TEST REPORT:

NOVUM WALL™ BY REDI-ROCK RETAINING BLOCK

BLOCK TO BLOCK INTERFACE SHEAR CAPACITY
0° FACE BATTER

Tested By:
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1.0 Introduction

This report presents the results of a laboratory testing project that was performed to evaluate the block-to-block interface shear capacity between Novum Wall™ by Redi-Rock retaining blocks with 0° face batter. The testing was performed by Aster Brands personnel, under the supervision of Aster Brands engineers at its testing facility located in Charlevoix, Michigan in October of 2024. Redi-Rock is an Aster Brands company.

2.0 Purpose

The objective of the test series for this project was to determine the interface shear capacity by investigating the 0° block-to-block interface shear of the Novum Wall™ blocks under varying normal loads using a large testing frame.

3.0 Materials

Novum Wall™ blocks are wet-cast concrete, precast modular block (PMB) units with a consistent height of 9 in (229 mm), and a width of 24 in (610 mm) plus the face texture of variation of 1-1/2 in (38 mm). The length of the block is 46-1/8 in (1172 mm). Standard block dimensions are as shown in **Figure 1** below. The blocks are manufactured from wet-cast, first purpose, air-entrained, non-reconstituted, structural grade concrete mixes in accordance with ASTM C94 or ASTM C685. They have a minimum specified 28-day compressive strength of 4,000 psi (27.6 MPa) and weigh approximately 610 lb (277 kg) +/- 30 lb (13.6 kg).

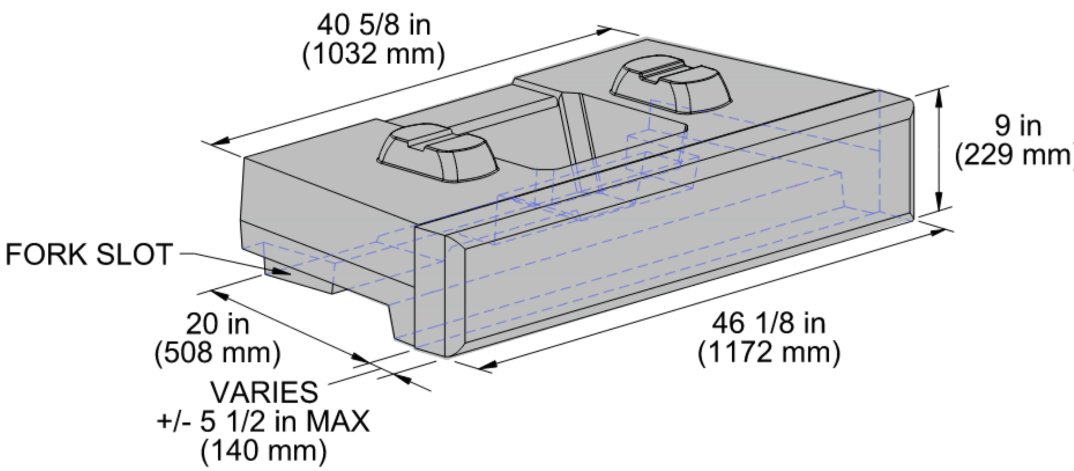

Figure 1 – Novum Wall™ Block Dimensions

Shear engagement between subsequent rows of blocks is achieved by two trapezoidal shaped shear knobs protruding from the top of the block that interlock with a groove cast into the bottom of the block above, as well as friction. The shear knobs also set the wall face batter at a nominal value of approximately 0 degrees, so the setback between two rows of blocks is approximately 0 in (0 mm). Blocks are designed to be dry stacked in a running bond configuration with the vertical joints offset, or staggered, by half of a block length.

Blocks used for this series of testing were produced by Truemont Materials at its Green Cove Springs, Florida facility. The blocks were produced in September 2024 and cured for 111 to 122 days prior to testing. Average 28-day compressive strength of the concrete that was used to produce the test blocks was 3,174 psi (21.9 MPa), and average compressive strength at the testing date was 3,310 psi (22.8 MPa), as determined by ASTM C39 on 4 in by 8 in (102 mm by 203 mm) field-cured concrete cylinder specimens.

4.0 Test Apparatus

All tests were completed in a high-capacity structural testing frame located at the Aster Brand testing facilities in Charlevoix, Michigan, USA. This testing frame consists of a reconfigurable, steel reaction frame mounted to a 40-inch (1.0 m) thick solid concrete “strong floor”.

Testing forces were induced by a precision hydraulic actuator system. The system is capable of providing up to 12 in (300 mm) of travel movement and a maximum of 150,000 lb force (670 kN) simultaneously in two directions using two separate hydraulic pump systems. This allows for precise control of both horizontal and vertical loading. The hydraulic systems are controlled by high-precision directional flow control, needle, and pressure relief valves.

Forces, pressures, and displacements were recorded with electronic sensing devices. Forces were measured with load cells mounted to the ends of the hydraulic cylinders and pushing directly on the block. Displacements were measured with an integral LDT sensor mounted inside the horizontal hydraulic cylinder.

All measurements were recorded with a National Instruments cDAQ data acquisition module and Labview data acquisition software. Data was recorded at a minimum of one datum per sensor per second.

5.0 Methodology

Interface shear capacity testing was completed in general accordance with ASTM D6916 “Standard Test Method for Determining the Shear Strength Between Segmental Concrete Units (Modular Concrete Blocks)”. In this test method, one block was set on top of two blocks in a staggered, running bond pattern, and an additional block without knobs was placed on top to disperse loading. Base blocks were firmly fixed, and a horizontal load was applied to the back of the middle block. A normal load was applied vertically on top of the top block to simulate varied wall heights. The middle block was then pushed to failure to determine the peak interface shear capacity between the block units. Details of the test set-up are shown in **Figure 2**.

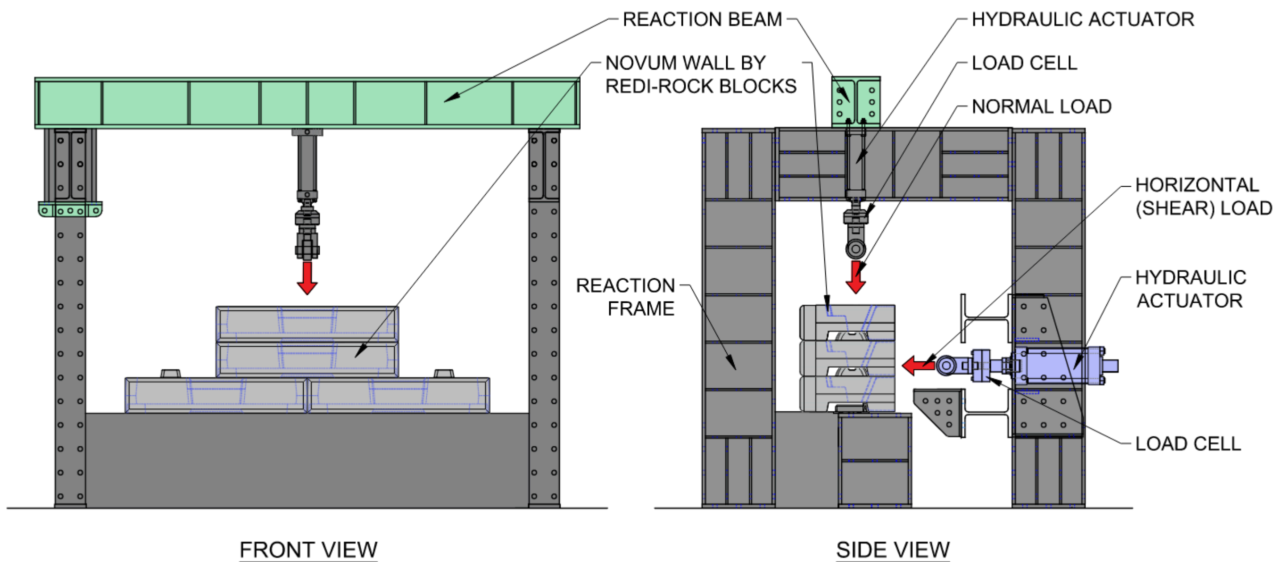

Figure 2 – Schematic test frame set-up

Test procedure began by moving the block forward so both of the shear knobs were fully aligned and engaged, and an average initial preload (alignment load) of 501 lb (227 kg) was placed on the block before deflection measurements were recorded. Displacement was measured at the point of load by the integral LDT sensor mounted inside the horizontal hydraulic cylinder. The displacement rate (velocity) at which the load was applied to the blocks as they were tested was manually controlled with an average displacement rate of 0.20 in/min (5.1 mm/min). All interface shear tests were taken to the point of maximum shear load to induce failure of the shear knobs or back of the groove, excessive deflection, or visible cracking in the test blocks.

For this testing project, normal load levels varied from 117 to 6,283 lb/ft (1.7 to 91.7 kN/m) to simulate the performance of block-to-block interface shear at different vertical locations in a wall cross-section. These values correspond to wall heights ranging from approximately 1 to 25 ft (0.3 to 7.6 m). Additional tests were run at similar nominal normal loads in order to check the repeatability of the testing protocol.

6.0 Laboratory Test Results

Two different failure modes were observed during the testing program. Both failure modes included translation of the top block onto the knobs of the block beneath in varying amounts. For tests imposing lower normal loads, some rotation and lifting of the top block onto the knobs was also observed. The first failure mode occurred when the shear knobs, or pieces of the knobs broke, sometimes one or both knobs, as shown in **Figure 3**. The second mode of failure resulted in cracked and/or broken bottom blocks, as shown in **Figure 4**.

Figure 3 – Broken shear knob

Figure 4 – Broken bottom block

Block displacement plotted against horizontal load for interface shear tests is shown in **Figure 5**. A summary of the peak shear test results is shown in **Table 1**.

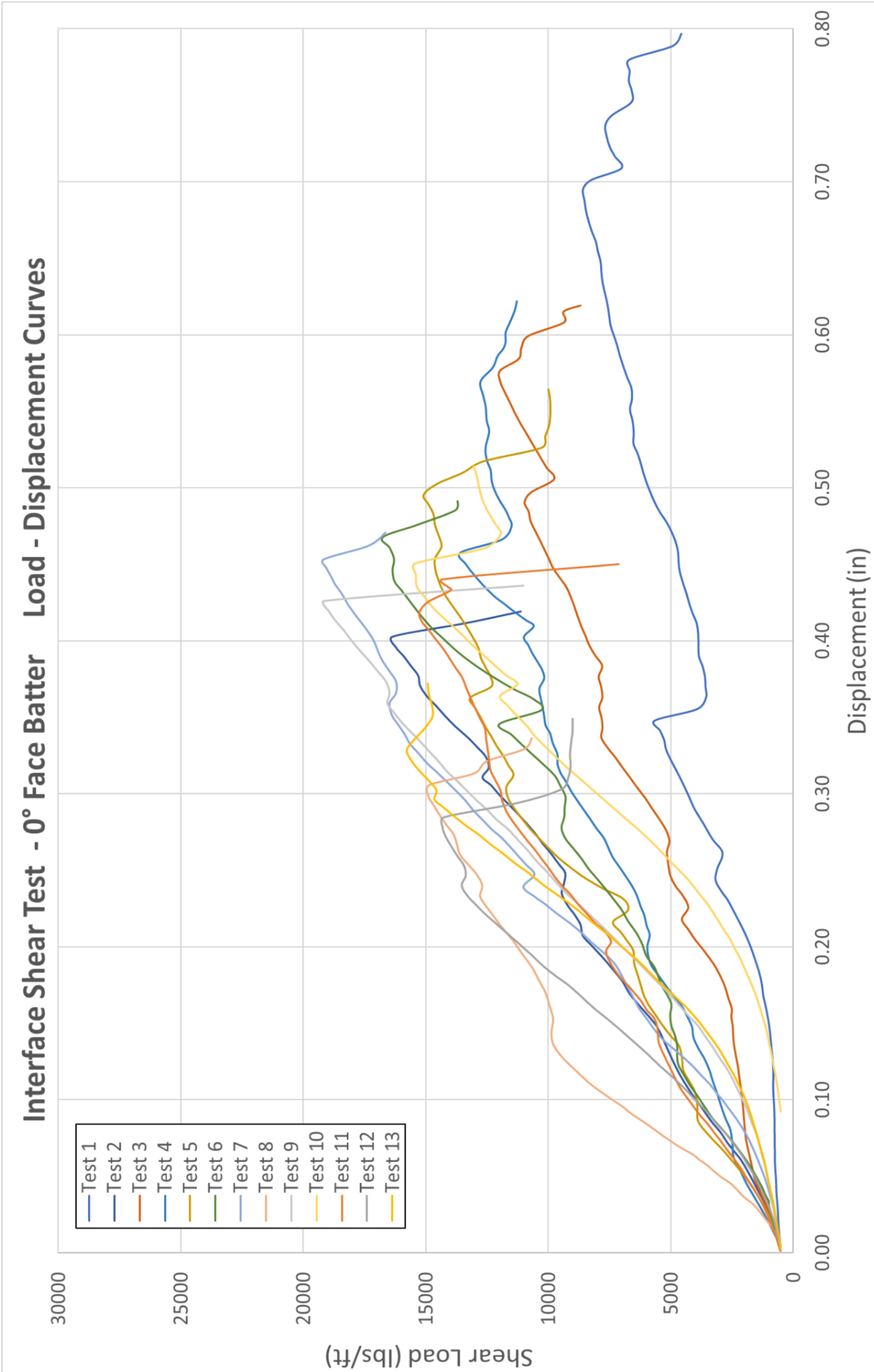

Figure 5 – Horizontal Interface Shear Force versus Horizontal Displacement

Table 1 – Summary of Peak Interface Shear Test Results

Test Number	Normal Load lb/ft	Normal Load kN/m	Peak Shear lb/ft	Peak Shear kN/m	Observed Failure
1	117	1.7	2,247	32.8	Broken Knobs
2	1,253	18.3	4,262	62.2	Broken Knob
3	379	5.5	3,129	45.7	Broken Knobs
4	681	9.9	3,546	51.7	Broken Knob
5	967	14.1	3,955	57.7	Broken Knobs
6	1,254	18.3	4,381	63.9	Broken Knobs
7	2,089	30.5	4,996	72.9	Broken Block
8	2,997	43.7	3,890	56.8	Broken Block
9	2,920	42.6	4,985	72.7	Broken Blocks
10	3,759	54.9	4,027	58.8	Broken Blocks
11	1,251	18.3	4,025	58.7	Broken Block
12	5,004	73.0	3,747	54.7	Broken Blocks
13	6,283	91.7	4,126	60.2	Broken Blocks

Peak interface shear loads were taken as the maximum measured load during each interface shear test. Peak loads plotted against normal loads are shown in **Figure 6**.

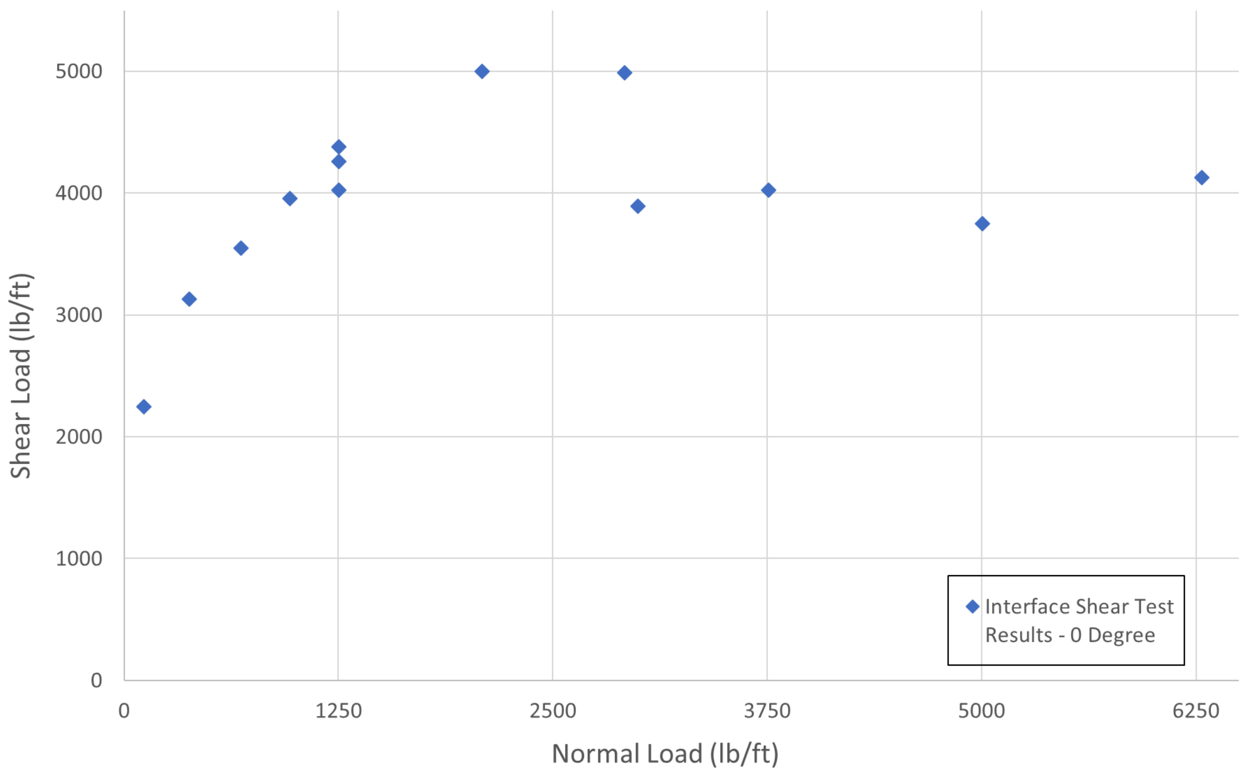

Figure 6 – Peak Shear Load versus Normal Load

7.0 Closure

The Novum Wall™ block to block interface shear capacity tests were conducted in general accordance to ASTM D6916.

The recommended interface shear capacity envelope for use in design and analysis can be found in the design resources for Novum Wall™.

The data and conclusions contained herein should be used with care. The user should verify that project conditions are equivalent to laboratory conditions and should account for any variations.

This test data is accurate to the best of our knowledge and understanding. It is the responsibility of the end user to determine suitability for the intended use.

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