. STRUCTURAL TEST AT 75%, & 150% OF INWARD DESIGN PRESSURE
(Ref. ASTM E 330)
TEST PROCEDURE
Apply positive pressure to the mockup of 2154.6 pa 45.0 PSF and hold for 10 seconds. Release the pressure difference across the mockup. After a recovery period of not less than 1 minute nor more than 5 minutes at zero load, record initial readings. Increase positive pressure to 4309.2 pa 90.0 PSF. Hold for 10 seconds. Reduce pressure to zero. After a recovery period of not less than 1 minute nor more than 5 minutes at zero load, record zero load readings to determine permanent deformation.

ACCEPTANCE CRITERIA:
Net permanent deflection of framing members shall not exceed L/1000 times the clear span. No permanent set to anchors of more then 1.58 mm 1/16”.

15. STRUCTURAL TEST AT 75%, & 150% OF OUTWARD DESIGN PRESSURE
(Ref. ASTM E 330)
TEST PROCEDURE
Apply negative pressure to the mockup of 2154.6 pa 45.0 PSF and hold for ten seconds. Release the pressure difference across the mockup. After a recovery period of not less than 1 minute nor more than 5 minutes at zero load, record initial readings. Increase negative pressure to 4309.2 pa 90.0 PSF hold for 10 seconds. Reduce pressure to zero. After a recovery period of not less than 1 minute nor more than 5 minutes at zero load, record zero load readings to determine permanent deformation.

ACCEPTANCE CRITERIA:
Same as procedure (14).

16. SEISMIC HORIZONTAL DISPLACEMENT PARALLEL 1.5 X DESIGN 109.7 mm 4.32”
(Ref AAMA 501.4)
TEST PROCEDURE
Using a hydraulic system the intermediate floor level will be moved to the left of center and then to the
right of center this shall be repeated for three cycles.

**ACCEPTANCE CRITERIA**
For all building occupancy types, a specimen subject to the 1.5 x design displacement test shall be considered passing if all of the glass is retained completely in the glazed opening with no glass fallout and no wall components fall off, unless otherwise specified.

### 3.00 CONCLUSIONS AND CLOSURE

#### 3.01 CONCLUSIONS

We make no statement of compliance other than a pass fail result of the material tested or analyzed to any specification. Based on specific data and information contained in this report, our general understanding of the test methods and principals involved, and general experience in the materials testing field, it is our professional judgment that all of the tested assembly meets the requirements set forth in the testing specifications and documents.

#### 3.02 CLOSURE

The findings in this report were prepared in accordance with generally accepted material engineering and testing principles and practices. No other warranty, either expressed or implied, is made. This report has been prepared for the above named client for the above named project. The use of this report for any other purpose shall be at the user’s own discretion based on their own interpretation of the results contained within.

END OF REPORT

Respectfully Submitted,
SMITH EMERY LABORATORIES, INC.

Dana Nelson
Smith-Emery Laboratories
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Los Angeles, Ca 90021
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213-494-3636 cell
Email: dnelson@smithemerylabs.com
ASTM E 283 Air infiltration
ASTM E331 static water penetration
AAMA 501.1 Dynamic Water Penetration
AAMA 501.4 Seismic Displacement.
FOR TYPICAL NOTES & ANCHOR NOTES REFER TO MU100