

# CERTIFIED TEST REPORT

## TENSILE AND SHEAR STRENGTH OF POST-INSTALLED ANCHORS IN CONCRETE ELEMENTS - *Per ASTM E488* -

Report Number: R-5.10\_10-28-20\_PS  
Date: December 17, 2020

**REPORT PREPARED FOR:**





Piazza Stoneworks  
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**Quality System:** The Structures and Materials Laboratory (SML) maintains a quality system in compliance with ISO 17025-2017, accredited under International Accreditation Service (IAS), testing laboratory TL-478 and qualified laboratory by the Florida Department of Transportation (FDOT) number ISM028. All the test results presented herein are linked through unbroken chain data. Analyzed data is obtained directly from the recorded raw data during testing, from which the test results are presented. This report contains analyzed tabulated data results.

**Procedures:** All tests and services are done in accordance with the SML Quality Manual (Version 6.0) revised November 30, 2019; relevant standard operating procedures (SOPs); and with the applicable requirements of the reference standard test methods, unless otherwise stated.

**Disclosure:** This document may contain confidential information; please contact an authorized entity prior to distributing. Conclusions reached and opinions offered in this document are based upon the data and information available to at the time of its issue, and may be subject to revision as additional information or data becomes available.

|                     |                   |
|---------------------|-------------------|
| <b>Controls:</b>    |                   |
| Superseded Report   | New report        |
| Reason for Revision | n/a               |
| Effective Date      | December 17, 2020 |

|   |   |
|---|---|
| <b>Test Report Approval Signatures:</b> |   |
| Quality review<br>Approval              | <p>I indicate that I have reviewed this Test Report and agree with the contents it presents, and find it meets all applicable laboratory requirements and policies. I approve for its release to the customer.</p> <p>Name: Francisco De Caso<br/>Signature: <br/>Date: December 17, 2020</p>          |
| Technical review<br>Approval            | <p>I indicate that I have reviewed this Test Report and agree with the technical contents it presents, and find it meets all applicable laboratory requirements and policies. I approve for its release to the customer.</p> <p>Name: Antonio Nanni<br/>Signature: <br/>Date: December 17, 2020</p> |

## 1. STRENGTH OF ANCHORS - ASTM E488

### 1.1. TEST SUMMARY INFORMATION

**Test Objective:** Determination of tensile and shear strength of post-installed anchors on Piazza Stone blocks substrate.

**Sample Under Evaluation:** Piazza Stonework blocks with Piazza-Con Hex Washer Concrete Screws with blue Dagger-Guard Coating. Refer to Figure 1.1. Also an affidavit is attached as an Annex for reference purposes.

**Test Standard Method/s:** ASTM E488/E488M – 18, Standard Test Method for Strength of Anchors in Concrete Elements as a guide, where deviations related primarily on the specimen size are reported herein.

**Test Set-up:** For the tensile strength of anchors: the setup as described herein was used by considering the minimum required clearance between the anchors and test support equivalent to twice the effective embedment length. This was accomplished by placing a ½-in. thickness rigid loading ring with an opening of 2- in. diameter on the specimen surface. Uniform contact was provided between the specimen surface and restraining fixture assembly. Anchor installation was on the form-finished specimen surface. The anchor was centered and secured in the locking device and the tensile load was applied concentrically with the anchor axis through the loading rod and perpendicular to the specimen surface. Load was applied under displacement control at 1.3 mm/min (0.05 in./min). Load and frame head displacement were recorded at the sampling rate of once per second. Refer to Figure 1.2.

For the shear strength of anchors: the anchors were installed through a loading plate with the thickness of ¼ in. to the formed face of the test members, with distance from the center of an anchor shaft to the edge of test member,  $C_a$ , of 20 mm (0.80 in.), allowing a distance between upper supports of the piece of 83 mm (3.25 in.). A Teflon sheet with a nominal thickness of 0.51 mm (0.02 in.) was used as friction-limiting material between the loading plate and base material surface, preventing normal reaction between the loading and base. Test specimens were positioned and fastened in the support system so that the test surface of the test member was parallel to the loading plate and the axis of the loading rod assembly. The load was applied parallel to the surface of the test specimen under displacement control of 2.54 mm/min (0.10 in./min). Load and displacement were recorded at the sampling rate of once per second. Refer to Figure 1.2.

**Test Location:** Structures and Materials Laboratory at the University of Miami. 1251 Memorial Dr., MEB108 Coral Gables, FL, 33146.

**Analyst/s:** Juan Manuel Palacios and Ana de Diego.

**Technical Test Record:** TDS\_E488\_PS-5.

**Test Report**

Specimen Dimensions: Piazza Stone block 101.6x101.6x25.4 mm (4x4x1 in.) with post installed anchor 1 ¼” x 3/16”.

Specimen Preparation: Piazza Stonework blocks with Piazza-Con Hex Washer Concrete Screws with blue Dagger-Guard Coating 1 ¼” x 3/16” was post-installed with a low torque setting, screw snug on a hole using a 5/32” drill bit. per the client instructions.

Sampling Reference: Provided by the client.

Specimen Conditioning: Minimum of 24 hours at 23 ± 1°C (73 ± 3°F) and 60 ± 5% RH.

Specimen ID: Specimens are labeled and uniquely identified for quality and traceability using the format M\_X; where M is the tested property (A-TNS for anchor tensile strength, and A-SHE for anchor shear strength); and X is specimen repetition number (1 to 5). Refer to Table 1.1.

Test Results: Tensile and shear anchor strength tests results are tabulated in Table 1.2 and Table 1.3, respectively. Representative failure modes are provided in Figure 1.3 and Figure 1.4, respectively.

Table 1.1 – Test matrix

| Specimen ID    | Material Identification  | Test date (mm.dd.yy) |
|----------------|--|----------------------|
| A-TNS_01 to 05 | Piazza Stonework blocks with Piazza-Con Hex Washer Concrete Screws with blue | 12.04.20             |
| A-SHE_01 to 05 | Dagger-Guard Coating   | 12.08.20             |

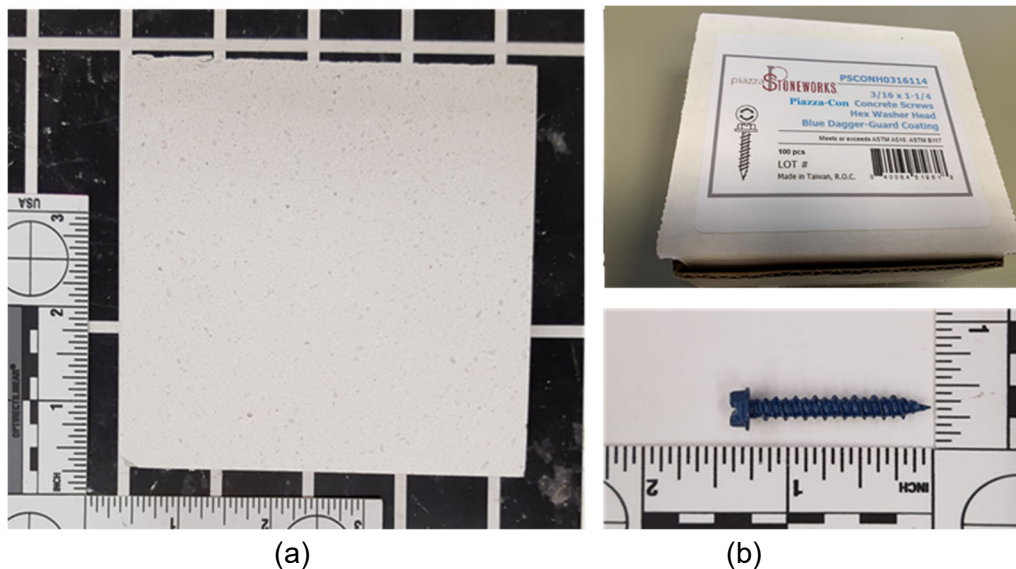


Figure 1.1 – Specimen items under evaluation: (a) Piazza Stone block substrate, and (b) Piazza-Con Hex Washer Concrete Screws 3/16 x 1-1/4

**Test Report****1.2. TEST RESULTS**Table 1.2 – Tensile anchor strength results, per ASTM E488<sup>R</sup>

| Specimen ID    | Embedment Depth |       | Maximum Load |            | Failure Mode* |
|----------------|-----------------|-------|--------------|------------|---------------|
|                | mm              | in.   | kN           | lbf        |               |
| A-TNS_01       | 19.81           | 0.780 | 2.23         | 501        | Tensile       |
| A-TNS_02       | 20.80           | 0.819 | 2.21         | 497        | Tensile       |
| A-TNS_03       | 21.03           | 0.828 | 2.61         | 587        | Tensile       |
| A-TNS_04       | 21.46           | 0.845 | 3.06         | 687        | Tensile       |
| A-TNS_05       | 21.41           | 0.843 | 2.20         | 494        | Tensile       |
| <b>Average</b> |                 |       | <b>2.46</b>  | <b>553</b> |               |
| $S_{n-1}$      |                 |       | 0.40         | 90         |               |
| CV( %)         |                 |       | 16.2         | 16.2       |               |

\*Refer to Figure 1.3 for representative failure mode.

Table 1.3 – Shear anchor strength results, per ASTM E488<sup>R</sup>

| Specimen ID    | Maximum load |            | Failure Mode* |
|----------------|--------------|------------|---------------|
|                | kN           | lbf        |               |
| A-SHE_01       | 1.60         | 360        | Shear         |
| A-SHE_02       | 1.42         | 319        | Shear         |
| A-SHE_03       | 1.78         | 400        | Shear         |
| A-SHE_04       | 1.87         | 420        | Shear         |
| A-SHE_05       | 1.53         | 344        | Shear         |
| <b>Average</b> | <b>1.64</b>  | <b>369</b> |               |
| $S_{n-1}$      | 0.20         | 45         |               |
| CV( %)         | 12.1         | 12.1       |               |

\*Refer to Figure 1.4 for representative failure mode.

<sup>R</sup>Used as a reference guide, where deviations related primarily on the specimen size are reported herein.

**1.3. VISUAL DOCUMENTATION**

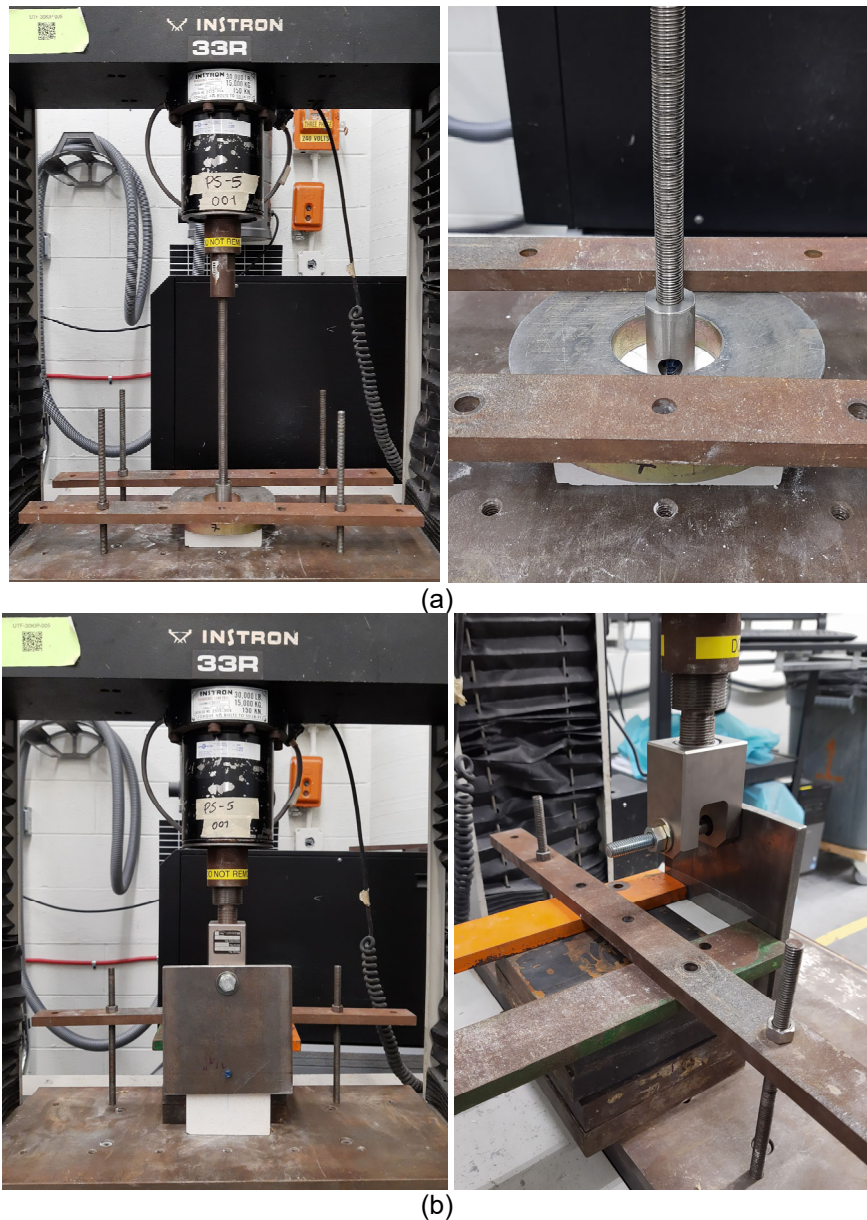


Figure 1.2 – Test setup: (a) Tensile strength of post-installed anchor, and  
(b) Shear strength of post-installed anchor



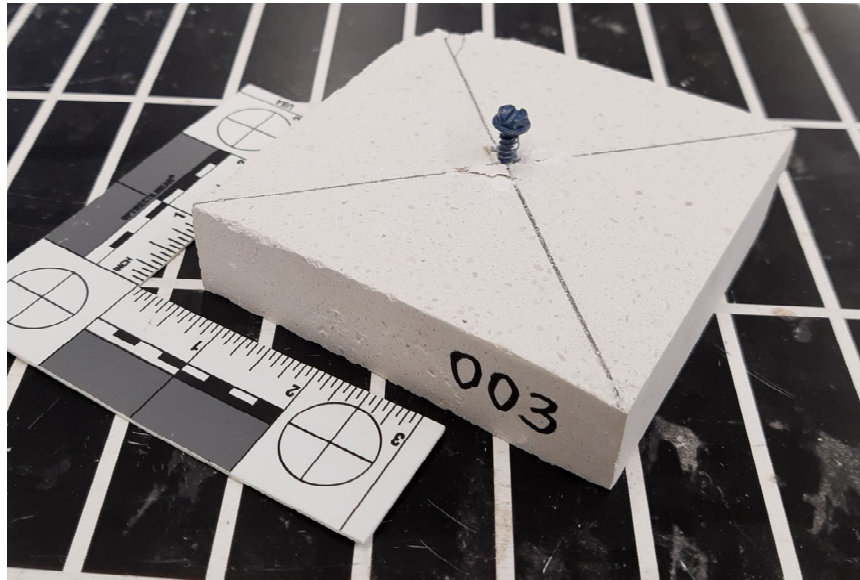


Figure 1.3 – Representative failure mode of anchor tensile strength test

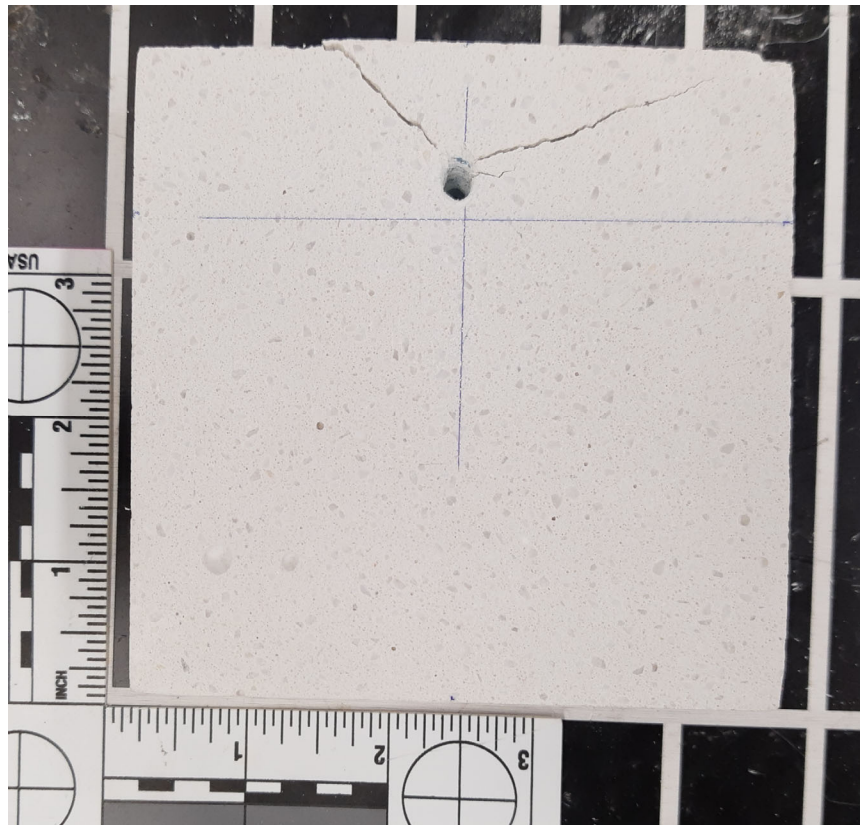


Figure 1.4 – Representative failure mode of anchor shear strength test

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