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BRE Test Report

Testing of Sintered Stone - Test Report

Prepared for: Date: Report Number: Mr Marco Terzi 01 November 2018 P105501 - 1000 Issue: 2

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Prepared by

Name Geoff Ashall

Position Principal Consultant, Building Technology Group

Date 01/11/2018

Signature

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Authorised by

Dr Martyn Webb
,

Position Principal Consultant, Building Technology Group

Date 01/11/2018

Signature

Martyn Webb.

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1 Introduction

Following instructions from Mr Marco Terzi (Lapitec SpA), BRE have completed a series of tests on a manufactured sintered stone. 3 different coloured stones were supplied (Purple, Grey and White designated 01, 02 and 03 respectively) but they have been treated as one homogeneous batch. The stone was delivered to BRE on the 27/04/2018.

This report provides a factual account of the testing carried out.

2 Test programme

BRE have carried out the following tests:

BS EN 14617-1:2013: Agglomerated stone. Test methods. Determination of apparent density and water absorption

BS EN 14617-2:2016: Agglomerated stone. Test methods. Determination of flexural strength (bending)

BS EN 14617-4:2012: Agglomerated stone. Test methods. Determination of the abrasion resistance**

BS EN 14617-5:2012: Agglomerated stone. Test methods. Determination of freeze and thaw resistance

BS EN 14617-6:2012: Agglomerated stone. Test methods. Determination of thermal shock resistance

BS EN 14617-8:2007: Agglomerated stone. Test methods. Determination of resistance to fixing (dowel hole)

BS EN 14617-9:2005: Agglomerated stone. Test methods. Determination of impact resistance

BS EN 14617-10:2012: Agglomerated stone. Test methods. Determination of chemical resistance**

BS EN 14617-10:2012: Agglomerated stone. Test methods. Determination of stain resistance

BS EN 14617-11:2005: Agglomerated stone. Test methods. Determination of linear thermal expansion coefficient

BS EN 14617-12:2012: Agglomerate stone. Test methods. Determination of dimensional stability

BS EN 1925: 1999, Natural stone test methods. Determination of water absorption coefficient by capillarity.*

BS EN 14231: 2003, Natural stone test methods. Determination of the slip resistance by means of the pendulum tester *

BS EN ISO 10456:2007 Building materials and products. Hygrothermal properties. Tabulated design values and procedures for determining declared and design thermal values

BS EN ISO 12572:2016: Hygrothermal performance of building materials and products. Determination of water vapour transmission properties. Cup method

* Please note BRE is UKAS accredited for this test.

**This test was carried out by an Independent Test Laboratory on behalf of BRE

3 Test Results

Given below is a summary of the test results, full details can be found in the Appendices.

Sintered Stone	Standard	Value	Units
Apparent Density M _v	BS EN 14617 - 1	2389	kg.m⁻³
Water Absorption C	BS EN 14617 - 1	0.02	% by mass
Flexural Strength Rtf	BS EN 14617 - 2	54.8	MPa
Abrasion Resistance	BS EN 14617 - 4	14.0	mm
Flexural Strength <i>RMf</i> (after 25 freeze/thaw cycles);	BS EN 14617 - 2	54.1	MPa
Coefficient of freeze/thaw resistance in flexural strength (after 25 freeze/thaw cycles); $KM_{f 25}$	BS EN 14617 - 5	98.7	
Flexural Strength R_{sf} (after 20 cycles thermal shock);	BS EN 14617 - 2	54.3	MPa
Coefficient of thermal shock resistance as change in flexural strength (as a percentage after 20 cycles). $\Delta R_{f, 20}$	BS EN 14617 - 6	0.9	%
Determination of resistance to fixing (undercut anchor) F	BS EN 14617 - 8	2078	Ν
Impact Resistance (L)	BS EN 14617 - 9	1.97	J
Chemical Resistance (Category)	BS EN 14617 - 10	C ₄	
Linear thermal expansion coefficient	BS EN 14617 - 11	5.79	10 ⁻⁶ (°C ⁻¹)
Dimensional Stability	BS EN 14617 - 12	Class A	
Thermal conductivity in dry state $\lambda_{10 \text{dry unit}}$	BS EN ISO 10456	1.3	W/(m.K)
Specific heat capacity	BS EN ISO 10456	840	J/(kg.K)
Water Vapour Resistance Factor Dry	BS EN ISO 10456	No value	
Water Vapour Resistance Factor Wet	BS EN ISO 10456	8	
Water Absorption by Capillarity	BS EN 1925	0.006	g/(m ² .s ^{0.5})
Slip Resistance slider 55 dry honed	BS EN 14231	79	
Slip Resistance slider 55 wet honed	BS EN 14231	26	

*Indicative value to be confirmed

Staining Agent	Result of cleaning after one hour	Result of cleaning after 24 hours
1. Red wine	No discolouration.	No discolouration.
2. Coffee - brewed	No discolouration.	No discolouration.
3. Freeze dried coffee powder	No discolouration.	No discolouration.
4. Ketchup	No discolouration.	No discolouration.
5. Cola	No discolouration.	No discolouration.
6. Citric Acid	No discolouration.	No discolouration.
7. Liquid Soap	No discolouration.	No discolouration.



4 Appendix A Detailed Test Results

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BSEN 14617 - 1: 2013: Determination of Apparent Density and Water Absorption						
Name of Stone:	Sintered Stone		Petrographic Nature:		Sintered Stone	
Block No 01,02, 03	Purple, Grev, White		Anisotropic F	Anisotropic Features:		-
Supplier:	Lapitec SpA	, ,	Country of Or	rigin:	Italy	
Dimensions:	100 x 100 x 1	12 mm	Project Refer	ence:	No data supplied.	
Surface Finish:	Polished		Preparation		Prepared to BSEN 14617-1	
Date Tested:	10/05/2018	15/05/2018	Tested by:		Alex Cantellov	V
BRE No	Мо	Mt	Ма	Apparent	Water	
				Density	Absorption	
P105501/18	g	g	g	kg.m⁻³	%	
01/281	297.528	297.59	173.242	2388	0.02	
01/282	296.713	296.77	172.766	2388	0.02	
01/283	297.464	297.52	173.133	2387	0.02	
02/281	309.241	309.31	180.155	2390	0.02	
02/282	308.935	309.01	179.788	2386	0.03	
02/283	307.974	308.05	179.476	2391	0.02	
03/281	307.081	307.186	179.065	2392	0.03	
03/282	302.705	302.788	176.433	2391	0.03	
03/283	308.302	308.376	179.653	2390	0.02	
			Mean	2389	0.02	
 * The calculation of apparent density assumes the density of water to be 998 kg.m⁻³ at 20 °C Mean water absorption C : 0.02 (%) 						
Approved by:	Date:	2389	(kg.m*)			
Name:	_		-			
Position: Principal Consultant Fire			Fire and Build	ding Technolo	gy Group	

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BSEN 14617-2: 2016 Determination of Flexural Strength Tested Dry



Name of Stone:	ne of Stone: Sintered Stone		Petrographic Nature:		Sintered Stone	
Block No 01,02, 03	Purple, Grey, White		Anisotropic Features:		None	
Supplier:	Lapitec SpA		Country of O	rigin:	Italy	
Dimensions:	300 x 75 x 12	2 mm	Project Refer	rence:	No data suppli	ed.
Surface Finish:	Tested polish	ed face up	Preparation		Prepared to BS	SEN 14617-2
Date Tested:	15/05/2018		Tested by:		Alex Cantellow	1
	Load	Span	Width	Thickness	Failure	Flexural
BRE no	Rate				Load	Strength
P105501/	MPa.s⁻¹	mm	mm	mm	N	MPa
01/241	0.25	280	75.0	12.7	1570	54.5
01/242	0.25	280	75.0	12.8	1600	54.7
01/243	0.25	280	74.9	12.4	1600	58.4
01/244	0.25	280	75.0	12.5	1640	58.8
02/241	0.25	280	74.9	12.9	1630	54.9
02/242	0.25	280	75.0	13.0	1820	60.3
02/243	0.25	280	75.0	13.1	1590	51.9
02/244	0.25	280	75.1	13.1	1380	45.0
03/241	0.25	280	75.0	13.1	1610	52.5
03/242	0.25	280	75.0	13.0	1720	57.0
03/243	0.25	280	75.0	75.0 13.0		57.7
03/244	0.25	280	75.0	13.2	1630	52.4
					Mean Rtf	54.8

Date:

Approved by:

G. Ashall

29/08/2018

St. Dev

Name:

Geoff Ashall

Position:

Principal Consultant, Fire and Building Technology Group

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Thameside Test & Research Limited Unit C2, Lomer Farm, Wrotham Road, Meopham, Kent DA13 0AN Thameside Tel: 01474 814466 Test & Research Ltd www.ThamesideTestandResearch.co.uk RS14/JAN16 Sample Number: T18/216/S14a Page 1 of 1 Lab. Scheme Number: 2655 Client: BRE Site ref: P105501/18/ Stone type: Agglomerated Stone Sampled by Client Product for test: Source n/a n/a Date Received: 17-May-18 **Date Prepared** 18/21-May-18 Date tested: 22-May-18 Test Method BSEN 14617-4:2012 Agglomerated stone- Determination of the abrasion resistance WIDE WHEEL ABRASION VALUE Specimen Individual abrasion value Mean abrasion value reference (mm) (mm) 14.0 01/91 01/92 13.5 02/91 14.5 02/92 14.5 14.0 03/91 14.0 15.0 03/92 Remarks 1. No surface preparation was carried out 2 The test results apply only to the specimens tested 3 Specimens were tested on a honed surface. Distribution: Authorised by Building Research Establishment Approved Signatory **Bucknalls Lane** PG Shrubsole () Principal Materials Engineer Garston, Watford Herts WD2 7JR Date 23/05/2018 FAO Geoff Ashall Thameside Test & Research Limited, Registered Office: Laaksola, Rhododendron Avenue, Culverstone Green, Gravesend, Kent DA13 0TT. Registered in England and Wales No. 7205145 Note: Thameside Test & Research Limited only accepts responsibility for the accuracy of the results contained in this report. No responsibility can be accepted for the results being representative of the material or litems sampled unless sampling has been carried out by the Thameside Test & Research Limited Thameside Test & Research Limited

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BSEN 14617-2: 2016 Determination of Flexural Strength Tested Dry after 25 cycles of freeze thaw conditioning to BSEN 14617 - 5



Name of Stone:	ne of Stone: Sintered Stone		Petrographic Nature:		Sintered Stone	
Block No 01,02, 03	1,02, 03 Purple, Grey, White		Anisotropic Features:		None	
Supplier:	Lapitec SpA		Country of O	rigin:	Italy	
Dimensions:	300 x 75 x 12	2 mm	Project Refer	ence:	No data suppli	ed.
Surface Finish:	Tested polish	ned face up	Preparation		Prepared to BS	SEN 14617-2
Date Tested:	15/05/2018		Tested by:		Alex Cantellow	,
	Load	Span	Width	Thickness	Failure	Flexural
BRE no	Rate				Load	Strength
P105501/	MPa.s⁻¹	mm	mm	mm	N	MPa
01/101	0.25	280	74.9	12.7	1580	54.9
01/102	0.25	280	75.0	12.9	1650	55.5
01/103	0.25	280	75.0	12.4	1560	56.8
01/104	0.25	280	75.3	12.6	1570	55.2
02/101	0.25	280	75.0	13.1	1750	57.1
02/102	0.25	280	74.9	13.0	1720	57.1
02/103	0.25	280	75.1	13.2	1750	56.2
02/104	0.25	280	75.1	13.0	1770	58.6
03/101	0.25	280	75.0	13.5	1640	50.4
03/102	0.25	280	75.0	13.5	1680	51.6
03/103	0.25	280	75.0	13.2	1460	46.9
03/104	0.25	280	75.0	13.3	1560	49.4

Approved by:

G. Ashall

29/08/2018

Mean RMf

St. Dev

Name:

Geoff Ashall

Position:

Principal Consultant, Fire and Building Technology Group

Date:

54.1

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BSEN 14617-2: 2016 Determination of Flexural Strength Tested Dry after 20 cycles of thermal shock conditioning to BSEN 14617 - 6



Name of Stone: Sintered Stone		Petrographic Nature:		Sintered Stone		
Block No 01,02, 03	2, 03 Purple, Grey, White		Anisotropic Features:		None	
Supplier:	Lapitec SpA		Country of O	rigin:	Italy	
Dimensions:	200 x 50 x 12	2 mm	Project Reference:		No data supp	lied.
Surface Finish:	Tested polish	ed face up	Preparation		Prepared to E	BSEN 14617-2
Date Tested:	19/10/2018		Tested by:		Alex Cantello	W
	Load	Span	Width	Thickness	Failure	Flexural
BRE no	Rate				Load	Strength
P105501/	MPa.s⁻¹	mm	mm	mm	N	MPa
01/310	0.25	280	75.0	12.7	1660	57.6
01/311	0.25	280	75.0	12.7	1450	50.3
01/312	0.25	280	75.0	12.6	1600	56.4
01/313	0.25	280	75.0	13.0	1770	58.7
02/310	0.25	280	75.0	12.9	1650	55.5
02/311	0.25	280	74.9	13.2	1770	57.0
02/312	0.25	280	74.9	13.2	1530	49.2
03/310	0.25	280	75.1	13.2	1590	51.0
03/311	0.25	280	75.0	13.2	1600	51.4
03/312	0.25	280	75.0 12.6		1570	55.4
				Mean Rsf	54.3	
					St. Dev	3.43

Approved by:

G. Ashall

29/08/2018

Name:

Geoff Ashall

Principal Consultant, Fire and Building Technology Group

Date:

Position:



BRE in house method for determining the pull out strength of an undercut anchor Tested dry :

Name of Stone:	Sintered Stone	Petrographic Nature:	Sintered Stone
Block number 01, 02, 03	Purple, Grey, White	Anisotropic Features:	None
Supplier:	Lapitec SpA	Country of Origin:	Italy
Dimensions:	250 x 250 x 13 mm	Project Reference:	No data supplied.
Surface Finish:	Polished	Preparation	BRE in house method
Load rate	50 N.s ⁻¹	Diameter of under cut	12.9 mm
Diameter of hole	10.9 mm	Depth of under cut	9.41 mm
Date Tested:	21/07/2018	Tested By:	Ian Rance
Date Tested:	21/07/2018	Tested By:	Ian Rance

BRE no.	Failure Load	Comments
P105501/	N	
01/156	1474	specimen split into 4 pieces
01/157	1949	specimen split into 4 pieces
01/158	1432	specimen split into 4 pieces
02/156	2869	specimen split into 4 pieces
02/157	2788	specimen split into 4 pieces
02/158	2567	specimen split into 4 pieces
03/156	1633	specimen split into 4 pieces
03/157	2299	localised failure around the fixing
03/158	1574	specimen split into 4 pieces
03/159	2190	specimen split into 4 pieces
Mean	2078	
St. Dev	546	
Co of var	0.26	

Mean resistance to fixing (F)

2078 N

Approved by:

r. Ashall

Date:

29/08/2018

Name:

Mr Geoff Ashall

Position:

Principal Consultant, Fire and Building Technology Group



BSEN 14617-9: 2016 Determination of Impact Resistance
Tested dry :

Name of Stone:	Sintered Stone		Petrographic Nature:	Sintered Stone		
Block number 01, 02, 03	Purple, Grey, White		number 01, 02, 03 Purple, Grey, White Anisotropic Features:		Anisotropic Features:	None
Supplier:	Lapitec SpA		Lapitec SpA Country of Origin:		Italy	
Dimensions:	200 x 200 x 12 mm		Project Reference:	No data supplied.		
Surface Finish:	Polished		Preparation	BSEN 14617 - 9		
Mass of impactor (kg)	1.04		Tested By:	Ian Rance		
Date Tested:	06/07/2018					

BRE no.	Failure Height	Fracture Work
P105501/	m	Joules (J)
01/320	0.210	2.14
01/321	0.160	1.63
02/320	0.160	1.63
02/321	0.210	2.14
03/320	0.210	2.14
03/321	0.210	2.14
	Mean	1.97

Mean Fracture work (L)

1.97 Joules

Approved by:

G. Ashall

Date:

29/08/2018

Name:

Mr Geoff Ashall

Principal Consultant, Fire and Building Technology Group

Position:



BSEN 14617-11: 2005 Determination of Linear Thermal Expansion Coefficient						
Name of Stone:	Sintered Stone		Petrographic N	lature:	Sintered Stone	
Block No 01,02, 03	Purple, Grev, White		Anisotropic Fe	atures:	None	
Supplier:	Lapitec SpA		Country of Orig	gin:	Italy	
Dimensions:	100 x 100 x	12 mm	Project Reference:		No data supplied.	
Surface Finish:	Polished and	Rear Face	Preparation		Prepared to BSEN 14617-11	
Date Tested:	31/08/2018		Tested by:		Alex Cantellow	
	•					
	Linear	Thermal Expan	sion Coefficient	x 10-6		
	су	cle 1	cycle	e 2		
DIOFFOIL	Polished	D F	Polished			
P105501/	Face	Rear Face	Face	Rear Face		
01/360	6.02 5.70	5.80	5.89	5.75	-	
01/361	5.70	5.94	5.96	6.52	-	
02/360	3.72	5.27	5.89	0.78	-	
02/301	4.43	5.00	5.64	0.02		
03/361	5.00	5.90	5.04	0.32		
Moan	5.52	5.20	5.86	6.04 6.09		
Mean Linea	10 ⁻⁶ .(°C ⁻¹)					
Approved by: Name:	G. ashall		Date:	07/09/2018		
Position:	Principal Cor	nsultant	Fire and Building Technology Group			



BSEN 14617-12: 2012 Determination of Dimensional Stability Name of Stone: Sintered Stone Petrographic Nature: Sintered Stone Block number 02 Grey Anisotropic Features: None Lapitec SpA Country of Origin: Supplier: Italy Dimensions: 300 x 300 x 12 mm Project Reference: No data supplied. Surface Finish: Polished face down Preparation BSEN 14617 - 12 Date Tested: Alex Cantellow 31/08/2018 Tested By: Temperature during test 21.4°C Digital Vertical Displacement P105501/18/02/370 Gauge mm d(3) 0.0 0.0 d(1) Displacement (D) 0.0 Class A Stable and not sensitive to humidity

*note no displacements were recorded at digital locations d2, or d4

Approved by:

G. Ashall

Date:

07/09/2018

Name: Mr Geoff Ashall Principal Consultant, Fire and Building Technology Group Position:

BS EN 14617-10 – Determination of chemical resistance								
Name of Stone:			Sintered Stone		Petrographic Nature:		Sintered Stone	
Block number			Purple, Grey, White		Anisotropic Features:		None	
Supplier:			Lapitec Sp	Â	Country of Origin:		Italy	
Dimensions:			300 x 300	x 12 mm	Project Reference:		No data supplied.	
Surface Finish:			Polished fa	ace	Preparation		BSEN 14617 - 12	
Initial test date			28/08/2018	3	Tested By:		Martyn We	bb
After conditionir	ng test date		10/10/2018	3				
Gloss Meter			Rhopoint N	lovoGloss S	520/60			
Sample								
P105501/18	02/3	331	03/333		01/330		03/332	
Condition	1 Hou	r HCI	8 Hour HCI		1 Hour NaOH		8 Hour NaOH	
Test No.	Before	After	Before	After	Before	After	Before	After
1	73.4	73.4	77.4	73.9	64.9	56	71.9	60.3
2	72.9	72.9	77.9	75.7	64.8	55.7	70.9	59
3	74.1	73.1	78.1	75.7	65.9	56	70.4	58.2
4	73.9	73.5	77	75.5	68.5	56	69.6	57.3
5	73.7	73.2	77	75.6	67.4	58.4	69	56.4
6	73.7	73.2	76.5	75.8	66.2	55.4	69.5	55.6
7	73.3	73.4	77.2	76.9	67.3	56.6	69.6	56.9
8	73.6	73.1	77.3	76.4	65.9	56.7	68.9	57.4
9	76	73.4	77.4	76.1	66.4	58.1	68.7	56.5
10	74.1	73.2	77.3	75.6	65.6	56.5	68.8	56.6
Average	73.9	73.2	77.3	75.7	66.3	56.5	69.7	57.4
Results	Results 99.1%		97.9%		85.3%		82.3%	
Results	Results C ₄		C ₄		C4		C ₄	

C4: materials, which keep at least 80 % of the reflection reference value after 8 h \pm 30 min of acid and basic attack (or if only in one specimen the attack is between 60 % and 80 %);

C3: materials, which keep between 60 % and 80 % of the reflection reference value after 8 h \pm 30 min of acid and basic attack; C2: materials, which keep between 60 % and 80 % of the reflection reference value after 1 h \pm 30 min of acid and basic attack; C1: materials, which keep less than 60 % of the reflection reference values after 1 h \pm 30 min of basic and acid attack.

Approved by:

J. Ashall Date:

10/10/2018

Name:

Mr Geoff Ashall

Position:

Principal Consultant, Fire and Building Technology Group



Deteri	BS EN 14 mination of the	231: 2003, l slip resista	Natural stone ance by mean	test methods. Is of the pendu	ulum tester		
		•	3	•			
Name of Stone:	Sintered Stone		Petrographic Nature:		Sintered Stone		
Block No: 01, 02, 03	Purple, Grey, White		Anisotropic Features:		None		
Supplier:	Lapitec SpA		Country of Origin:		Italy		
Dimensions:	250 x 250 x 1	2 mm	Project Reference:		No data supplied.		
Surface Finish:	Polished		Preparation		Prepared to BSEN 14231		
Date Tested:	18/05/2018		Tested by:	Tested by:		Alex Cantellow	
Slider	Slider 55		Temperature during test		20°C		
	•						
BRE no			Con	dition: Dry	1	1	
P105501/	01/81	01/82	02/81	02/82	03/81	03/82	
Direction 0°	76	74	76	74	86	81	
Direction 180°	80	79	79	78	83	78	
Mean	78	76	78	76	85	80	
BRE no			Cone	dition: Wet			
P105501/	01/81	01/82	02/81	02/82	03/81	03/82	
Direction 0°	28	26	26	26	25	26	
Direction 180°	28	26	25	25	25	25	
Mean	28	26	26	25	25	26	
	Mean Slip Resistance Value Dry79Mean Slip Resistance Value Wet26						
Approved by: Name:	Geoff Ashall						
						0.055	
Position:	Principal Consultant Fire and Building Technology Group						

BSEN 1925:1999: Determination of Water Absorption Coefficient by Capillarity							
Name of Stone:	Sintered Stone Petrographic Nature: Sintered Stone						
Block No 01, 02, 03	Purple, Grey	, White	Anisotropic	Features:	None		
Supplier:	Lapitec SpA	·	Country of	Origin:	Italy		
Dimensions:	100 x 100x 1	2 mm	Project Ref	erence:	No data supplied.		
Surface Finish:	Polished Fac	e	Preparation	ו	BSEN 1925		
Date Tested:	31/08/2018	08/09/2018	Tested by:		Ian 'Rance		
BRE No 105501/ 01/210 01/211 01/212 02/210 02/211 02/212 03/211 03/211 03/212 *Calculated following of	Width 1 m 0.0999 0.1002 0.1001 0.1001 0.1001 0.1000 0.1000 0.1001 0.1001	Width 2 m 0.1009 0.1001 0.1001 0.1000 0.1000 0.0999 0.0986 0.0998 0.0998	Water a	absorption * m ² s ^{0.5)} 0.006 0.007 0.004 0.007 0.006 0.005 0.012 0.011 0.015			
	Mean Water	absorption:	C 1	0.006	g.m ² s ^{-0.5}		
Approved by:			Date:	02/10/2018			
Name:	Mr Geoff Ashall						
Principal Consultant, Fire and Building Technology Group Position:							





BS EN ISO 10456:2007 Building materials and products. Hygrothermal properties. Tabulated design values and procedures for determining declared and design thermal values

Name of Stone	2	Sintered St	one					
Block No: 01, 0)2, 03	Purple, Gre	ev, White					
Country of Orio	gin: Italy							
Supplier:	Lapitec SpA							
Date Assessed	ł	29/08/2018						
Petrographic N	Nature: Sintered Stone							
BRE Project nu	umber	P105501						
	Property							
				Value	units			
	Density			2390	Kgm-3			
	Thermal co	nductivity in	dry state λ 10 dry unit	1,3	W/(mK)			
	Specific he	Specific heat capacity			J/(kgK)			
	Water vapo	our resistance	e factor dry	no tabulated va	lue			
	Water vapo							
* Tabulated values based on the product being assessed as ceramic								
Approved by:	Marty	, Webb.		Date:	29/08/2018			
Name:	Dr. Martyn	Webb						
Position:	Principal Consultant Fire and Construction Technology Group							



In house testing to the principles of BS EN 16301:2013 Staining test - Natural stone test methods Determination of sensitivity to accidental staining.

The following staining agents were used to create a stain:

- 1 Red Wine
- 2 Coffee Ground
- 3 Coffee Freeze Dried
- 4 Ketchup
- 5 Cola
- 6 Citric Acid
- 7 Liquid Soap.

Method of application.

The liquid was dispensed on to the surface to cover an area of diameter 35mm as the time went on the hand wash and Citric Acid spread out slightly to the size of a 38mm and when the time was up 1 Hour, 24 Hour respectfully they were cleaned of as follows.

Cleaning

After each test the residue was cleaned off with a clean paper towel then wiped over with a damp towel then wiped over with a clean dry paper towel

1. Red wine



No discolouration after 1 hour dwell

No discolouration after 24-hour dwell

2 Coffee – Ground

Commercial in Confidence



No discolouration after 1 hour dwell

No discolouration after 24-hour dwell

3 Coffee - Freeze Dried



No discolouration after 1 hour dwell

No discolouration after 24-hour dwell

Commercial in Confidence

4 Ketchup



No discolouration after 1 hour dwell

No discolouration after 24-hour dwell

5 Cola



No discolouration after 1 hour dwell

No discolouration after 24-hour dwell

6 Citric Acid

Commercial in Confidence



No discolouration after 1 hour dwell

No discolouration after 24-hour dwell

7 Liquid Soap.



No discolouration after 1 hour dwell

No discolouration after 24-hour dwell