Architectural Precast Innovations, Inc.
3369 Paxtonville Road
Middleburg, PA 17842

Test Report
Test Metal Stud Crete MSC
Shear Connector Strip

Prepared by:

Thomas A. Kolden, P.E.
Specialized Testing, Inc.

Digitally signed by Thomas A. Kolden
Date: 2025.05.01 09:44:21 -05'00'

Rev. No.	Date	Description
R0	24 Apr 2025	Original Report
R1	01 May 2025	Correction to Figure 3 on page 6

INTRODUCTION:

Specialized Testing, Inc. entered into an agreement with Architectural Precast Innovations, Inc. on April 8, 2024 to perform tests on assemblies consisting of 2 inch-thick by 16 inch-wide by 24-inch-tall concrete panel with embedded MSC Shear Connectors attached to a 24 inch long 6-inch steel stud with sheet metal screws. Tests were limited to loading the steel stud relative to the concrete panel in shear (loaded parallel to the axis of the stud, i.e., “in-plane vertical”), in compression (stud loaded toward the panel surface, i.e., “transverse-inward”) and in tension (stud loaded away from the panel, i.e., “transverse-outward).

Specialized Testing, Inc. (STI), dba Specialized Testing, was the laboratory of record for this test program. Specialized Testing, Inc. is accredited under ISO 17025 by the International Accreditation Service (IAS) as listed on IAS TL-228. All testing reported herein was performed at the laboratory facilities of Specialized Testing located in Santa Fe Springs, CA. Specialized Testing is an independent testing laboratory contracted by the client to perform the testing described herein.

TEST PLAN

The client’s test plan is outlined in the figure below. The gravity load is the “in-plane vertical load” and the out-of-plane load is the “transverse-inward” (compression) and “transverse-outward” (tension); see Figure 1. The figure implies the loads are applied through the concrete panel, which reflects the intended actual field condition; however, for the purpose of test, the loads will be applied to the steel stud with the concrete panel restrained. The intent of the tests is to determine the performance of the MSC Connector.

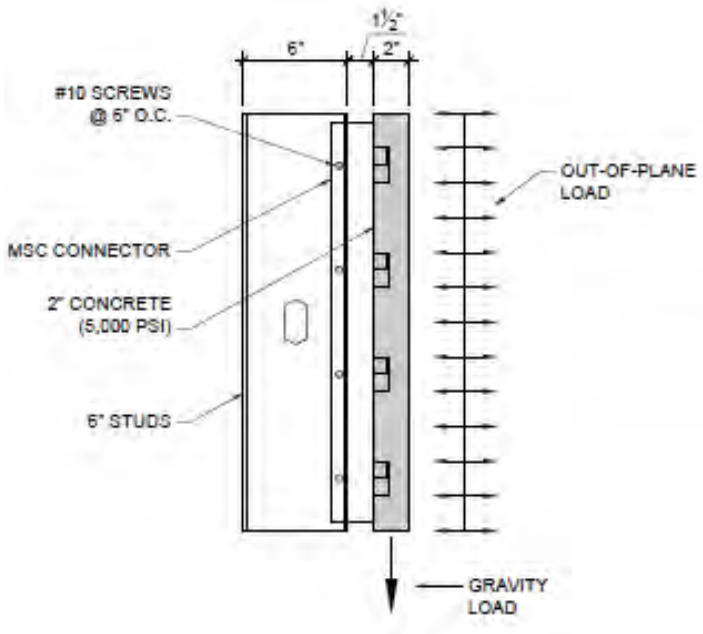


Figure 1: Test Loads

The Metal Stud Crete® Composite System, i.e., MSC Connector, is cast-in-place into the concrete panels, and subsequently attached to the steel studs using self-tapping self-drilling sheet metal screws, as reflected in Figure 2.

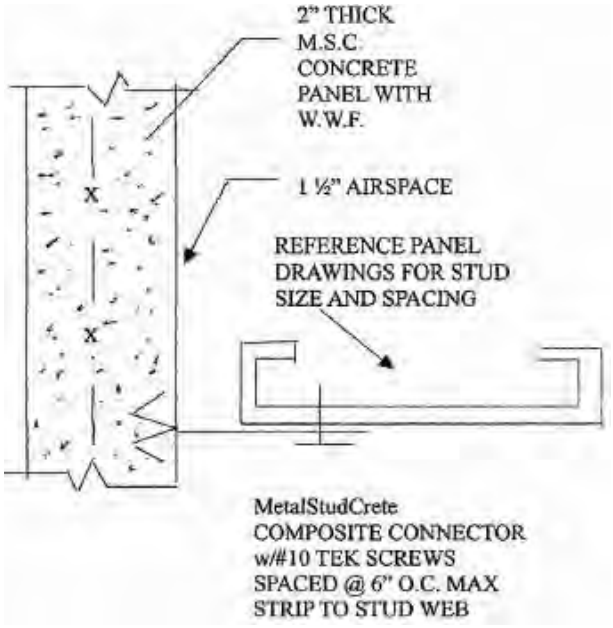


Figure 2: MSC Configuration
(0.598" thick 6" Steel Stud used)

RECEIVED ITEMS

The client prepared the test assemblies (panel, MSC Connector, steel stud and screws) at their facility in Middleburg, PA and subsequently shipped them to STI, where they were received on April 8, 2025, and entered into the receiving log as LN1717.1 and LN1717.2. A total of eight (8) test assemblies were received, together with sixteen (16) 4"Ø x 8" concrete cylinders. The concrete panels had been cast on March 31, 2025.


Photo 1: Received Crate


Photo 2: Crate Contents

Photo 3: Assembly

Photo 4: Assembly
(opposite view)

Photo 5: Assembly

Photo 6: Assembly

CONCRETE SUBSTRATE:

The composition of the concrete was not provided to STI. The compressive strength of the concrete was determined by performing tests on the cylinders furnished by the client and was determined pursuant to ASTM C39. The concrete was cast on March 31, 2025, and the cylinders were tested upon receipt, and on the two days the assemblies were tested. The results of cylinder tests are presented in Table 1. The compressive strength at the time of assembly tests was 6,760 psi based on the average of the six compression test results over the two days the assemblies were tested.

Table 1: Concrete Cylinder Compression Tests (ASTM C39)

Date	Age	Cylinder Diameter (inch)		Compressive Area	Load	f'_c
	(days)	1	2	(in^2)	(lbf)	(lbf)
03/31/25	Cast Date	-	-	-	-	-
04/08/25	8	4.00	4.00	12.57	73,430	5,843
04/08/25	8	4.00	4.00	12.57	75,410	6,001
04/08/25	8	4.00	4.00	12.57	74,790	5,952
04/17/25	17	4.00	4.00	12.57	86,390	6,875
04/17/25	17	4.00	4.00	12.57	82,290	6,548
04/17/25	17	4.00	4.00	12.57	82,560	6,570
04/18/25	18	4.00	4.00	12.57	87,290	6,946
04/18/25	18	4.00	4.00	12.57	82,580	6,572
04/18/25	18	4.00	4.00	12.57	88,570	7,048

ASSEMBLY TESTS:

The furnished assemblies were tested using a United Universal Test Machine (UTM). It was deemed necessary to stiffen the steel stud with nominal 2X Douglas Fir wood to prevent buckling of the stud and force the load into the MSC Connector. The wood was cut to not interfere with the sheet metal screws that attached the MSC Connector to the steel stud. The tested configurations are depicted in the following photographs.

Photo 7: In-Plane Vertical Shear Test Setup

Photo 8: In-Plane Vertical Shear Test Setup

Photo 9: Transverse-In Test Setup

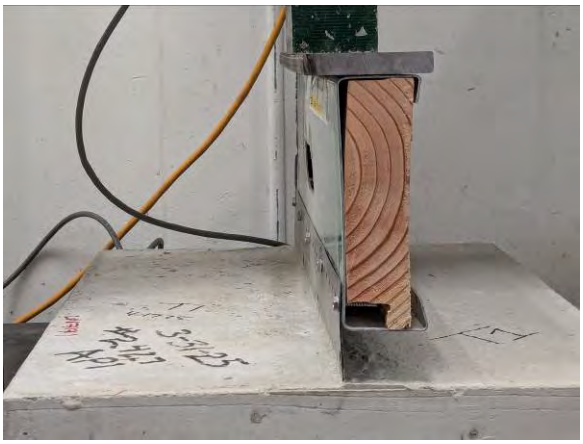


Photo 10: Transverse-In Test Setup

Photo 11: Transverse-Out Test Setup

Photo 12: Transverse-Out Test Setup

STEEL STUD:

Based on identification markings from the stud manufacturer, the steel stud is 0.0538 (i.e., 54 mils) 50 ksi G90 steel stud, with reference to ICC-ES ESR-4062. ESR-4062 pertains to cold-formed steel framing for Ware Industries, Inc., dba MARINO|WARE.

TEST SCHEDULE, PERSONNEL DISPOSITION OF MATERIALS:

The tests were conducted on April 17 and 18, 2025. The STI personnel who participated in this project are listed below.

Luis Guiterrez: Senior Test Technician
Mojtaba Afzali: Project Supervisor
Tom Kolden: Report Author

The residue of the tested assemblies, remaining untested assemblies and concrete cylinders are subject to disposal thirty days after the date of this report.

SUMMARY OF TEST RESULTS:

The test results are summarized in Table 2.

Table 2: Summary of Test Results

Test Direction	United Test Number	Date	Ultimate Load (lbf)	Displacement at Ultimate Load (in.)	Average Ultimate Load (lbf)	Average Displacement (in.)
In-plane Shear	12746	04/17/25	5,564	0.351	5,713	0.379
In-plane Shear	12757	04/17/25	5,807	0.428		
In-plane Shear	12758	04/17/25	5,769	0.357		
Transverse-In	12759	04/17/25	5,158	0.302	5,005	0.265
Transverse-In	12760	04/17/25	4,852	0.228		
Transverse-Out	12762	04/17/25	2,596	0.180	2,326	0.155
Transverse-Out	12764	04/17/25	2,057	0.130		

Failure Modes: Screw-connection between MSC Connector and steel stud for In-Plane Vertical Shear tests, Buckling of MSC Connector and Stud in Transverse-Inward tests, and flexural rupture of concrete panel at the location of the MSC Connector for Transverse-Outward tests.

Figure 3: In-Plane Vertical Shear Load-Displacement

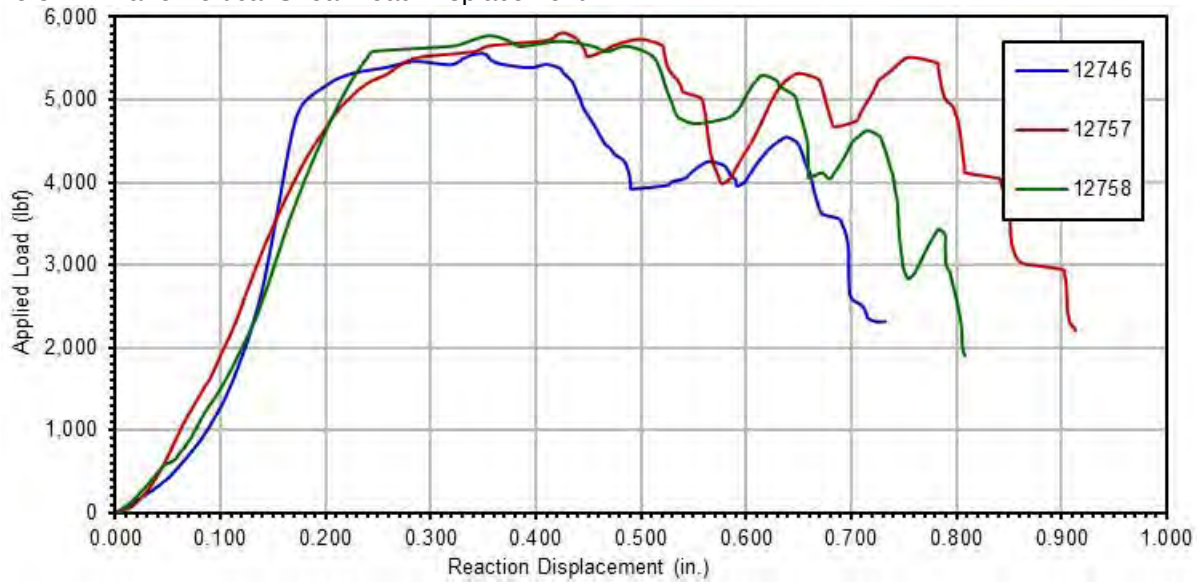


Figure 4: Transverse-Inward (Compression) Load-Displacement

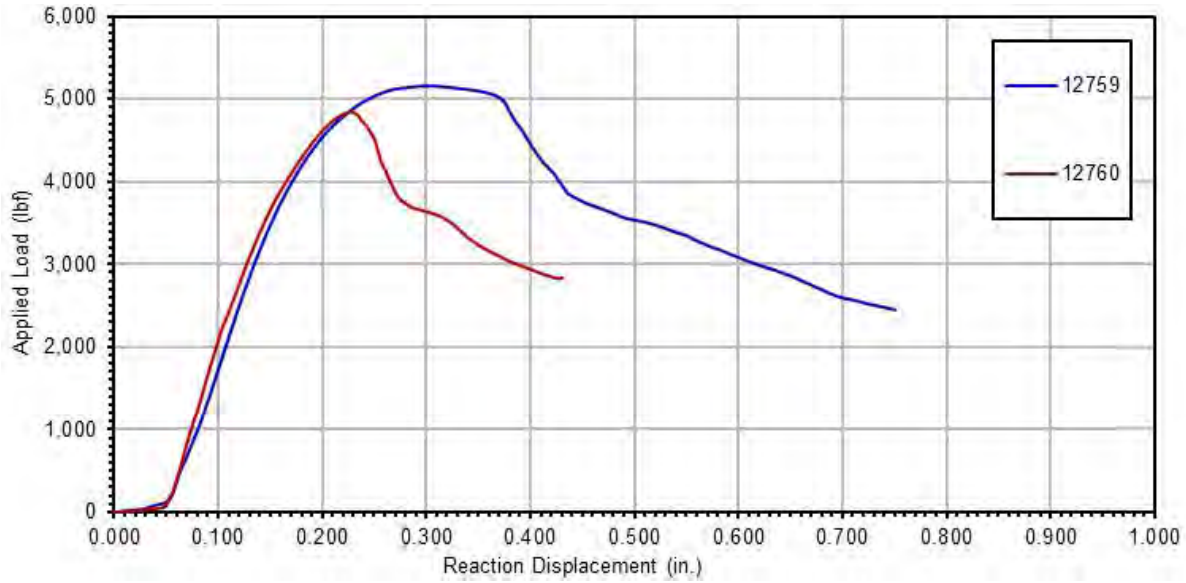
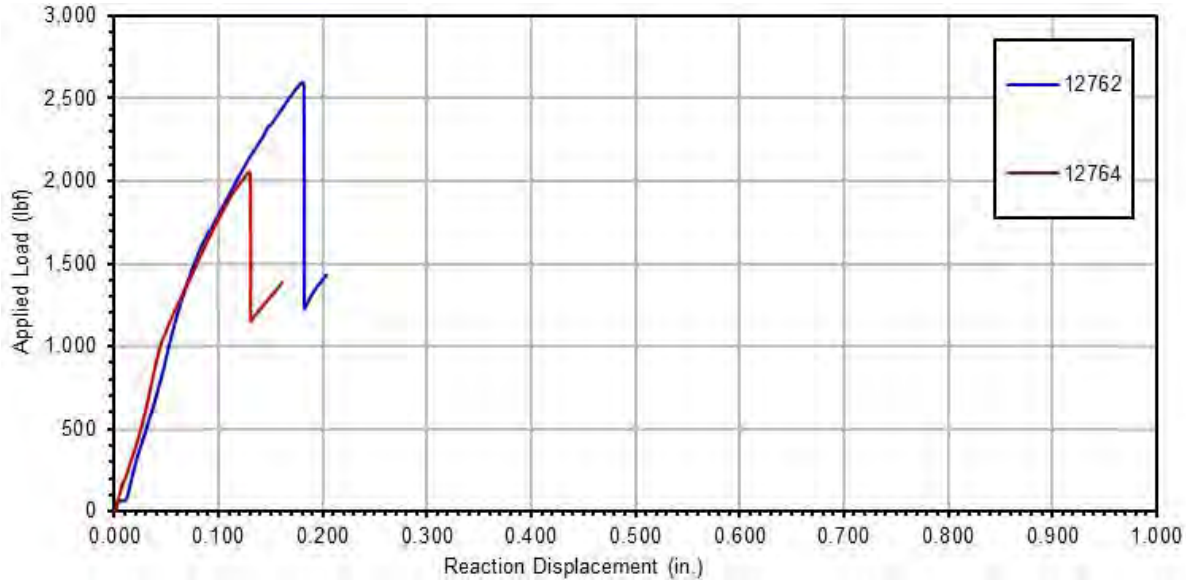


Figure 5: Transverse-Outward (Tension) Load-Displacement



CONCLUSION:

For the tested assemblies in the tested conditions, described above, the average test load per foot (without safety factor) of the MSC Connector was 2,855 lb/ft for In-Plane Vertical Shear, 2,500 lb/ft for Transverse-Inward (compression) and 1,160 lb/ft for Transverse-Outward (tension) loads, demonstrating the tested MSC Connector specimens is capable of supporting the test loads. However, it shall be up to the designing engineer using the data presented herein to determine the suitability of the test results for use in the field to support Cladding Panels, Load Bearing Shear Walls or other load bearing applications.

PHOTOGRAPHS OF FAILURE MODES:

Photo 13: Failure of Test 1
Vertical In-Plane Shear

Photo 14: Failure of Test 2
Vertical In-Plane Shear

Photo 15: Failure of Test 3
Vertical In-Plane Shear

Photo 16: Failure of
Transverse-Inward Tests

Photo 17: Failure of
Transverse-Outward Tests

Photo 18: Failure of
Transverse-Outward Tests