



GROVE WHITBED

This technical data sheet was compiled by the Building Research Establishment (BRE) at the request of Albion Stone and is updated by Albion Stone to incorporate current test results. The 862 tests have been carried out in accordance with current European standards by the BRE on Albion Stone's behalf, or by other accredited testing houses. The early test data that pre-dates the introduction of Euro-codes has been included providing the test methods were very similar. The work carried out by the BRE on this technical data sheet has been undertaken as a paid commission and does not represent an endorsement of the stone by the BRE.

This data includes the Lowest and Highest Expected Values (LEV & HEV) using the statistical calculations from the Euro-codes. We are confident that these results give a good indication of the stones value, but as it is a natural material we, like other stone producers, are unable to guarantee individual results for specific stones. Instead, we recommend that an appropriate factor of safety is used to ensure satisfactory performance, Cladding Annex 1 of the Technical Manual provides further information, but we suggest that a suitably qualified stone consultant with geological and testing experience is employed to provide further information.

Petrography

Macro Examination: This appeared to be a fine-grained sedimentary limestone. Light creamy-white coloured matrix containing an abundance (>10%) of highly elongate light-grey (brownish-grey when weathered) coloured fossiliferous material. This material was orientated primarily in one direction which probably represented bedding. These fossiliferous clasts were observed up to 3µm in length. Voidage appeared modest and the fluorescent resin take up appeared high. This sample appeared to be a fairly uniform fine-grained material in which no bedding or linear features other than the fossiliferous material was apparent.

Strength**Compression - BS EN 1926**

Lowest Expected Value 35.53 MPa

Highest Expected Value 61.06 MPa

Average: 47.04 Mpa from 26 tests

Flexural Strength - BS EN 13161

Lowest Expected Value 3.80 MPa

Highest Expected Value 8.55 MPa

Average: 5.88 MPa from 101 tests

Breaking Load at Dowel Hole - BS EN 13364:2002

Specimen Thickness (mm)	Mean Breaking Load (N)	Lowest Expected Value (N) / Highest Expected Value (N)
75	4667	3383 / 6281
60	2249	1777 / 2816
50	1860	1460 / 2342
40	1191	922 / 1519
30	667	539 / 817

Durability

Water Absorption - BS EN 13755

Lowest Expected Value 2.88%

Highest Expected Value 10.37%

Average: 5.78% from 121 tests

Density - BS EN 1936

Lowest Expected Value 2,014 kg/m³

Highest Expected Value 2,393 kg/m³

Average: 2,198 kg/m³ from 162 tests

Porosity - BS EN 1936

Lowest Expected Value 11.89%

Highest Expected Value 26.63%

Average: 18.48% from 194 tests

Saturation Coefficient - BS EN 1936

Lowest Expected Value 0.52

Highest Expected Value 0.82

Average: 0.64 from 108 tests

Salt Crystallisation – BS EN 12370

Lowest Expected Value 0.18%

Highest Expected Value 6.14%

Average: 2.05% from 6 tests

Thermal Shock Resistance—BS EN 14066

(% change in elastic modulus)

Lowest Expected Value 0%

Highest Expected Value 32%

Average: 4.51% from 10 tests

Water Absorption by Capillarity - BS EN 1925

59.41g/m².sec⁻²

Flooring / Paving

Abrasion Resistance - EN 14157

Lowest Expected Value 22.10

Highest Expected Value 25.30

Average: 23.63 from 12 tests

Slip Resistance - TRRL Pendulum Test: Grit 120 (Flooring)

Lowest Expected Value 66

Highest Expected Value 87

Wet Average value 76 from 24 tests

Lowest Expected Value 76

Highest Expected Value 102

Dry Average value 88 from 24 tests

Freeze/Thaw — Flexural Strength - BS EN 12372 & 14066 (Pre-thermal testing)

Lowest Expected Value 3.65 MPa

Highest Expected Value 7.31 MPa

Average: 5.25 MPa from 20 tests

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Freeze/Thaw—BS EN 12372 & 14066 (Average figure 14-168 cycles)

Lowest Expected Value 1.70 MPa

Highest Expected Value 9.42 MPa

Average: 4.37 MPa from 50 tests

Freeze/Thaw — Flexural Strength - BS EN 12372 & 14066 (After 14 (20) cycles) For cladding in accordance with EN 1469

Lowest Expected Value 3.30 MPa

Highest Expected Value 7.70 MPa

Average: 5.15 MPa from 20 tests

Freeze/Thaw — Flexural Strength - BS EN 12372 & 14066 (After 56 cycles) For paving in accordance with EN 1341

Lowest Expected Value 0.66 MPa

Highest Expected Value 12.17 MPa

Average: 3.40 MPa from 10 tests

Freeze/Thaw — Flexural Strength - BS EN 12372 & 14066 (after 168 cycles) in accordance with EN 771-6

Lowest Expected Value 1.33 MPa

Highest Expected Value 7.84 MPa

Average: 3.48 MPa from 10 tests

Light Reflectance - tested using NCL Colour Scan instrument - Grit 60: Mean Value 57.00
(Value from Grove Whitbed test, however these stones are very similar)

Internal Flooring

Grove Whitbed is suitable for all flooring applications up to semi-intensive use such as shops and offices with estimated visitor numbers of 5,000,000 with a service life without significant wear of 20 years. The slip resistance results of over 40 demonstrate that the stone will be safe in all applications.

Technical Summary

Prepared by: Dr T Yates, BRE (Building Research Establishment): Durability and Weathering

It is important that the results from the sodium sulphate crystallisation tests are not viewed in isolation. They should be considered with the results from the porosity and water absorption tests and the performance of the stone in existing buildings. Stone from the Portland Whitbed is traditionally acknowledged as generally being a very durable building stone and it has been used extensively in many towns and cities in the UK. Comparing the results for the Whitbed Stone from Jordans Quarry to those collected from buildings, exposure trials and tests on quarry samples collected by BRE during the last 70 years shows that this stone compares very well with the traditional view of Portland Whitbed. Previous research at BRE has shown that Portland limestone which has a low saturation coefficient (<0.72), a low microporosity (<11.0 of the stone by volume) and an open oolitic structure generally performs well over long periods when used on buildings. The results summarised on these sheets show that the limited number of samples tested meet these criteria. The average crystallisation test results show the stone to be Class C which BRE Report 141 suggests is suitable for most uses including where exposure conditions are to be more severe, for example high concentrations of sulphur dioxide or severe frosts, or where a long life is required (for example >50 years). In all cases it is important that the detailing of the stonework is designed to offer the maximum protection from rainwater and rainwater runoff.

Based on current research it seems likely that the stone would weather at a rate of between 1 and 2 mm per 100 years but it could be greater in severe exposures.

(Weathering rates are based on the BRE interpretation of historical data dating from 1932).

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