# Physical Properties of Timbercrete

| Characteristic Compressive Strength of Timbercrete Units | |
|---|---|
| Characteristic Compressive Strength, $f'_{uc}$ | 3.2 to 6 MPa |

The compressive strength of a unit is its ability to resist crushing. The unit is placed in a compression testing machine, loaded until it fails, and the unconfined compressive strength is calculated. Solid or cored units must be fully bedded in the test and the compressive strength calculated using the full bed area. Hollow units must be bedded only on the face shells, and the compressive strength calculated using the face shell area. An aspect ratio factor is applied to account for the confining effect the machine platens on short wide units, such as bricks. AS 3700 requires the designer to include, on the drawings, the required characteristic compressive strength of the units.

The characteristic value reported above is based on the following tests to AS/NZS 4456.4, and calculated using AS 3700 Appendix B.

| Testing Authority | Test Report | Date | No of Samples | Mean Result | Coefficient of Variation |
|---|---|---|---|---|---|
| Bemac Laboratories | 8264 | 1/4/07 | 4 | 3.7 | 2.7% |

| Characteristic Lateral Modulus of Rupture of Timbercrete Units | |
|---|---|
| Characteristic Lateral Modulus of Rupture, $f'_{ut}$ | 1.1 MPa |

Lateral Modulus of Rupture is a measure of the horizontal flexural strength of masonry units. If the lateral modulus of rupture of units is too low, a wall could crack vertically when subjected to horizontal out-of-plane loads such a wind or earthquake. The reported characteristic lateral modulus of rupture is in excess of the AS 3700 default value of 0.8 MPa.

The characteristic value reported above is based on the following tests to AS/NZS 4456.15, and calculated using AS 3700 Appendix B.

| Testing Authority | Test Report | Date | No of Samples | Mean Result | Coefficient of Variation |
|---|---|---|---|---|---|
| Test Rite Coring Pty Ltd | 26288 | 11/11/04 | 10 | 1.29 | 11% |

## Initial Rate of Absorption of Timbercrete Units

| | |
|---|---|
| Mean Initial Rate of Absorption | 0.6 kg/m$^2$/min |

Initial Rate of Absorption (IRA) is the property of masonry units commonly known as “suction”. It is the quantity of water absorbed in one minute by a standard area of the bedding face of a unit under standard conditions, and may be used to assist in the selection of appropriate mortars to maximise bond strength.

The mean value reported above is based on the following tests, in accordance with AS/NZS 4456.17.

| Testing Authority | Test Report | Date | No of Samples | Mean Result | Coefficient of Variation |
|---|---|---|---|---|---|
| Bemac Laboratories | 6586 | 8/6//04 | 6 | 0.6 kg/m$^2$/min | 22% |

## Freeze-Thaw Loss of Timbercrete Units

| | |
|---|---|
| Freeze-Thaw Loss at 25 cycles | All samples lost less than 0.2% at 25 cycles. |

When masonry is subject to freeze-thaw-freeze cycles, small quantities of water in the pores of the units turn to ice, expand, and cause fine cracking and spalling. The Freeze-Thaw test is intended to identify those masonry units most at risk of spalling under the a given number of freeze-thaw-freeze cycles.

The value reported above is based on the following tests, in accordance with ASTM C1262-05a.

| Testing Authority | Test Report | Date | No of Samples | Mean Result | Coefficient of Variation |
|---|---|---|---|---|---|
| Enysis | R Anderson | Sept 2005 | 5 | Loss of 0.09% at 25 cycles | 56% |

## Characteristic Compressive Strength of Timbercrete Masonry

| | |
|---|---|
| Characteristic Compressive Strength, $f'_m$ | 1. 25 mm thick bed joints 3.84 MPa<br>2. 10 mm thick bed joints 3.78 MPa<br><br>Use 3.8 MPa for joint thicknesses in the range of 10 mm to 25 mm. |

The compressive strength of masonry is its ability to resist crushing. It is also the basic property used in the design of reinforced masonry for flexure. Stack bonded masonry piers, of at least three units high with mortar joints, are crushed in a compression testing machine until the laterally expanding mortar splits the units, and the unconfined compressive strength is calculated. The tests indicate that the characteristic compressive strength is not sensitive to the thickness of the bed joints.

The characteristic value reported above is based on the following tests to AS 3700 Appendix C, and calculated using AS 3700 Appendix B.

| Testing Authority | Test Report | Date | No of Samples | Mean Result | Coefficient of Variation |
|---|---|---|---|---|---|
| Bemac | 8264 | 7/5/07 | 1. 3 | 4.42 MPa | 4% |
| Laboratories | 8264 | 7/5/07 | 2. 3 | 4.36 MPa | 4% |

## Characteristic Flexural Tensile Strength of Timbercrete Masonry

| | |
|---|---|
| Characteristic Bond Strength, $f'_{mt}$ | It is recommended that design be based on the AS 3700 default value of 0.2 MPa for mortars complying with Table 10.1. |

The flexural tensile strength of masonry is the ability of the mortar and block to adhere to each other, thus providing bending resistance. It is tested using a bond wrench to break off units from a stack bonded masonry piers. AS 3700 Clause 3.3.3 permits the use of a characteristic flexural strength of 0.2 MPa for mortars complying with Table 10.1

The mean values reported below are based on the following tests to AS 3700 Appendix D.

| Testing Authority | Test Report | Date | No of Samples | Mix | Mean Result | Coefficient of Variation |
|---|---|---|---|---|---|---|
| Test Right | 26288 | 10/11/04 | 3 | 1:1:6 + Dynex | 0.331 MPa | 14.3% |
| Test Right | 26288 | 10/11/04 | 3 | 1:4 (Aalborg white) | 0.254 MPa | 37.6% |
| Test Right | 26822 | 10/11/04 | 3 | 1:1:6 (Off white) | 0.265 MPa | 19.4% |
| Test Right | 25811 | 9/6/04 | 3 | 1:1:6 | 0.361 MPa | 32.5% |
| Test Right | 25811 | 9/4/04 | 3 | Shield Coat Glue | 0.258 MPa | 7.4% |

## Loadbearing Fire Tests of Timbercrete Masonry

| | |
|---|---|
| Fire Resistance Levels | 240/240/240 (minutes)<br><br>Structural Adequacy / Integrity / Insulation<br>For loadbearing walls up to 2,980 mm. |

BCA Volume 1 and BCA Volume 2 specify the required fire resistance levels for various types of building and applications. AS 3700 Section 6 provides the means of interpreting the test results, to translate the into design information.

The values reported above is based on the following tests, in accordance with AS 1530.4.

| Testing Authority | Test Report | Date | No of Samples | Mean Result | Coefficient of Variation |
|---|---|---|---|---|---|
| CSIRO | FSV 1094<br>FS 3717/2685 | 11/2/04 | One loadbearing wall 2,940 high | 240/240/240 | NA |

## Thermal Properties of Timbercrete Masonry

| | Material density $\gamma$ kg/m$^3$ | Thermal conductivity k W/m.K | Specific heat s J/kg.K | Thermal resistivity m.K/W | Volumetric thermal capacitance MJ/m$^3$.K |
|---|---|---|---|---|---|
| Timbercrete (Solid - Fine sawdust) | 900 | 0.234 | 737 | 4.274 | 663 |
| Timbercrete (Solid - Low density ) | 1,000 | 0.314 | 850 | 3.185 | 850 |
| Timbercrete (Solid - High density) | 1,100 Note | 0.414 | 759 | 2.415 | 843 |

BCA Volume 1 Part J and BCA Volume 2 Section 3.12 specify the requirements for energy efficiency in buildings. Two method are available to designers - Alternative Solutions incorporating computer simulation and Deemed-to-Satisfy construction.

Note: 200 mm thick walls with a density of at least 1,100 kg/m$^3$ will result in a wall of density at least 220 kg/m$^2$. This will qualify this wall for concessions under the BCA Vol 1 and BCA Vol 2. The density of mortar is in the range of 1,500 to 1,700 kg/m$^3$, i.e. more dense than the wall.

The following information is based on test results reported by Engineered Energy and Environmental Control Systems - Ensys Limited, in their assessment of the thermal properties
of six Timbercrete with a Hot Disk Thermal Analyser, at University of Canterbury, Christchurch, New Zealand.

| Testing Authority | Test Report | Date | No of Samples | Mean Result | Coefficient of Variation |
|---|---|---|---|---|---|
| Ensys Limited, | - | - | 2<br>2<br>2 | 0.234<br>0.314<br>0.414 | NA |