RDH BUILDING SCIENCE LABORATORIES

ASTM E331 Water Testing Report | Project R-22966.001

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Test Date – May 23, 2023
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1 General

Report Issued to: Canadian Precast/Prestressed Concrete Institute PO Box 24058 Hazeldean Road Ottawa ON K2M 2C3 Attn: Val Sylaj **Dates of Testing:** May 23, 2023	**Test Laboratory:** RDH Building Science Laboratories 167 Lexington Court – Unit 6 Waterloo ON N2J 4R9 Attn: Jonathan Smegal **Date of Final Report:** November 9, 2023

2 Test Program Summary

2.1 Objective

This test program was developed to assess the water tightness of two different precast concrete wall assembly: a single wythe precast concrete wall assembly (without insulation), and a double wythe insulated precast concrete wall assembly (with insulation encapsulated between the two wythes of concrete.

2.2 Test Specifications

ASTM E 331-2023, *Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference*.

Laboratory tests were performed to determine the water penetration performance of the precast concrete wall assemblies. These wall assemblies were subjected to a series of static pressures during water application from a spray rack to assess the water penetration performance of the wall systems at numerous pressure conditions.

2.3 Test Assembly Description

Two test assemblies were prepared for this test program. Each measured 2591mm (102 in.) in width and 2616mm (103 in.) in height from the exterior edges of the concrete, for a total area of 6.8 m^2 (73.0 ft^2). Each test assembly was constructed to have a single 2616mm (103 in.) long vertical joint and a single 1066 mm (42 in.) horizontal joint. Both assemblies included a window opening that was entirely within one of the precast concrete components measuring 1200mm (47 in.) in height, and 600mm (24 in.) in width. A surrogate window was inserted into the openings since this scope of these tests only included precast panel and joint performance, and did not include window performance. A piece of self adhered membrane was installed around the perimeter of the rough opening to cover the insulation layer. The membrane was wet set against sealant in the corners to eliminate potential water leakage pathways from the exterior to the interior past the flashing membrane.

The two mock-up wall assemblies were:

- Wall 1: Single wythe – A single 102 mm (4 in.) thick concrete wythe; without any insulation. A cross section of the joint is shown in Figure 2.7. An elevation of the assembly is shown in Figure 2.6
- Wall 2 : Double wythe insulated – A 64 mm (2.5 in.) thick exterior concrete wythe with a 76 mm (3 in.) thick layer of XPS insulation (continuous edge-to-edge); with a 76 mm (3 in.) thick interior concrete wythe. A cross section of the joint is shown in Figure 2.8. An elevation of the assembly is shown in Figure 2.6.

Figure 2.1

Test wall assembly from the interior side, showing back of precast concrete panels and connections to steel frame.

Figure 2.2

Test wall assembly viewed from exterior side, showing surrogate window opening, vertical and horizontal joints, and drain hole near the bottom of the vertical joint.

Figure 2.3

Surrogate window opening with drain openings at the bottom of each vertical joint.

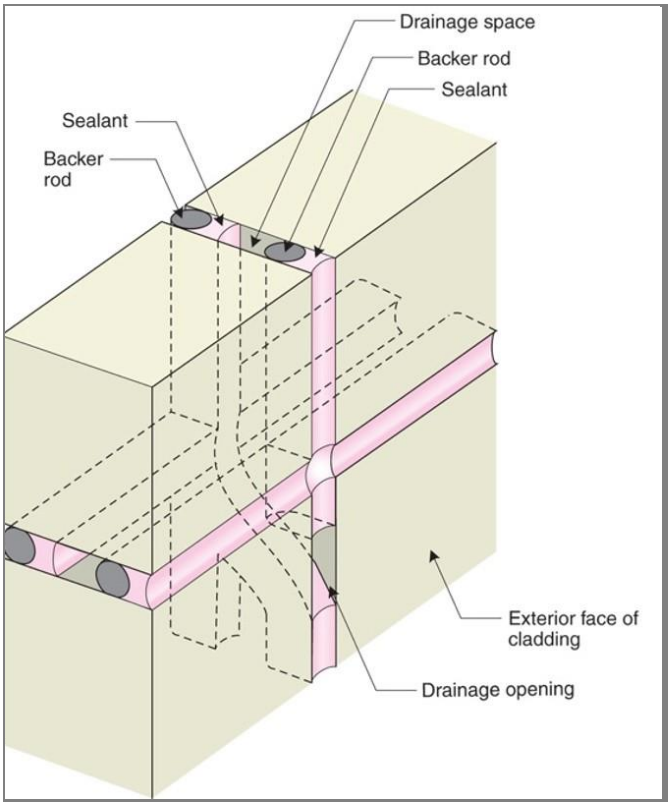

Figure 2.4

Two stage joints as shown in this schematic were used on all sealant joints on the test specimens.

2.3.1 Window Rough Opening Treatment

Prior to installing a window with a two staged drained joint, the window rough opening was prepared. Sill pan flashings complete with back dams and end dams are best practice in punched openings on any construction project, but they are not yet common practice in some places. The sequence of drawings in Figure 5 shows an acceptable (but not best practice) rough opening window preparation for the double wythe insulated precast wall assembly that was used for the water testing. A self adhered flashing membrane is installed across the insulation layer so that it laps and seals onto the concrete of both the interior and exterior wythe. This membrane is held back from the front edge so it's not visible following the window installation, but should be at least as deep into the opening as the back of the window so that a continuous perimeter seal for air and water control can be installed between the window and the membrane. This membrane should not be a construction or sheathing tape, but an approved flashing membrane product for water control in rough openings. Because of the irregular surface of concrete in the bottom corners, and the nature of membranes, it is expected that they will not complete a perfect seal on the concrete in the corners. A small bead of compatible sealant was installed first in the bottom corners, and the membrane was installed on the sill and several inches up the jambs while the sealant was wet. This sequence ensures that there is good water and air seal between the membrane and the concrete in the corners. Next, self-adhered membrane is installed into the remainder of the rough opening, ensuring that it shingle laps the membrane from the sill on the jambs by at least 2" minimum. Other options such as fluid applied rough opening treatments would also work well provided the window is installed with a two staged drained joint and there is continuity between the fluid applied membrane and window frame on the interior.

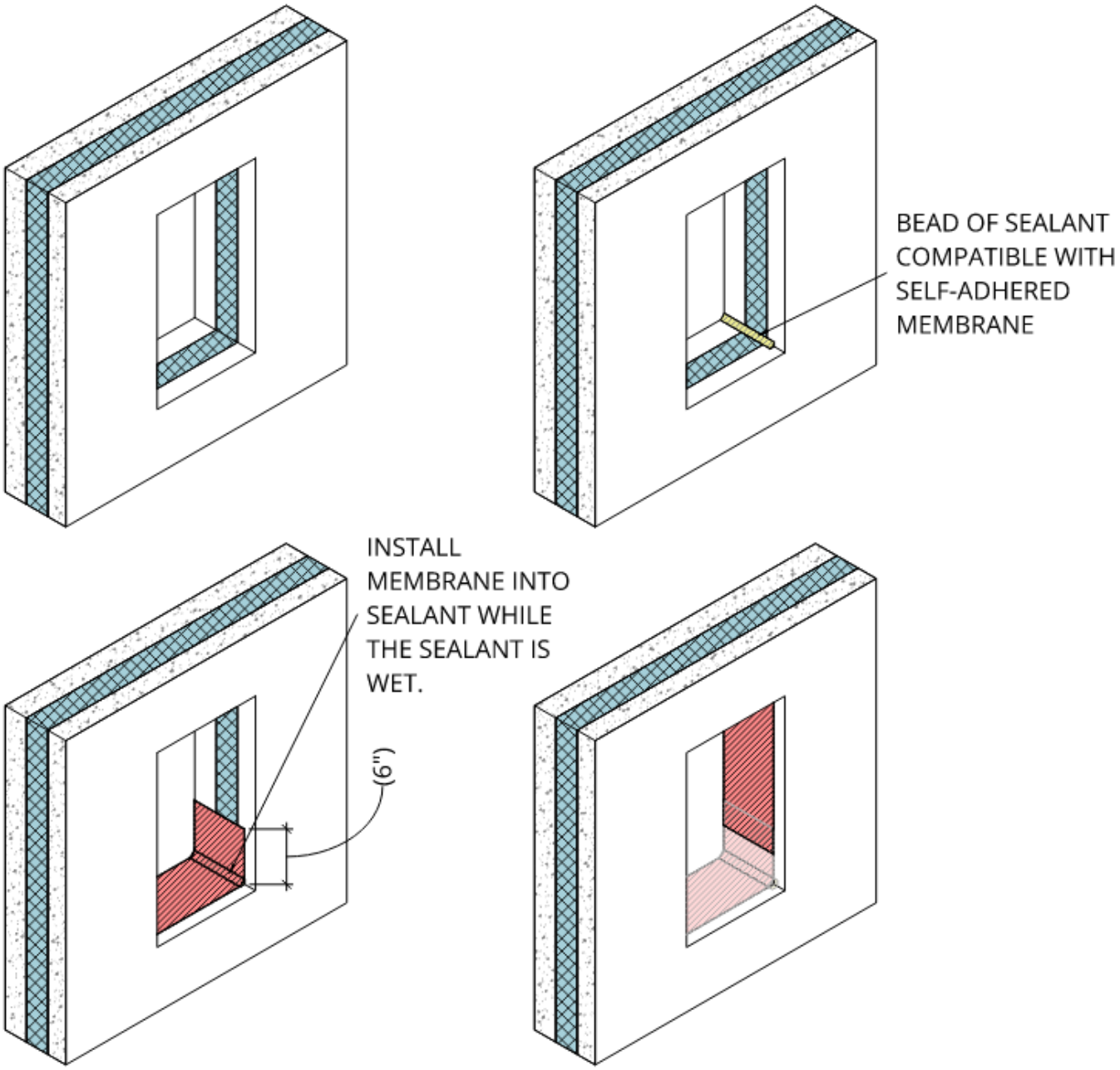

Figure 5 : Window rough opening preparation

2.4 Drawings of Assemblies

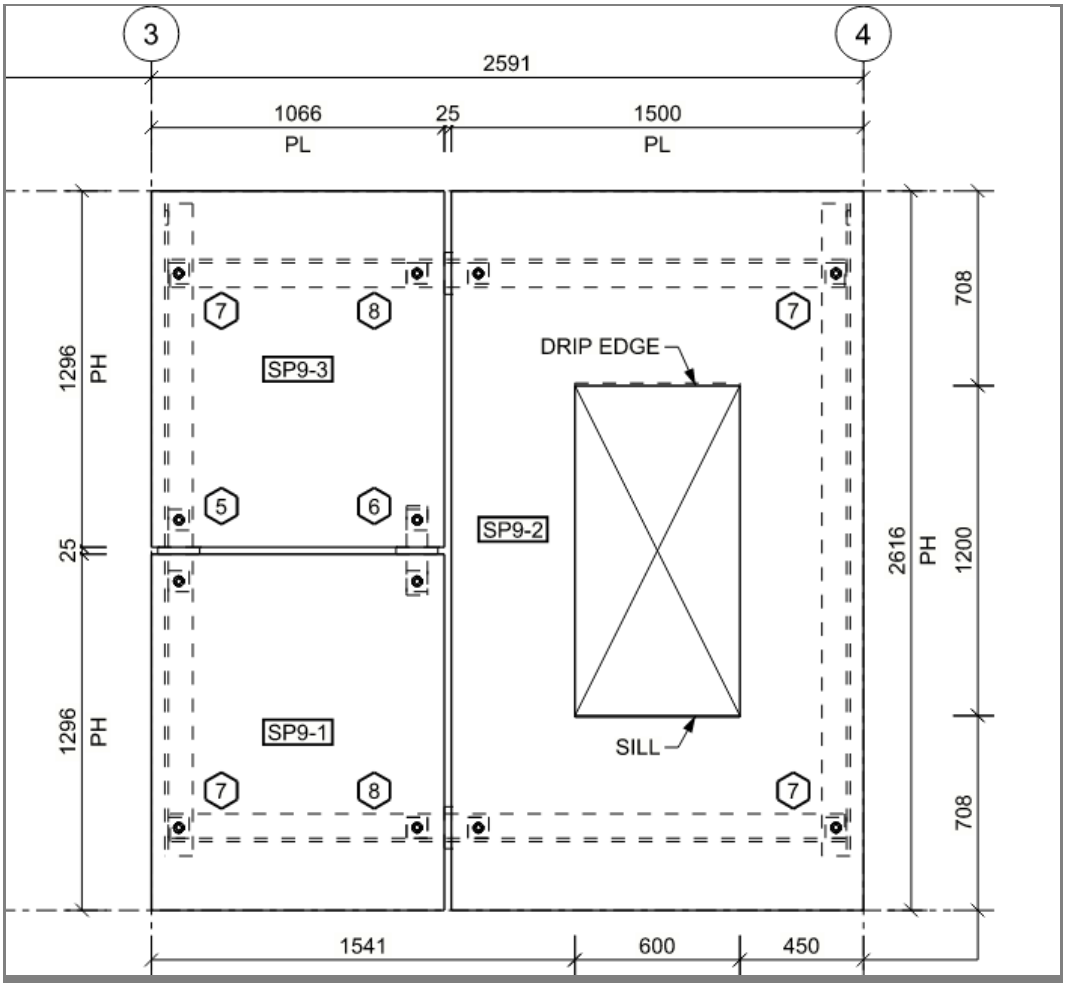

Figure 2.6 - Elevation showing panel layout and dimensions for test wall specimens . The panel layout and dimensions were the same for both test walls.

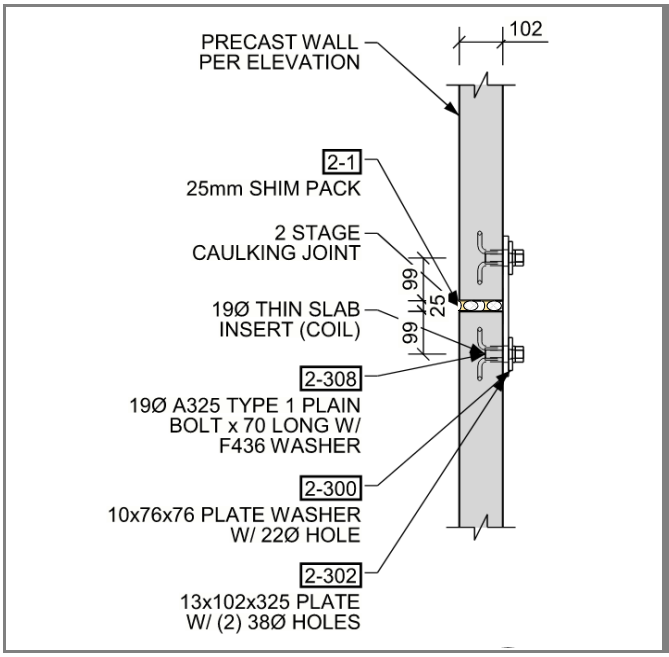

Figure 2.7

Vertical section of single wythe test assembly (with no insulation) showing attachment hardware and joint with dimensions. Exterior surface is the left side of the image.

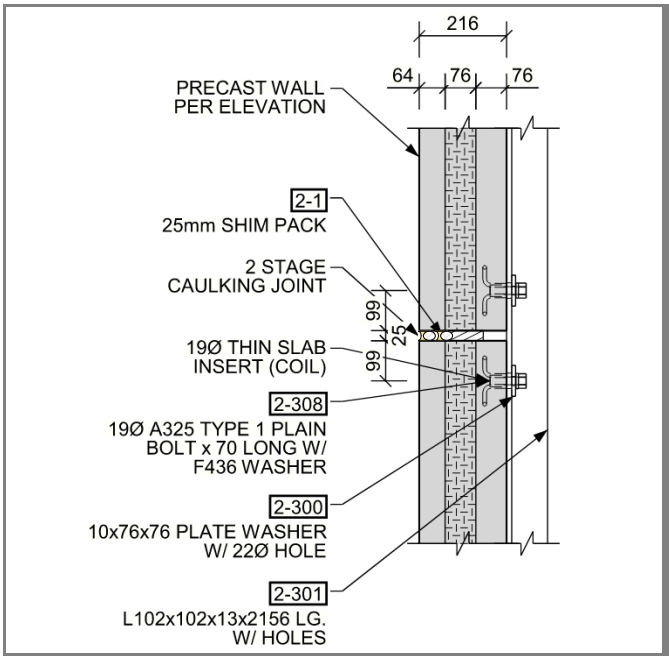

Figure 2.8

Vertical section of double wythe insulated precast concrete test wall assembly showing attachment hardware and joint with dimensions. Exterior surface is the left side of the image.

2.5 Test Parameters

The test chamber was secured and sealed to the front (exterior) surface of the precast test assemblies as shown (from the back) in Figure 2.9. A calibrated spray rack inside the test chamber applied water to the test specimens at a rate of 5 gal/ft² · hr (3.4 L/m² · min) during the test. The pressure across the specimens was increased gradually throughout the test at 15 minute increments from 0 Pascals to 600 Pascals.

Both the single wythe and double wythe precast concrete test assemblies were subjected to the same sequence of test conditions.

TABLE 2.1 TEST PARAMETERS

STAGE	WATER FLOW RATE	AIR PRESSURE	DURATION
Stage 1	5 gal/ft² · hr (3.4 L/m² · min)	0 Pa	15 min
Stage 2	5 gal/ft² · hr (3.4 L/m² · min)	150 Pa	15 min
Stage 3	5 gal/ft² · hr (3.4 L/m² · min)	300 Pa	15 min
Stage 4	5 gal/ft² · hr (3.4 L/m² · min)	450 Pa	15 min
Stage 5	5 gal/ft² · hr (3.4 L/m² · min)	600 Pa	15 min

Figure 2.9 – The test chamber during testing is clamped to the test specimen, showing the air pressurization system on the back of the test chamber.

3 Test Results

During the testing procedure, the test specimens were continuously monitored for any water leakage on the interior of the assembly. No water leakage was observed passing the interior sealant or interior face of the precast panels. Both the single wythe and double wythe insulated precast concrete specimens with two-stage drained joints passed the ASTM E331 water test.

4 Closing

This test report does not constitute certification of the products or system under consideration. Nothing contained in this document shall represent an engineering opinion or endorsement from RDH Building Science Laboratories. The test results relate only to the products and assemblies tested. This report is the exclusive property of the client and shall not be reproduced, except in full, without the written approval of RDH.

Yours truly,

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