ASSESSMENT OF THE AS3700 RELATIONSHIP BETWEEN SHEAR BOND STRENGTH AND FLEXURAL TENSILE BOND STRENGTH IN UNREINFORCED MASONRY

Masia, Mark J.1; Simundic, Goran2; Page, Adrian W.3

1 PhD, Senior Lecturer, The University of Newcastle, Centre for Infrastructure Performance and Reliability, mark.masia@newcastle.edu.au

2 ME, Structural Testing Manager, The University of Newcastle, Centre for Infrastructure Performance and Reliability, goran.simundic@newcastle.edu.au

3 PhD, Emeritus Professor, The University of Newcastle, Centre for Infrastructure Performance and Reliability, adrian.page@newcastle.edu.au

A pilot study was conducted to assess the accuracy and relevance of the mathematical relationship provided in Australian Standard AS3700-2011 Masonry Structures for determining the shear bond strength (cohesion) of masonry based on its flexural tensile bond strength. Flexural tensile strengths were determined using bond wrench tests in accordance with AS3700 and shear bond strengths (initial shear strengths) were determined using triplet tests in accordance with European Standard EN1052-3 for comparison with the AS3700 mathematical relationship. A range of masonry units and mortar types typical of Australian construction practice were investigated. It was found that the two properties are correlated and that the AS3700 relationship is conservative for all of the masonry combinations tested in the current study. The level of conservatism is small and so based on the results of the current study, no changes to the AS3700 provisions are recommended.

Keywords: Masonry, shear, tensile, bond

INTRODUCTION

The tensile bond and shear bond behaviour of mortar joints in unreinforced brick and block masonry walls plays a crucial role in the load resisting systems of such walls under both in-plane and out-of-plane horizontal loads. Tensile and shear bond strengths depend on the type of masonry unit (brick or block) and the mortar used to bind them, as well as other factors such as workmanship. It is reasonable to suggest that there exists a relationship between tensile bond strength and shear bond strength for any given masonry (combination of masonry unit and mortar). Pluijm (1993) reported the results of direct tension tests and shear couplet and triplet tests using three different types of brick units (two clay and one calcium silicate) and two different mortars. He found that the ratio of shear bond strength (cohesion) to direct tensile bond strength varied between 1.3 and 6.5 and the ratio was largest for low values of tensile bond strength.

Australian Standard AS3700-2011 Masonry Structures (Standards Australia 2011) provides a default value (without testing) of 0.20MPa for the characteristic flexural tensile strength of masonry ($f'_{ml}$) at a mortar joint. Note that the flexural tensile strength is a measure of the tensile bond strength of masonry but is not equal to the direct tensile strength (Pluijm 1996).
In cases where designers wish to justify the use of higher values of $f'_{mt}$ (up to 1.0MPa), referred to as “Special Masonry” in AS3700, the standard specifies two alternative test methods; a masonry beam test and a bond wrench test. Both tests are relatively easy to perform, but the latter is usually preferred because it allows testing of every joint in a specimen and hence the efficient calculation of mean and characteristic strength values. By comparison, the beam test obtains a strength value which is the weakest of several joints and only one result is obtained for each relatively large beam specimen. Pluijm (1996) assessed various test methods proposed for measuring the tensile bond strength of masonry. Pluijm considered various types of wallette and beam specimens, a bond wrench test, and direct tension tests using both rotationally restrained platens and hinged platens. Pluijm concluded that the bond wrench test was as statistically sound as any other proposed test and therefore suitable for use in determining the flexural tensile bond strength of masonry. For these reasons, the bond wrench test specified in AS3700 was used for the experimental determination of flexural tensile bond strength in the current study.

By contrast, very few countries have adopted in their national design standards test procedures for the measurement of shear bond strength and other associated material parameters required to characterise the shear behaviour of mortar joints in masonry. Undoubtedly, this situation has arisen from the difficulty in finding a simple test method which can be used to accurately describe the shear failure behaviour of mortar joints at a material point (Jukes and Riddington 1997). Australian Standard AS3700 (Standards Australia 2011) does not provide a test method to determine shear bond strength but rather provides the following mathematical relationship (Equation 1 (Standards Australia 2011)):

$$f'_{ms} = 1.25 f'_{mt} \quad 0.15 \text{MPa} \leq f'_{ms} \leq 0.35 \text{MPa}$$

(1)

where $f'_{ms}$ is the design characteristic shear strength (shear bond strength) in horizontal mortar joints. Although it would be reasonable to expect that the upper limit of 0.35MPa may not apply in the case of Special Masonry, AS3700 makes no mention of such a relaxation and so the limit applies regardless of the value of $f'_{mt}$ demonstrated by test.

The aim of the current study was to experimentally evaluate the suitability of Equation 1 for a range of masonry units and mortar types typical of Australian construction practice. In order to do this, flexural tensile strengths (including the calculation of characteristic values) were obtained by performing bond wrench tests in accordance with AS3700 and shear bond strengths (including characteristic values) were obtained by performing triplet tests in accordance with European Standard EN1052-3 (CEN 2002). Note that EN1052-3 adopts the terminology “initial shear strength” when referring to shear bond strength, this meaning the shear strength of the masonry bed joint when subjected to zero normal compressive stress. The choice of the EN1052-3 triplet shear test for the assessment of shear bond strength was based on two considerations: (i) of the various shear testing procedures proposed in the literature, it is relatively simple and easy to conduct, and (ii) it is codified and therefore, the testing procedure is precisely defined and repeatable. Various researchers (Zijl 2004, Stockl et al. 1990, Jukes and Riddington 1997, Riddington et al. 1997, Cabellero Gonzalez and Schubert 1995, Masia et al. 2006) have critically evaluated a range of experimental shear testing procedures which have been proposed over the past several decades including the EN 1052-3 triplet test. While their findings will not be repeated here, aspects of their conclusions related to the latter test are discussed in this paper.
EXPERIMENTAL PROGRAM

Materials

The experimental program is summarized in Table 1. The program was conducted in two series. Series 1 was designed to consider a wide range of masonry units and mortar types typical of Australian construction practice. Three different types of clay brick, one type of concrete brick and one type of hollow concrete block were selected. The bricks were all 230mm long x 110mm wide (thickness of wall) x 76mm high. This is the traditional brick size used in Australia. The concrete block units were 390mm long x 140mm wide x 190mm high with a face shell width of 30mm. For each unit type the initial rate of absorption (IRA) was determined in accordance with AS/NZS4456.17 (Standards Australia 2003). The IRA values shown in Table 1 are each the mean of 10 specimens and are based on gross bedded areas for the brick units and net bedded area for the block units.

Each of the clay bricks were combined with three different mortar types, the concrete brick with two mortar types and the concrete block with one mortar type as shown in Table 1. All mortar joints were 10mm thick and struck flush with the face of the units; fully bedded for the brick units (230mm x 110mm bedded area) and face shell bedded for the concrete blocks (2 x 390mm x 30mm bedded area). The mortar classifications M2, M3, and M4 are those used in AS3700 and correspond to increasing strength and durability respectively. The ratios in brackets behind each mortar classification are the proportions of cement:lime:sand by volume.

Series 2 was designed to better understand the relationship between mean and characteristic values of flexural tensile strength and shear bond strength by focusing on just one of the masonry types already tested in Series 1 but using a much larger number of repeat specimens. Series 2 was also used to compare the results obtained for shear bond strength using Procedures A and B in EN1052-3, as detailed further below.

Table 1: Experimental Program

<table>
<thead>
<tr>
<th>Masonry unit</th>
<th>Mortar</th>
<th>Flexural tensile bond strength AS3700</th>
<th>Shear bond strength EN1052-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressed clay brick</td>
<td>IRA=6.19kg/m²/min</td>
<td>M2 (1:2:9) 10 joints</td>
<td>6 specimens at zero precompression</td>
</tr>
<tr>
<td>Extruded clay brick</td>
<td>IRA=0.43kg/m²/min</td>
<td>M2 (1:2:9) 10 joints</td>
<td>6 specimens at zero precompression</td>
</tr>
<tr>
<td>Extruded clay brick</td>
<td>IRA=1.43kg/m²/min</td>
<td>M2 (1:2:9) 10 joints</td>
<td>6 specimens at zero precompression</td>
</tr>
<tr>
<td>Concrete brick</td>
<td>IRA=6.39kg/m²/min</td>
<td>M3 (1:0:5 + water thickener) 10 joints</td>
<td>6 specimens at zero precompression</td>
</tr>
<tr>
<td>Concrete block</td>
<td>IRA=1.03kg/m²/min</td>
<td>M4 (1:0:3 + water thickener) 10 joints</td>
<td>6 specimens at zero precompression</td>
</tr>
<tr>
<td>Series 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extruded clay brick</td>
<td>IRA=0.43kg/m²/min</td>
<td>M3 (1:1:6) 50 joints</td>
<td>44 specimens at zero precompression + 3 specimens @ each of 0.2, 0.6, 1.0MPa precompression</td>
</tr>
</tbody>
</table>

Flexural tensile bond strength (AS3700)

For each of the masonry combinations shown in Table 1 the flexural tensile bond strength of each joint was determined by bond wrench testing in accordance with AS3700 - Appendix D
Brick specimens were constructed as six unit high stack bonded piers so that each specimen yielded five joint strengths. Concrete block specimens were three units high resulting in two joints per specimen. The bond wrench apparatus is depicted schematically in Figure 1 (Standards Australia 2011):

![Figure 1: Bond wrench setup in accordance with AS3700 (Standards Australia 2011)](image)

where $l_u$ and $t_u$ are the length and width of the masonry units respectively, $d_1$ and $d_2$ are the distances from the tension face of the specimen to the centre of mass ($m_1$) of the wrench and to the point of application of the applied load (mass $m_2$) respectively and $m_3$ is the mass of the upper masonry unit. The basis of the test is that the specimen is subjected to vertical compression combined with bending about an axis normal to the plane of Figure 1. Assuming linear elastic behaviour up until failure, the flexural tensile strength $f_{sp}$ of each joint is calculated as being equal to the stress at the tension face of the specimen (left side in Figure 1) at the point of failure (Equation 2):

$$f_{sp} = \left( \frac{M_{sp}}{Z_d} \right) - \left( \frac{F_{sp}}{A_d} \right)$$  (2)

where $M_{sp}$ is the bending moment about the centroid of the bedded area of the tested joint at failure (Equation 3):

$$M_{sp} = 9.81m_2 \left( d_2 - \frac{t_u}{2} \right) + 9.81m_1 \left( d_1 - \frac{t_u}{2} \right)$$  (3)

$Z_d$ is the section modulus about the axis about which the bending moment is applied of the bedded area $A_d$ and $F_{sp}$ is the total compressive force on the bedded area (Equation 4):
The mass \( m_2 \) was applied by the person operating the wrench transferring their body mass, gradually and without shock, onto the loading handle until failure of the specimen occurred. The force associated with mass \( m_2 \) was determined using strain gauges fitting to the loading handle. The strain gauges were connected to an electronic device which recorded the largest strain in the handle and hence the largest force applied.

**Shear bond strength (EN1052-3)**

For each of the masonry combinations shown in Table 1 the shear bond strength (initial shear strength) was determined in accordance with EN1052-3 including Amendment A1 2007 (CEN 2002 and CEN 2007). All specimens (brick and block) were constructed as 3 unit high stack bonded piers as shown in Figure 2a (EN1052-3 Type I specimens). In no case were the units cut. The specimens constructed using the brick units complied directly with EN1052-3. However, in the case of the concrete block specimens which had a unit length \( l_u = 390\text{mm} \), EN1052-3 requires that the units be cut such that the length of the specimen \( l_s \) is not greater than 350mm. This was not done in the current study as it was felt that the removal of the end web in each concrete block unit would result in potential instability of the face shells during testing. Therefore, the concrete block triplet specimens had a specimen length of \( l_s = 390\text{mm} \).

For each masonry type in Series 1, six specimens were tested with zero pre-compression applied normal to the mortar bed joints (EN1052-3 Procedure B). For Series 2, 44 specimens were tested at zero pre-compression (Procedure B) and 9 specimens were tested in accordance with EN1052-3 Procedure A (Figure 2b) by testing three specimens at each of three pre-compression levels (0.2MPa, 0.6MPa and 1.0MPa) applied normal to the mortar bed joints.

\[
F_{sp} = 9.81(m_1 + m_2 + m_3)
\]  

The basis of the test is that the normal pre-compression (if any) is applied first and held constant. The shearing force \((F\text{ in Figure 2})\) is then applied at a constant rate until failure occurs and the maximum force resisted is recorded. Failure usually occurs at the unit/mortar interface, through the mortar or via a combination of interface and mortar failure. All three of these modes were observed during the current study. EN1052-3 also allows for the possibility
of shear, crushing and/or splitting failures occurring within the units. Failures within the units were not observed during the current study. For each triplet specimen the shear strength is calculated using Equation 5 and the normal pre-compression stress (if any) is calculated using Equation 6:

\[ f_{voi} = \frac{F_{i,max}}{2A_i} \]  

\[ f_{pi} = \frac{F_{pi}}{A_i} \]  

where, for specimen \( i \): \( f_{voi} \) is the shear strength, \( F_{i,max} \) is the maximum shearing force resisted, \( A_i \) is the cross sectional area of the specimen parallel to the bed joints (equal to the bedded area and hence the same as \( A_d \) used in the calculation of flexural tensile bond strength), \( f_{pi} \) is the normal pre-compression stress and \( F_{pi} \) is the normal pre-compression force.

For Procedure B, in which no pre-compression is applied, the values of \( f_{voi} \) are directly the shear bond strengths (initial shear strengths) for each specimen from which the mean initial shear strength \( (f_{vo}) \) and characteristic initial shear strength for a given masonry combination can be obtained. For Procedure A, the individual values of shear strength \( f_{voi} \) are plotted against the corresponding values of normal pre-compression stress \( f_{pi} \). A linear regression is then fitted to the data and the y-axis intercept (at zero normal stress) is taken as the mean initial shear strength \( (f_{vo}) \) (shear bond strength) for that masonry.

Equations 5 and 6 above assume that the normal and shearing stresses are uniform over the specimen cross section during testing. Using finite element analyses, various researchers (Stockl et al. 1990 and Riddington et al. 1997 to name just two) have been able to show that the assumptions of uniform stress distributions are often far from true. Joint failure usually initiates at a point at a shear stress higher than the average value calculated from the failure load. Strength values based on average stresses therefore represent an underestimation of the true local shear bond strength. Using finite element analyses, Riddington et al. (1991) demonstrated that when the EN1052-3 triplet test setup is used with zero pre-compression the local shear bond strength at a material point may be as much as 50% higher than the average shear stress at failure (as calculated using Equation 5 above). Further to this, for tests including more than one joint such as the EN1052-3 triplet shear test, the weaker of the two joints will fail first. The result is that the value of shear strength obtained from a large number of such tests will be less than the average joint strength in the population. Lawrence (1983) discussed this effect and suggested a correction factor based on order statistics which can be applied to estimate the true mean joint shear strength. For triplet shear tests conducted by Lawrence the coefficient of variation (COV) values ranged from 16% to 26%. Based on a COV of 21% (the average of the COVs observed by Lawrence) the correction factor resulted in the relationship: mean joint shear strength = 1.14 x mean triplet shear strength. Combining the two effects observed above the true local shear bond strength at a material point could be as much as 1.50 x 1.14 = 1.7 x shear bond strength from the EN1052-3 triplet test. This effect will be considered in the following section when interpreting the results for the current study.

**Characteristic values**

Equation 1 is expressed in terms of characteristic values of flexural tensile bond strength and shear bond strength. Therefore, it was necessary in the current study to determine
characteristic values from the experimental data obtained. AS3700 – Appendices A and B (Standards Australia 2011) were used to determine mean and characteristic ($f'_{mi}$) values of flexural tensile strength and EN1052-3 (CEN 2002 & 2007) was used to determine values of mean initial shear strength ($f_{vo}$) and characteristic initial shear strength ($f_{vok}$). As the approaches prescribed by the two standards differ slightly, the AS3700 approach was also applied to determine characteristic shear bond strengths to allow direct comparison with the characteristic flexural tensile strengths. The approaches are summarised below, but the reader is referred to the respective standards for the procedures in full.

AS3700 - Appendix A sets out an approach for calculating the mean strength of a set of test results. It includes a procedure by which the data can be statistically assessed for abnormal test results, and any such results may be removed from the data set before calculating the mean strength value. AS3700 - Appendix B defines the characteristic value ($f'$) of a set of test results as shown in Equation 7:

$$f' = k \cdot f_{spl} \quad (n < 10) \quad or \quad f' = k \cdot f_{ksp} \quad (n \geq 10)$$  (7)

where $n$ is the number of test results, $f_{spl}$ is the least of the $n$ individual results and $f_{ksp}$ is the lower 5 percentile value for the set of test results. The value of $f_{ksp}$ is found by ranking the test results in increasing order and $f_{ksp}$ is interpolated from a location in the ranked list which depends on $n$. For $n \leq 10$, $f_{ksp} = f_{spl}$. The characteristic value factor $k$ is read from a table in the standard and is a function of $n$ and the coefficient of variation (COV) of the test data. For $n < 30$, AS3700 requires that the COV is estimated from past practice for the type of strength property being assessed. For flexural tensile strength, AS3700 recommends a COV of 30%. For $n \geq 30$ the COV is taken as the calculated COV of the actual test results being assessed. For comparison purposes in the current study, regardless of the number of results $n$, the COVs and hence the characteristic strengths were estimated using both the calculated COVs and the code value of 30%.

For EN1052-3 Procedure A (specimens tested with pre-compression), the mean initial shear strength ($f_{vo}$) is obtained from the y-axis intercept of the linear regression fitted to the shear strength versus normal stress data. The characteristic initial shear strength ($f_{vok}$) is then estimated crudely as $f_{vok} = 0.8f_{vo}$. For EN1052-3 Procedure B, the mean initial shear strength ($f_{vo}$) is calculated as the average of the six or more initial shear strength test results obtained under zero normal pre-compression stress. For Procedure B, two alternative approaches are provided for the determination of characteristic initial shear strength. The first (referred to in EN1052-3 as the “Simple Method”) states: $f_{vok} = 0.8f_{vo}$ or the lowest individual strength $f_{voi}$, whichever is less. The second approach (referred to in EN1052-3 as the “Statistical Method”) requires calculating the base 10 logarithm ($Y_i$) of each of the individual test results ($f_{voi}$). The mean ($Y_{mean}$), standard deviation ($s$) and characteristic value ($Y_c$) of the log results are determined, and then the characteristic initial shear strength is found from $f_{vko} = \text{antilog}_{10}(Y_c)$. For the current study, characteristic initial shear strengths (shear bond strengths) were determined using both the Simple Method and the Statistical Method.

RESULTS AND DISCUSSION
The experimental results are shown in Table 2. The table presents mean, COV and characteristic strength values calculated using the various approaches summarised above. Column (8) of Table 2 shows the ratios of mean shear bond strength to mean flexural tensile bond strength for each masonry combination. Column (9) shows the ratios of characteristic
shear bond strength to characteristic flexural tensile bond strength, calculated using characteristic values based exclusively on the AS3700 procedure using the actual COV of each set of test results. Using characteristic values calculated in this way allows a direct comparison using the same statistical approach for both flexural tensile and shear bond strengths.

Table 2: Experimental Results

<table>
<thead>
<tr>
<th>Unit</th>
<th>Mor-tar</th>
<th>Flexural tensile bond strength AS3700</th>
<th>Shear bond strength EN1052-3</th>
<th>Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(1) Mean (MPa) CV =30%</td>
<td>f's (MPa) Actual COV</td>
<td>(4) Mean f_v (MPa) COV</td>
</tr>
<tr>
<td>Pressed clay brick</td>
<td>M2</td>
<td>0.34 (26%)</td>
<td>0.19</td>
<td>0.52 (12%)</td>
</tr>
<tr>
<td></td>
<td>M3</td>
<td>0.69 (17%)</td>
<td>0.38</td>
<td>0.67 (23%)</td>
</tr>
<tr>
<td></td>
<td>M4</td>
<td>0.89 (42%)</td>
<td>0.29</td>
<td>1.02 (32%)</td>
</tr>
<tr>
<td>Ext. clay brick – low IRA</td>
<td>M2</td>
<td>0.26 (21%)</td>
<td>0.14</td>
<td>0.47 (14%)</td>
</tr>
<tr>
<td></td>
<td>M3</td>
<td>0.76 (13%)</td>
<td>0.45</td>
<td>0.70 (32%)</td>
</tr>
<tr>
<td></td>
<td>M4</td>
<td>1.23 (12%)</td>
<td>0.76</td>
<td>0.92 (18%)</td>
</tr>
<tr>
<td>Ext. clay brick – high IRA</td>
<td>M2</td>
<td>0.37 (35%)</td>
<td>0.18</td>
<td>0.42 (19%)</td>
</tr>
<tr>
<td></td>
<td>M3</td>
<td>0.85 (15%)</td>
<td>0.50</td>
<td>0.71 (33%)</td>
</tr>
<tr>
<td></td>
<td>M4</td>
<td>0.90 (46%)</td>
<td>0.18</td>
<td>1.04 (14%)</td>
</tr>
<tr>
<td>Conc. brick</td>
<td>M3</td>
<td>0.14 (29%)</td>
<td>0.06</td>
<td>0.30 (36%)</td>
</tr>
<tr>
<td></td>
<td>M4</td>
<td>0.63 (30%)</td>
<td>0.30</td>
<td>0.74 (32%)</td>
</tr>
<tr>
<td>Conc. block</td>
<td>M4</td>
<td>0.18 (35%)</td>
<td>0.08</td>
<td>0.27 (27%)</td>
</tr>
</tbody>
</table>

**Series 2** – (EN1052-3 Procedure B)

| Ext. clay brick – low IRA     | M3      | 0.95 (21%)               | NA                          | 0.68 (30%)           | 0.28                    | 0.37                           | 0.34                           | 0.72                | 0.62            |

**Series 2** – (EN1052-3 Procedure A)

| Ext. clay brick – low IRA     | M3      | As above                  | 0.87 (NA)                   | 0.70                  | NA                      | NA                             | 0.92                           | NA                  |

**Average (COV)**

|                         | 1.19 (35%) | 1.45 (81%) |

**Bold and underline** indicates masonry combinations for which Equation 1 (including limits on f_m) over-predicts the characteristic shear bond strength.

Based on the results presented in Table 2, the following observations can be made:

1. For each type of masonry unit, the mean values (best estimates) of flexural tensile bond strength and shear bond strength increase with the cementitious binder content of the mortar (M2 to M3 to M4). Furthermore the ratios of mean strength values (Column (8)) themselves have a COV of only 35% indicating that there is a clear correlation between flexural tensile bond strength and shear bond strength with the latter being, on average, 20% greater than the former.

2. The values of f_m in Columns (2) and (3) of Table 2 range from 0.06MPa to 0.91MPa, and fall below 0.20MPa for six of the twelve masonry combinations tested. This indicates that the default value of 0.20MPa provided in AS3700 may not always be conservative.

3. The values of characteristic shear bond strength based on the AS3700 procedure agree reasonably closely with those based on the EN1052-3 Statistical Method. The ratios of characteristic shear bond strength to characteristic flexural tensile bond strength (Column (9)) range from 0.43 to 4.93. The mean of the ratios (1.45) is comparable with the 1.25
ratio implied by Equation 1. The large COV (81%) indicates a significantly poorer correlation between characteristic values than was observed between mean values.

4. The ratios in Columns (8) and (9) associated with the three types of clay unit combined with the M3 mortar are all low relative to the column averages. This is likely the result of an error in experimental procedure in which the triplet specimens associated with this mortar mix were not subjected to a pre-compression load during curing as specified in EN1052-3. This resulted in lower shear strength values and hence lower ratios of shear bond strength to flexural tensile bond strength for these masonry combinations.

5. Applying Equation 1 (including the limits on \( f'_{mt} \)) to the values of \( f'_{mt} \) in Columns (2) or (3) of Table 2, as appropriate, shows that the characteristic shear bond strengths are over-predicted by AS3700 for 5 of the 12 masonry combinations investigated. Of these five cases, two are associated with the specimens using M3 mortar described above and, if excluded, leaves just three combinations for which AS3700 results in non-conservative predictions. If the correction factor of 1.7 was applied to the shear bond strengths to account for the effects discussed by Riddington et al. (1991) and Lawrence (1983) then the characteristic shear bond strengths would be increased, implying that Equation 1 would be conservative for all of the masonry combinations tested in the current study. Note that the correction factor was not applied in a quantitative sense in the current study due to its approximate nature.

6. Comparing Series 1 and 2 results for the low IRA extruded clay brick unit with M3 mortar, the values of \( f'_{mt} \) agree closely, particularly when the Series 1 value of \( f'_{mt} \) is calculated using the actual COV of the test results. The values of characteristic shear bond strength calculated using Procedure B also agree closely, leading to suspicion that the Series 2 specimens were also not cured under pre-compression. Unfortunately, this could not be confirmed at the time of writing. The Series 2 mean shear bond strength obtained using Procedure A is higher than that obtained using Procedure B, but the difference is not large. The significant difference between Procedure A and B characteristic shear bond strengths is thought to result from the simple method in Procedure A not adequately taking account of the significant variability in the test data.

CONCLUSION
A study was conducted to assess the suitability of the mathematical relationship provided in Australian Standard AS3700-2011 for determining the shear bond strength (cohesion) of masonry based on its flexural tensile bond strength. It was found that the two properties are indeed correlated and that the AS3700 relationship is conservative for all of the masonry combinations tested in the current study. The level of conservatism is small and so based on the results of the current study, no changes to the AS3700 provisions for shear bond strength are recommended. However, of some concern, the study found that the experimentally determined values of characteristic flexural tensile bond strength were less than the AS3700 default value of 0.2MPa for 6 of the 12 masonry combinations investigated, implying that the default value may not always be conservative.

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