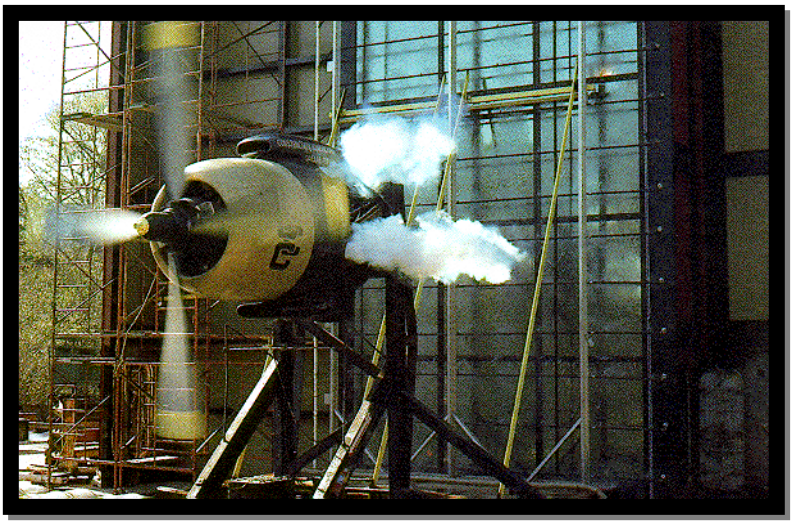
CONSTRUCTION CONSULTING LABORATORY, *INTERNATIONAL*



TEST REPORT:

AAMA 501-05 Performance and ASTM E 1996-09 and ASTM E 1886-05 Impact and Cyclic Test Report

C.R. Laurence Co., Inc.

Series: StormWall®XL

Product/Type: Twin Span Curtain Wall

REPORT #CCLI-11-226

December 5, 2011

Prepared for:

C.R. LAURENCE CO., INC.

Los Angeles, California

S-UNITED, INC.
A Quality Control Company

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APPENDIXES

Refer to drawings in **Appendix A**, this report is not complete unless these drawings are stamped and initialed by **CCLI** as illustrated below.

Sheet	Details	Date	Stamped as illustrated
1	Title and Test Procedure	8/05/11	Construction Consulting Laboratory International 1601 Luna Road Carrollton, Texas 75006 (972) 242-0556
2	Elevation / Scope	8/05/11	
3	Plan View	8/05/11	
3A	Splice Section View	8/05/11	
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1. PROJECT DATA

1.1. REPORT ISSUED

C.R. Laurence Co., Inc.
2503 E. Vernon Ave.
Los Angeles, CA 90058

1.2. TEST LABORATORY

Construction Consulting Laboratory, International
1601 Luna Road
Carrollton, Texas 75006

2. PROJECT SUMMARY

2.1. **PRODUCT TYPE:** Twin Span Curtain Wall with 90° Outside Corner

2.2. **SERIES / MODEL:** StormWall®XL

2.3. **COMPLIANCE STATEMENT:** Results obtained are tested values and were secured by using the designated test methods. The test specimen was tested in accordance with the AAMA 501-05 "Methods of test for Exterior Walls", ASTM E 1886-05 "Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials", and ASTM E 1996-09 "Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes". The specimen met the performance requirements set forth in the specifications and Methods for a +/-100.0 Psf Design Pressure rating.

2.4. **Test Dates:** October 19, 2011 through October 25, 2011

2.5. **Test Location:** Construction Consulting laboratory, International in Carrollton, Texas

2.6. **Test Sample Source:** The specimen was manufactured and installed by Oldcastle BuildingEnvelope® at CCLI. Representative Samples and drawings will be retained by **CCLI** for a minimum period of ten (10) years from the test completion date.

2.7. **Drawing Reference:** The specimen drawings have been reviewed by CCLI and are representative of the specimen installed and tested. If observed, deviations shall be listed on the appended drawings.

2.8. **Observers:**

Witnessed By	**(Representative)**	
Oldcastle BuildingEnvelope®	George Gonzalez	
CCLI	Jeffrey Crump	Wesley Wilson

3. TEST SPECIFICATIONS / METHODS

AAMA 501-05: Methods of test for Exterior Walls.

ASTM E 1996-09: Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes

ASTM E 1886-05: Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.

4. MOCK-UP DESCRIPTION

Product Type:	Aluminum Twin Span Curtain Wall **Product Drawings, Appendix A, Photograph, Appendix E**.	
Series Model:	StormWall®XL	
Specifications and Methods:	AAMA 501-05 / ASTM E 1886 (+/-100.0 Psf) ASTM E 1996 Large Type D Missile / Small Type A Missile	
Frame Size:	**Width**	**Height**
Frame Size	20'-8 1/16" (248.125")	27'-1" (325")

The mock-up is identified on the C.R. Laurence Co., Inc. drawings as StormWall®XL Curtain Wall System Captured Twin Span. The specimen was constructed and installed with an overall linear width of and height of 20'-8 1/16" by 27'-1" and contained one (1) 90° OS corner, reference**, Elevations Sheet 2.** The mock-up was manufactured and installed by Oldcastle BuildingEnvelope®.

WEEP ARRANGEMENT:

Pressure Plate	(5/16") diameter weep hole spaced approximately 17" from each end
Face Cap	(5/16") diameter weep hole at the underside, mid-span of DLO

GLASS: All Glass Laminated Sealed Insulating Glass (SIG)

Glass	Glass Composition	Manufacturer	Max D.L.O	Max Ft²
G4A	1 5/16" SIG, ¼" tempered, ½" air space, ¼" H.S Sentry glass .090" interlayer over ¼" H.S.	DuPont	57½" x 96"	38.3
G12	1 5/16" SIG, ¼" tempered, ½" air space, ¼" H.S .075" Vanceva/Storglass interlayer over ¼" H.S.	Solutia	57½" x 96"	38.3
G7	1 ¼" SIG, ¼" tempered, ½" air space, ¼" H.S .060" Butacite PVB interlayer over ¼" H.S.	DuPont	57½" x 84"	33.54
G36	1 ¼" SIG, ¼" tempered, ½" air space, ¼" H.S .060" Solutia Saflex PVB interlayer over ¼" H.S.	Solutia	57½" x 84"	33.54

GLAZING: All glass is setting block supported part # XLSB2102 and exterior glazed with Dow Corning - 995 structural silicone and EPDM Glazing gasket part # FG5185 at the full interior perimeter of glass. Two (2) lower lites face of specimen, adjacent to frame jamb glazed with GE-SSG4600 silicone. Exterior pressure plate with EPDM compression gasket part # XLG117 and EPDM thermal isolator gasket part # XLG107 secured to frame and adaptor darts with part # XLF325 (#12-14- 1 ½") self tapping screws spaced on 9" centers (max spacing).

SEALANT: The specimen was perimeter sealed with foam backer rod and Dow Corning - 795 silicone. Horizontal to vertical connections within the glass pocket were zone plugged with a plastic plug part # XLD352 set in and tooled with Dow Corning - 795 silicone. Internal horizontal to vertical connections sealed with Dow Corning - 795 silicone. Vertical mullion splice conditions bridged with bond-breaker tape at sleeve and sealed with Dow Corning - 795 silicone. Stack head and sill intermediate horizontal part # XL536-BP shear block connected at the splice location and sealed with backer rod and Dow Corning - 795 silicone at the interior and exterior lateral edge.

REINFORCEMENT: XL500-BP reinforcements are anchored with a part # XLF325 #12-14 x 1g½" concealed within intermediate horizontal shear blocks

Location	Mullion	Reinforcement	Description
Jambs and 90°O.S Corner	XL500-BP	XLBR25	Steel C-Channel 1.875" x 4.721" x .250" full span above and below splice.
Mullion adjacent to corner	XL500-BP	XLBR25	Steel C-Channel 1.875" x 4.721" x .250" x 11' 9"below splice and 13'-10 ½" above splice.
		XLBR15	Steel Flat Bar 4.00" x .500" x 11' 9" below splice and 7'-11"above splice.
Heavy Mullion adjacent to jamb	XL510-BP	XLS20101	Extruded Aluminum 6063-T6 x 12' 2 5/8" below splice and x 7'-11"above.
		XLBR15	Steel Flat Bar 4.00" x .500" x 12' 2 5/8" below splice and 14' 1" above splice.

JAMB ANCHORAGE: Jamb mullion part # XL500-BP anchored at head and sill with one (1) 6063-T6 Aluminum F-Anchor part # XLA10301 inserted into anchor sleeve part # XLS20001 inside mullion and attached to chamber steel with two (2) Type F ½" x 2" self threading bolts. F-Anchors and Anchor sleeve pinned inside mullion by three (3) shear block fasteners part # XLF009 #14 x 1¼" HH screws per shear block. Steel angle 6" x 4" x $^{5}/_{16}$" thick x 5" tall dead - load anchor welded to chamber steel with a $^{3}/_{16}$" weld by 4" length at the top, bottom, and heel of angle. Mullion fitted with a 5" x 5"x ¼"thick steel jamb tap plate attached to lateral face of jamb with eight (8) part # XLF259 ¼-20 x 1" PFH Type F screws. Steel angle shimmed with korolath shim and attached to mullion through tap plate with two (2) $^{5}/_{8}$" 18 x 1¾" Grade 5 Hex Bolts

OUTSIDE CORNER MULLION ANCHORAGE: Corner mullion part # XL240-BP 90° degree anchored at head and sill with one (1) 6063-T6 Aluminum T-Anchor part # XLA10502 inserted into anchor sleeve part # XLS20001 inside mullion and attached to chamber steel with two (2) Type F ½" x 2" self threading bolts, one (1) bolt each side of mullion. T-Anchors and Anchor sleeve pinned inside mullion by three (3) shear block fasteners part # XLF009 #14 x 1 ¼" HH screws per shear block. Steel bent plate dead - load anchor 13 5/16" x 5/16" thick x 5" tall bent 136° degrees to allow a 4" bearing on chamber steel is welded to chamber steel with a 3/16" weld by 4" length at the top, bottom, and heel of plate. Plate, korolath shim, mullion, and reinforcement are through bolted with two (2) 5/8" 18 x 4 ½" Grade 5 Hex bolts with flat washer and nut per bolt.

XL500-BP MULLION ANCHORAGE: Mullion anchored at head and sill with one (1) 6063T6 Aluminum T-Anchor part # XLA-105-01 inserted into anchor sleeve part# XL20001 inside mullion and attached to chamber steel with two (2) Type F ½" x 2" self threading bolts, one (1) bolt each side of mullion. T-Anchors and Anchor sleeve pinned inside mullion by three (3) shear block fasteners part # XLF009 #14 x 1¼" HH screws per shear block. Two (2) steel angles 6" x 4" x 5/16" thick x 5" tall dead - load anchor welded to chamber steel with a 3/16" weld by 4" length at the top, bottom, and heel of angles. Steel angle, korolath shim, mullion, and reinforcement are through bolted with two (2) 5/8" 18 x 4 ½" Grade 5 Hex bolts with flat washer and nut per bolt.

XL500-BP MULLION ANCHORAGE: Mullion anchored at head and sill with one (1) 6063-T6 Aluminum T-Anchor part # XLA10501 inserted into anchor sleeve part # XLS-200-01 inside mullion and attached to chamber steel with two (2) Type F ½" x 2" self threading bolts, one (1) bolt each side of mullion. T-Anchors and Anchor sleeve pinned inside mullion by three (3) shear block fasteners part # XLF009 #14 x 1¼" HH screws per shear block. Two (2) steel angles 6" x 4" x 5/16" thick x 5" tall wind - load anchor with two (2) vertical .656" x 1.0" anchor bolt slots welded to chamber steel with a 3/16" weld by 4" length at the top, bottom, and heel of angles. Steel angle, korolath shim, mullion, and reinforcement are through bolted with two (2) 5/8" 18 x 4½" Grade 5 Hex bolts with flat washer and nut per bolt.

OTHER FEATURES: Intermediate horizontal to intermediate vertical connection by aluminum 6063-T6 shear blocks. Shear Block Part # XLB18301 attached to vertical mullion with four (4) part # XLF009 #14 x 1½" HH screws and Shear Block Part # XLB18001 attached to vertical mullions with two (2) part # XLF009 #14 x 1½" HH screws. Horizontals attached to each part # XLB18301 and XLB18001 shear block through glazing pocket, exterior face with one (1) part # XL-118 #10 x 1" PFH screw per shear block.

5. TEST EQUIPMENT

5.1. Test chamber consisted of structural steel beams, columns, and bulkheads and was accessible through a bulkhead door.

5.2. Test chamber consisted of structural steel beams, columns, and bulkheads and was accessible through a bulkhead door.

5.3. Pressure differentials were created with reversible pumps for positive/negative loading.

5.4. Pressure differentials between the specimen interior and the atmosphere were measured with manometers.

5.5. Air infiltration was measured with a Meriam laminar flow element and inclined manometers. Chamber pressure was measured with a Dwyer inclined manometer.

5.6. Water was applied to the specimen from a spray rack equipped with swirl-type nozzles spaced two feet on center in vertical and horizontal directions, which, under controlled pressure, delivered a minimum of five gallons per square foot per hour on the specimen.

5.7. Structural variations were measured with Chicago Dial gauges with maximum movement hands located throughout the test specimen.

5.8. Large Missile Impact test was performed with a pneumatic charged cannon with laser guided sight and Keyence FS- V31/32 optic with Keyence KV-16ASR timer.

5.9. Small Missile Impact test was performed with a pneumatic charged cannon and chronograph timer.

6. TESTING ALLOWABLES

6.1. AIR INFILTRATION: Total amount of air infiltration shall not exceed **.30 L/s m² (.06 Cfm/ ft²)** of the curtain wall area tested. The perimeter sealant was included in the test of the mock-up.

ALLOWABLE INFILITRATION: **168.0 L/s (33.60 Cfm) Based upon 560 ft²**

6.2. STATIC WATER PENETRATION: There shall be no uncontrolled water penetration during or at the conclusion of this test at the static pressure of **20.0 psf**.

Note: "Uncontrolled water" is defined as any water that appears on any normally exposed interior surfaces, that is not contained or drained back to the exterior, or that can cause damage to adjacent materials or finishes. Water contained within drained flashings, gutters, and sills is not considered water leakage. The collection of up to one half (½) ounce of water (14.8 cc) in a fifteen (15) minute test period on top of any interior stop or stool integral with the wall system shall not be considered water leakage.

6.3. DESIGN LOAD DEFLECTIONS: There shall be no system failure and deflection of aluminum members at 100% of design load and shall not exceed L/240+.250 on spans exceeding 13' 6" and L/175 for spans up to 13' 6". Deflections recorded on the longest unsupported spans.

TEST SPECIMEN DESIGN CRITERIA
Positive / Negative 4800 Pa (100.00 Psf) - 30-Second Duration All Loads
Vertical Span (L): 175.50" / L/240 + .250: Allowable = 24.91mm (.981 inches)
Horizontal Span (L): 62.75" / L/175: Allowable = 9.12mm (.359 inches)

6.4. PROOF LOAD RESIDUAL: The permanent deformation of the aluminum members shall not exceed 2% of span at 150% of design load.

TEST SPECIMEN PROOF LOAD
Positive / Negative 7200 Pa (150.0 Psf) - 30-Second Duration All Loads
Vertical Span (L): 175.50" / 500: Allowable = 8.91mm (0.351 inches)
Horizontal Span (L): 62.75" / 500: Allowable = 3.20mm (0.126 inches)

7. TESTING SEQUENCE

As used throughout this report, positive pressure applied to the test specimen is considered to be **inward** acting and negative pressure is considered to be **outward** acting. All location references or comments are as viewing the test specimen from the interior (room side) of the test chamber and wall system.

	DESIGN CRITERIA: Positive / Negative 4800 Pa (100.0 Psf)	TEST STANDARD
	AAMA 501-05 Performance Testing	
1	Pre Load Positive / Negative @ 50 % of Design – 2400 Pa (50.0 psf)	ASTM E 330-02
2	Static Pressure Air Infiltration Test @ 300 Pa (6.24 psf)	ASTM E 283-04
3	Structural Load by Static Pressure Test @ 50% & 100% Design Loads	ASTM E 330-02
4	Static Pressure Water Penetration Test @ 960 Pa (20.0 psf)	ASTM E 331-00
5	Uniform Load Deflections Positive / Negative @ 150 % of Design	ASTM E 330-02
	ASTM E 1996-09 Impact Performance Testing	
1	Large Type D Missile Impact Testing	ASTM E 1996-09
2	Small Type A Missile Impact Testing	ASTM E 1996-09
	ASTM E 1886 Uniform Load Cyclic Performance Testing	
1	4500 Cycles Positive	ASTM E 1886-05
2	4500 Cycles Negative	ASTM E 1886-05

8. AAMA 501-05 TESTING RESULTS

8.1. **Preload to 2400 Pa (50.0 psf) Positive Pressure per ASTM E 330-02**

Subject the test specimen to a static pressure differential of **2400 Pa (50.0 psf)**. This load was maintained for thirty (30) seconds and released. An inspection was made to determine if any failure occurred.

Results: No Damage

8.2. **Static Pressure Air Infiltration Test @ 300 Pa (6.24psf) per ASTM E283-04**

The specimen and perimeter sealant joints were completely covered with 4-mil sheet plastic material and sealed with duct tape to the chamber perimeter, thus allowing no movement of air through the specimen. The exterior face of the specimen was subjected to a positive pressure differential of 300 Pa (6.24 psf) to obtain a leakage rate for the test chamber. The plastic bag was removed and the chamber again pressurized to a positive 6.24 Psf to measure total air infiltration. The chamber infiltration was subtracted from the total air infiltration resulting in the infiltration rate of the test specimen, **Photograph 2, Appendix E.**

Results:

Chamber	Specimen & Chamber	Cfm	Cfm/ Ft²	L/s m²	Total CFM Allowable
45.42 Cfm	**48.6.01 Cfm**	**3.01**	**>0.01**	**>.05**	**33.59 Cfm / 167.95 L/s**

8.3. **Uniform Structural Load @ 50% & 100% of Design Loads per ASTM E330-02**

Dial indicators were installed to measure deflection and residuals at ends and mid-span of typical horizontal and vertical members.

Test: With the specimen pre loaded in a positive mode, all indicators were set on zero. A positive pressure of **2400 Pa (50.0 psf) - inward** equal to 50% of the design load was applied and held for thirty (30) seconds, then released. A positive pressure of **4800Pa (100.0 psf) - inward** equal to 100% of the design load was applied and held for thirty (30) seconds, then released. The indicators were read and the data was recorded.

Test: With the specimen pre loaded in a negative mode, all indicators were set on zero. A negative pressure of **–2400 Pa (50.0 psf) - outward** equal to 50% of the design load was applied and held for thirty (30) seconds, then released. A negative pressure of **-4800 Pa (100.0 psf) - outward** equal to 100% of the design load was applied and held for thirty (30) seconds, then released. The indicators were read and the data was recorded.

Results: All the positive and negative net deflections were below the allowable, for indicator locations, **See Indicator Location Plan View, Appendix B.**

50% & 100% DESIGN STRUCTURAL DEFLECTION TABLE													
	+50.0 Psf			+100.0 Psf			-50.0 Psf			-100.0 Psf			
Ind.	Total	Set	Net	Total	Set	Net	Total	Set	Net	Total	Set	Net	Allowable
1	.13	.00		.26	.02		.10	.00		.23	.00		
2	.54	.00	.465	1.04	.04	.885	.40	.00	.345	.98	.02	.835	.981
3	.14	.00		.32	.05		.18	.00		.34	.02		
4	.10	.00		.21	.02		.01	.00		.02	.01		
5	.02	.00		.05	.00		.01	.00		.06	.01		
6	.08	.00		.18	.01		.12	.00		.25	.00		
7	.53	.00	.475	1.02	.05	.880	.59	.00	.530	1.01	.04	.885	.981
8	.20	.00		.47	.05		.29	.00		.48	.01		
9	.08	.00		.25	.01		.04	.00		.19	.00		
10	.03	.00		.10	.00		.00	.00		.00	.00		
11	.01	.00		.01	.00		.02	.00		.06	.01		
12	.06	.00	.05	.16	.02	.110	.07	.00	.05	.23	.01	.170	.981
13	.02	.00		.10	.00		.03	.00		.06	.00		
14	.01	.00		.01	.00		.00	.01		.02	.01		
15	.04	.00	.04	.08	.02	.08	.04	.01	.04	.04	.02	.04	.359
16	.00	.00		.00	.00		.00	.00		.01	.00		
17	.13	.00		.32	.03		.20	.01		.42	.05		

8.4. **Static Pressure Water Penetration Test @ 960 Pa (20.0psf) per ASTM E331-00**

Water was applied to the exterior face of the specimen at a minimum rate of five (5) gallons per square foot per hour of wall area, in such a way as to continuously and completely cover the exterior face of the specimen. Simultaneously, a positive **inward** differential static pressure of **960 Pa (20.0 psf)** was applied against the face. The application of pressure and water was maintained for a period of fifteen (15) minutes, with observers inside the chamber checking for water penetration, **Photograph 3, Appendix E**.

Results: No water penetration observed

8.5. **Uniform Structural Proof Load @ 150% of Design Loads per ASTM E330-02**

Dial indicators were installed to measure deflection and residuals at mid-span of typical horizontal and vertical members.

Test: With the specimen preloaded, all indicators were set on zero. The following pressures were applied and held for a period of thirty (30) seconds. At the conclusion of each load the indicators were read and the data recorded.

Results: All the positive and negative net deflections were below the allowable, for indicator locations, **see Indicator Location Plan View, Appendix B.**

100% & 150% DESIGN STRUCTURAL DEFLECTION TABLE													
	4800Pa (+100.0 Psf)			7200Pa (+150.0 Psf)			4800 Pa (-100.0 Psf)			7200 Pa (-150.0 Psf)			
Ind.	Total	Set	S-Net	Total	Set	S-Net	Total	Set	S-Net	Total	Set	S-Net	Allowable
1	.26	.02		.52	.06		.23	.00		.50	.01		
2	1.04	.04	.02	1.89	.13	.09	.98	.02	.01	1.38	.03	.01	.351
3	.32	.05		.48	.08		.34	.02		.52	.03		
4	.21	.02		.28	.05		.02	.01		.25	.02		
5	.05	.00		.09	.02		.06	.01		.09	.03		
6	.18	.01		.16	.06		.25	.00		.39	.05		
7	1.02	.05	.04	1.80	.08	.04	1.01	.04	.04	1.53	.05	.01	.351
8	.47	.05		.70	.05		.48	.01		.75	.10		
9	.25	.01		.33	.03		.19	.00		.33	.07		
10	.10	.00		.14	.02		.00	.00		.11	.03		
11	.01	.00		.03	.00		.06	.01		.12	.03		
12	.16	.02	.02	.30	.03	.02	.23	.01	.01	.42	.08	.06	.351
13	.10	.00		.18	.02		.06	.00		.10	.00		
14	.01	.00		.14	.01		.02	.01		.	.00		
15	.08	.02	.02	.08	.02	.02	.04	.02	.02	.06	.02	.02	.126
16	.00	.00		.01	.00		.01	.00		.02	.00		
17	.32	.03		.56	.06		.42	.05		.59	.05		

9. ASTM E 1996-09 IMPACT TESTING RESULTS

9.1. The specimen was Type D Large Missile impacted with a #2 yellow pine nominal 2" x 4" x 8' 2" length. Large Missile Impact locations on the mock-up were to the glazing, horizontal and vertical mullions below the mid-span anchor and mid-span of the upper mullion at the outside corner. The missile weight prior to testing was 9 Lbs 1 oz. Nominal impact speed set at 50 feet per second. Fifteen (15) total Large Missile Impacts were performed on the mock-up, for impact locations and speeds see **Impact Location Diagram, Appendix C, Photograph 4, Appendix E.**

9.2. The specimen was Type A Small Missile impacted with Ten (10) 2-gram solid steel 5/16 diameter balls. Small Missile Impact locations on the mock-up were to the glazing only. Twenty one (21) small missile Impacts were performed on the mock-up, for impact locations see **Impact Location Diagram, Appendix C.**

10. ASTM E 1886-05 UNIFORM LOAD CYCLIC TESTING RESULTS

Design Load: (4800 Pa) 100.0 Psf **/ Load Direction:** Positive							
Sequence	**Range**	**Average Cycle Time**	**Cycles**	**Indicator Max Deflection**			
				#2	**#7**	**#12**	**#17**
Cycle 1	0.2 P to 0.5 P	5 seconds	3500	1.08"	1.08"	.25"	.35"
Cycle 2	0 to 0.6 P	6 seconds	300	1.15"	1.10"	.28"	.48"
Cycle 3	0.5 P to 0.8 P	5 seconds	600	1.15"	1.11"	.28"	.50"
Cycle 4	0.3 P to 1.0 P	6 seconds	100	1.21"	1.19"	.30"	.52"

Design Load: (4800 Pa) 100.0 Psf **/ Load Direction:** Negative							
Sequence	**Range**	**Average Cycle Time**	**Cycles**	**Indicator Max Deflection**			
				#2	**#7**	**#12**	**#17**
Cycle 1	0.3 P to 1.0 P	5 seconds	50	1.70"	1.38"	.38"	.41"
Cycle 2	0.5 to 0.8 P	4 seconds	1050	1.65".	1.35"	.38"	.40"
Cycle 3	0 to 0.6 P	5 seconds	50	1.58"	1.30"	.35"	.39"
Cycle 4	0.2 P to 0.5 P	5 seconds	3350	1.50"	1.28"	.33"	.36"

Note: With 300 cycles remaining during Negative Cycle 2, the lower lite face of wall, adjacent to O.S. corner mullion deglazed from the intermediate mullion, **See Deglazed location Diagram, Appendix D, Photograph 5, Appendix E**. Failure was attributed to separation of glass from air spacer. Inspection revealed interior pieces of glass remained glazed to the mullion. The opening was covered with plywood and sealed with duct tape to complete Cycle 2 and the remaining cycles.

11. DISCLAIMER

The mock-up performed within the specified criteria. This report does not constitute certification of this product. The results contained within this document apply only to the tested specimen.

Respectfully submitted,

CONSTRUCTION CONSULTING LABORATORY, *INTERNATIONAL*

WESLEY WILSON
LABORATORY MANAGER

JEFFREY CRUMP
TESTING MANAGER

APPENDIX A

Sheet	Details	Date
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2	Elevation / Scope	8/05/11
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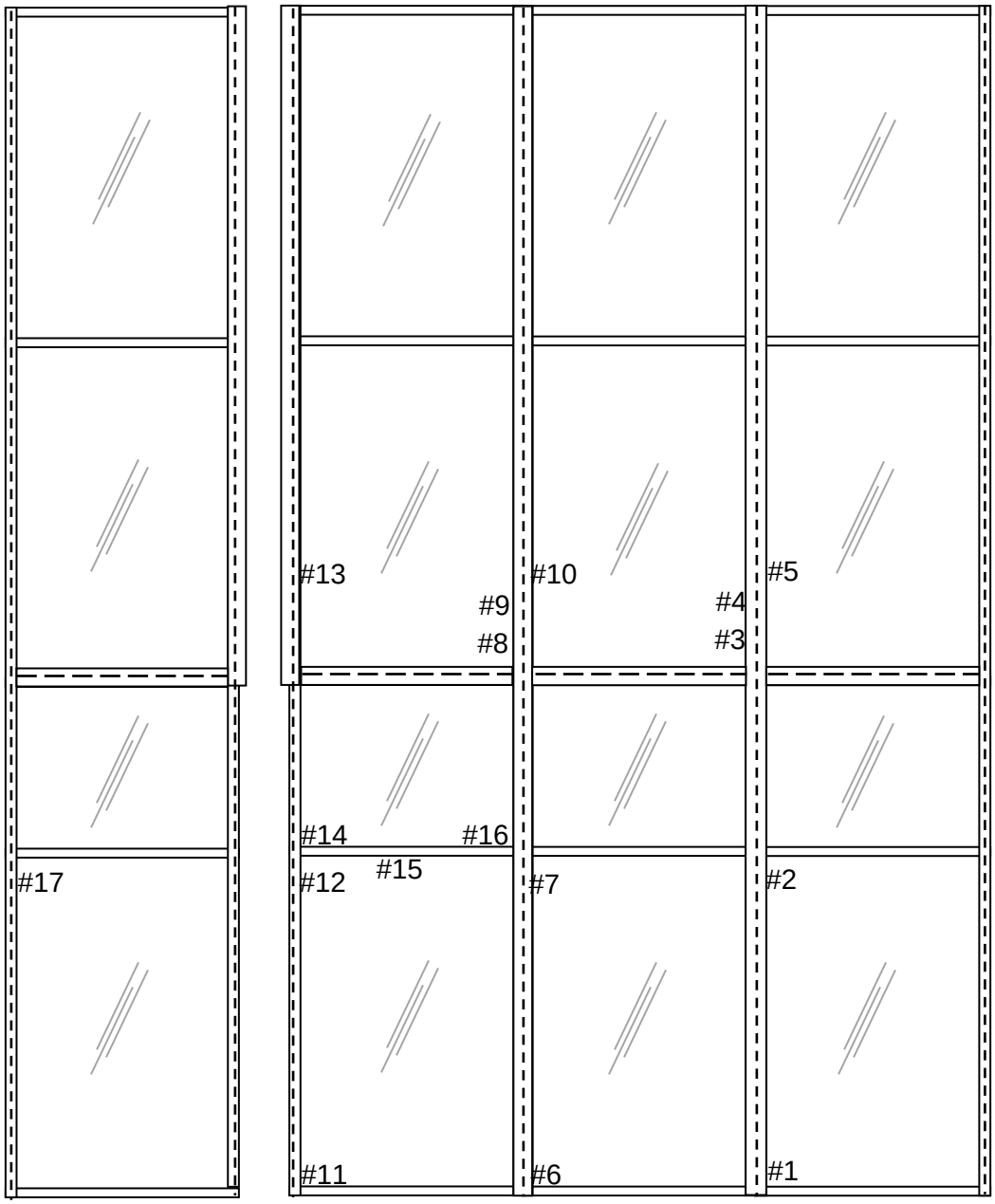
APPENDIX B

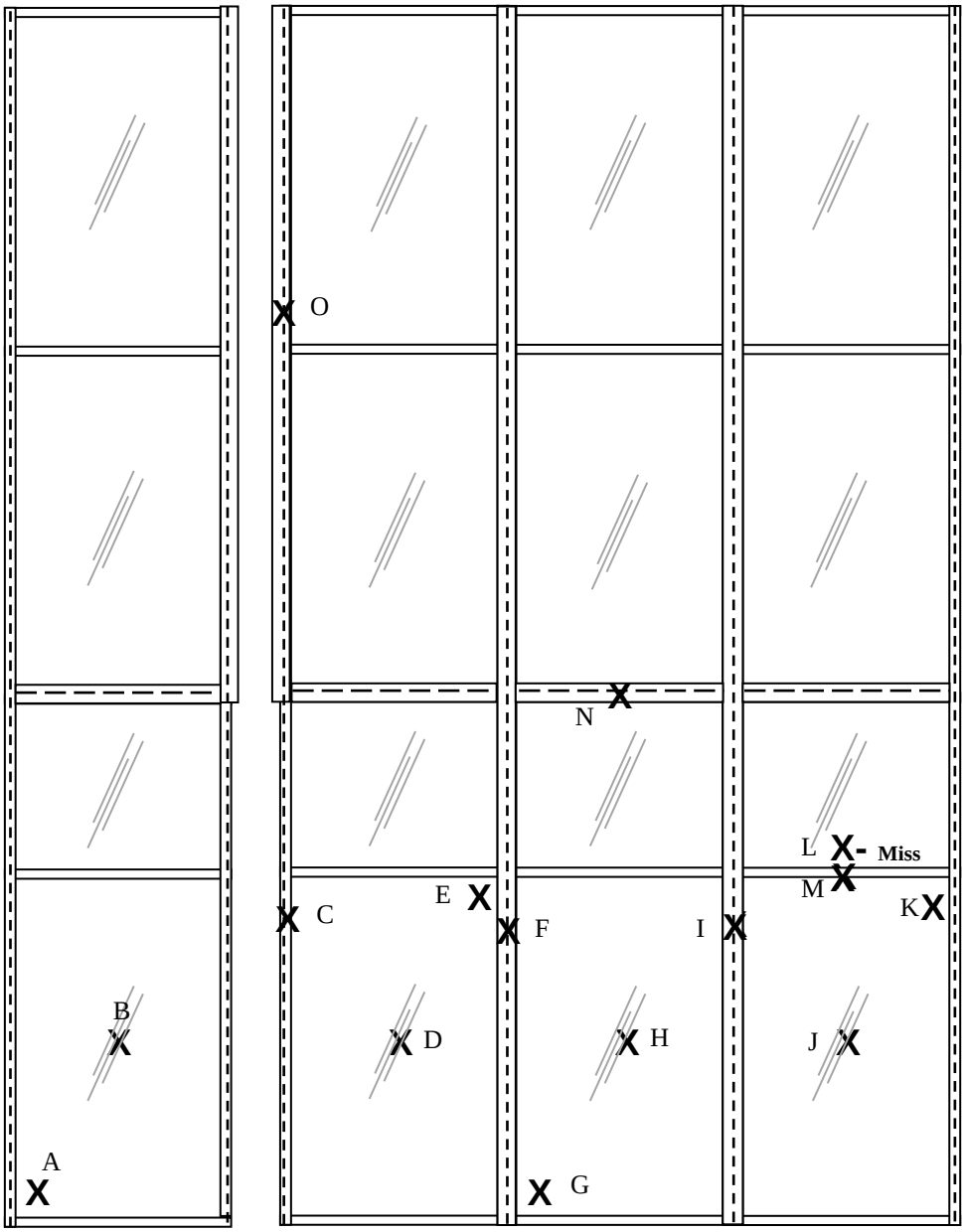
DIAL INDICATOR LOCATION DIAGRAM



APPENDIX C

LARGE MISSILE IMPACT LOCATIONS

Fifteen (15) X- LARGE MISSILE - Shot L- Miss-hit to base of glass,



Impact	Speed Ft per Second	Note
A	51.0	Pass
B	50.0	Pass
C	51.2	Pass
D	49.8	Pass
E	50.1	Pass
F	50.0	Pass
G	50.1	Pass
H	50.8	Pass
I	50.5	Pass
J	51.2	Pass
K	51.1	Pass
L	52.0	Miss-Hit
M	50.1	Pass
N	51.0	Pass
O	50.5	Pass

AAMA 501-05 AND ASTM IMPACT PERFORMANCE TEST REPORT
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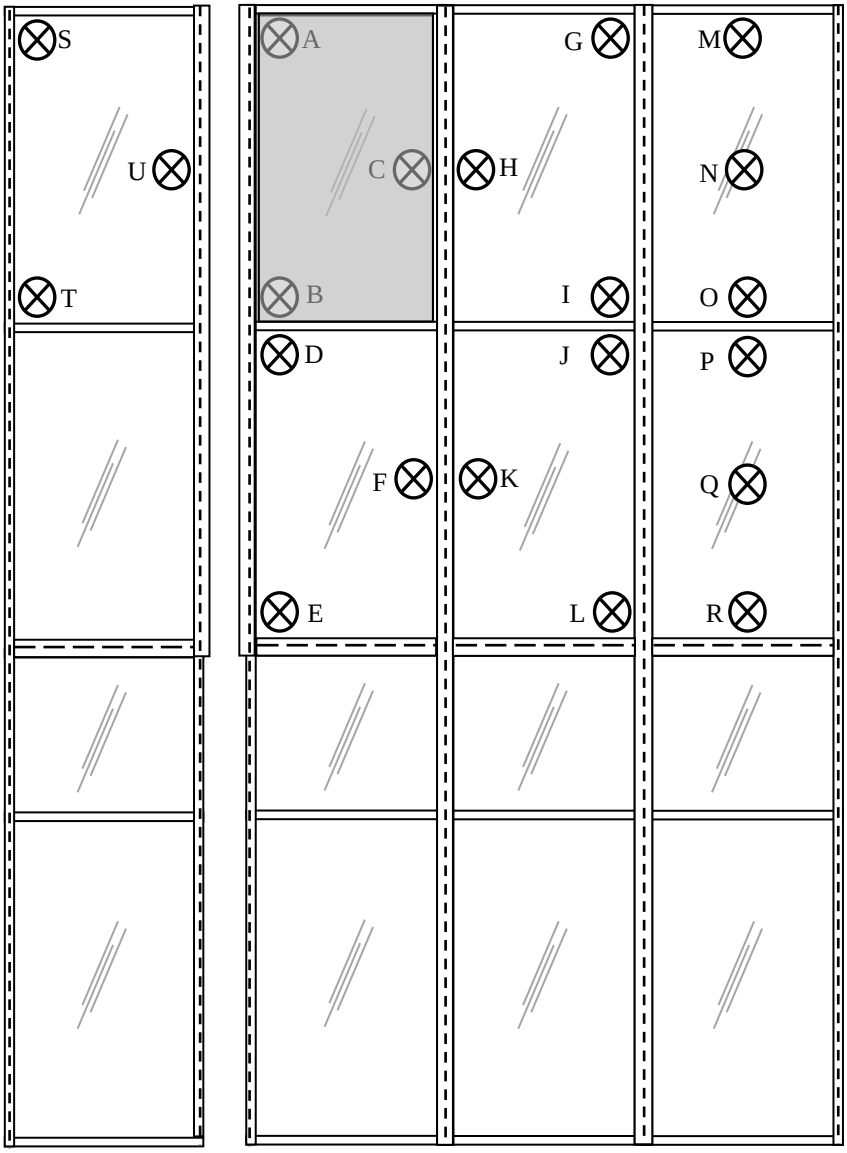
SMALL MISSILE IMPACT LOCATIONS
⊗ Twenty-one (21)* - SMALL MISSILE

***Three (3) Shots added to corner bay, shaded adjacent bay glazed with sacrificial lite at interior**



Impact	Speed Ft per Second	Note
A	131.0	Pass*
B	130.6	Pass*
C	128.9	Pass*
D	132.8	Pass
E	130.3	Pass
F	130.3	Pass
G	129.9	Pass
H	131.2	Pass
I	131.3	Pass
J	131.7	Pass
K	129.1	Pass
L	129.8	Pass
M	129.9	Pass
N	130.1	Pass
O	131.5	Pass
P	130.3	Pass
Q	129.9	Pass
R	131.0	Pass
S	131.6	Pass
T	129.8	Pass
U	131.2	Pass

*Shaded area was glazed with sacrificial lite at the interior face of insulating unit. Corner bay was impacted so that three (3) (G7) SIG units would be impacted with the same glazing infill method.

Note: In all cases, other than Shot A-C, the sacrificial lite was broken after the 1st impact to the glass unit. **CCLI** cleared all broken glass from the field prior to the 2nd impact to each glass unit

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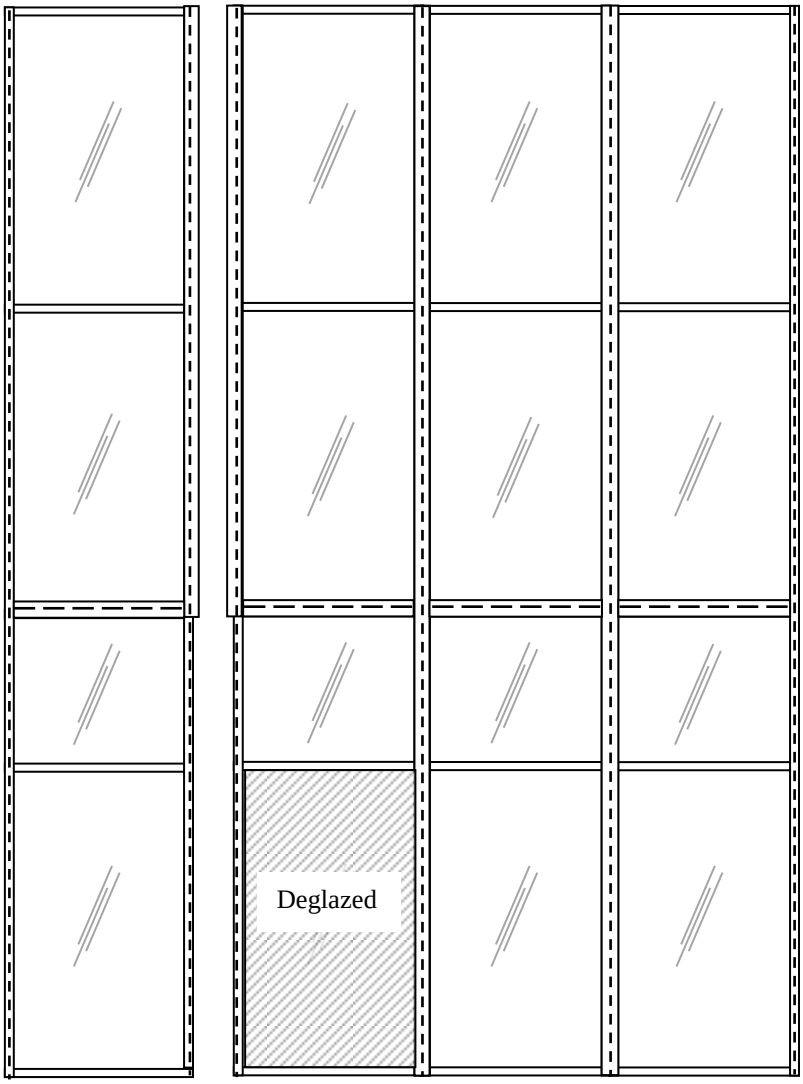
APPENDIX D

DEGLAZED LOCATION DIAGRAM



Note: With 300 cycles remaining during Negative Cycle 2, the lower lite face of wall, adjacent to O.S. corner mullion deglazed from the intermediate mullion. Failure was attributed to separation of glass from air spacer. Inspection revealed interior pieces of glass remained glazed to the mullion. The opening was covered with plywood and sealed with duct tape to complete Cycle 2 and the remaining cycles.

APPENDIX E

PHOTOGRAPHS

AAMA 501-05 AND ASTM IMPACT PERFORMANCE TEST REPORT
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Photograph 1

The mock-up is identified on the C.R. Laurence Co., Inc. drawings as StormWall®XL Curtain Wall System Captured Twin Span. The specimen was constructed and installed with an overall linear width of and height of 20'-8 $^{1}/_{16}$" by 27'-1" and contained one (1) 90° OS corner, reference**, Elevations Sheet 2.** The mock-up was manufactured and installed by Oldcastle BuildingEnvelope®.

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Photograph 2

Static Pressure Air Infiltration Test @ 300 Pa (6.24psf) per ASTM E283-04

The specimen and perimeter sealant joints were completely covered with 4-mil sheet plastic material and sealed with duct tape to the chamber perimeter, thus allowing no movement of air through the specimen. The exterior face of the specimen was subjected to a positive pressure differential of 300 Pa (6.24 psf) to obtain a leakage rate for the test chamber. The plastic bag was removed and the chamber again pressurized to a positive 6.24 Psf to measure total air infiltration. The chamber infiltration was subtracted from the total air infiltration resulting in the infiltration rate of the test specimen.

Results:

Chamber	Specimen & Chamber	Cfm	Cfm/ Ft^2	L/s m^2	Total CFM Allowable
45.42 Cfm	**48.6.01 Cfm**	**3.01**	**>0.01**	**>.05**	**33.59 Cfm / 167.95 L/s**

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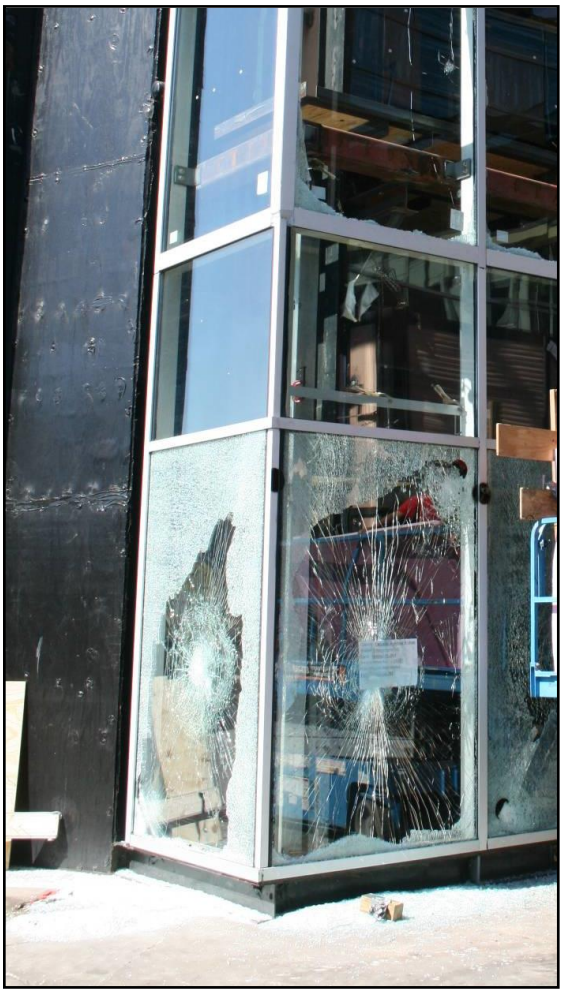
Photograph 3

Static Pressure Water Penetration Test @ 960 Pa (20.0psf) per ASTM E331-00

Water was applied to the exterior face of the specimen at a minimum rate of five (5) gallons per square foot per hour of wall area, in such a way as to continuously and completely cover the exterior face of the specimen. Simultaneously, a positive **inward** differential static pressure of **960 Pa (20.0 psf)** was applied against the face. The application of pressure and water was maintained for a period of fifteen (15) minutes, with observers inside the chamber checking for water penetration.

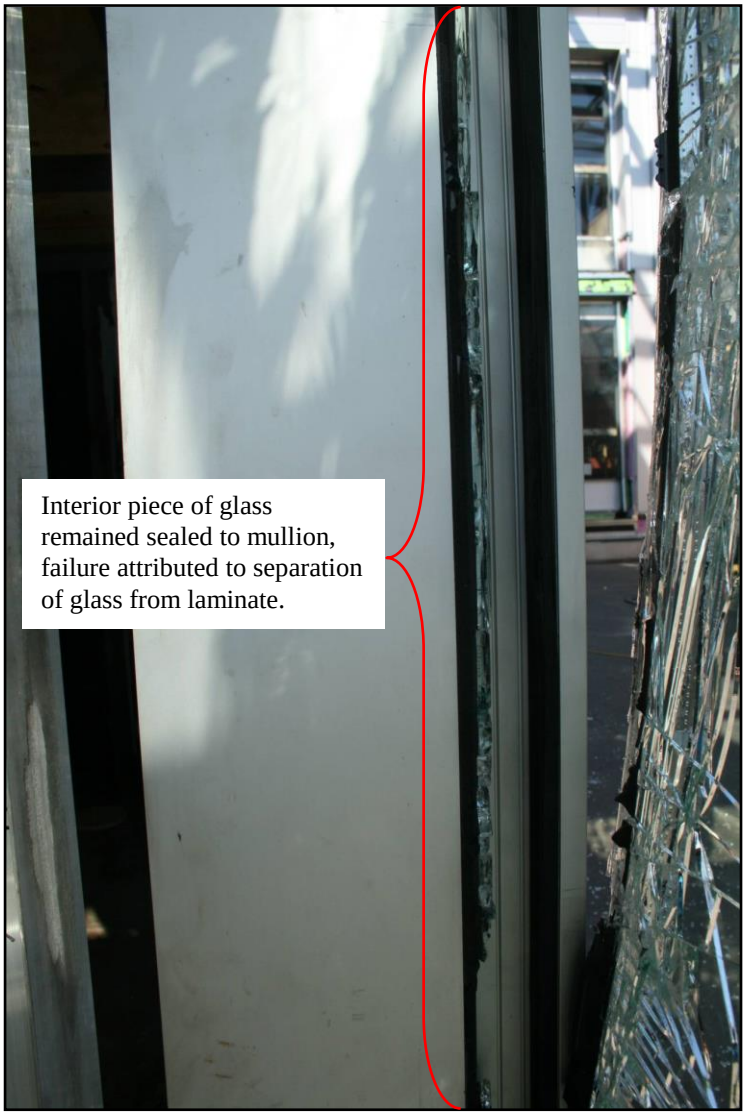
Results: No water penetration observed.



Photograph 4

The specimen was Type D Large Missile impacted with a #2 yellow pine nominal 2" x 4" x 8' 2" length. Large Missile Impact locations on the mock-up were to the glazing, horizontal and vertical mullions below the mid-span anchor and mid-span of the upper mullion at the outside corner. The missile weight prior to testing was 9 Lbs 1 oz. Nominal impact speed set at 50 feet per second. Fifteen (15) total Large Missile Impacts were performed on the mock-up, for impact locations and speeds see

The specimen was Type A Small Missile impacted with Ten (10) 2-gram solid steel 5/16 diameter balls. Small Missile Impact locations on the mock-up were to the glazing only. Twenty one (21) small missile Impacts were performed on the mock-up, for impact locations see.



Photograph 5

Note: With 300 cycles remaining during Negative Cycle 2, the lower lite face of wall, adjacent to O.S. corner mullion deglazed from the intermediate mullion, **See Deglazed location Diagram, Appendix D**. Failure was attributed to separation of glass from laminate. Inspection revealed interior piece of glass remained glazed to the mullion. The opening was covered with plywood and sealed with duct tape to complete Cycle 2 and the remaining cycles

- END OF REPORT -