



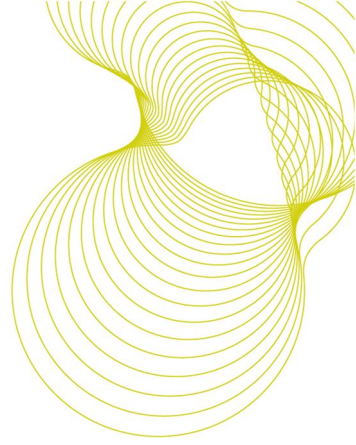
bre

**Testing of Ancaster
Limestone**

Prepared for:
Phil Kerry
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Lincolnshire
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25th July 2013

Test report number 287818 - 4



Prepared by

Name Geoff Ashall
Position Principal Consultant, Building Technology Group
Date 25/07/13

Signature 

Approved on behalf of BRE

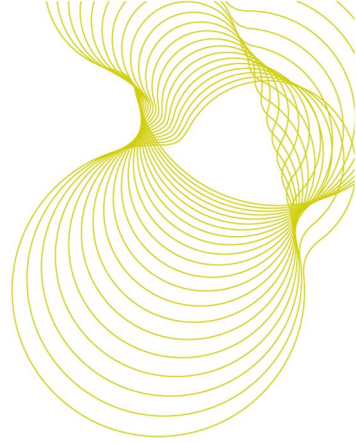
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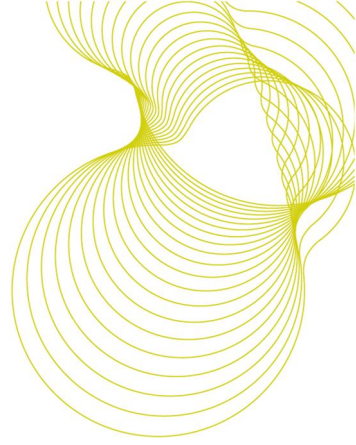
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1 Introduction

Following instruction from Phil Kerry (Goldholme Stone Ltd.), BRE have completed a series of tests on specimens of stone reported to be Ancaster Limestone. The stone was delivered to BRE on the 29/05/13. This report provides a factual account of the testing carried out.

2 Test Details

The following tests were carried out:

BS EN 1936: Natural stone test methods. Determination of real density and apparent density, and of total and open porosity *

BS EN 13755, Natural stone test methods. Determination of water absorption at atmospheric pressure*

BS EN 772-1 Natural stone test methods. Determination of uniaxial compressive strength*

BS EN 12372: 2006, Natural stone test methods. Determination of flexural strength under concentrated load.

BSEN 772-11, Methods of test for masonry units - Part 11: Determination of water absorption of aggregate concrete, manufactured stone and natural stone masonry units due to capillary action and the initial rate of water absorption of clay masonry units*

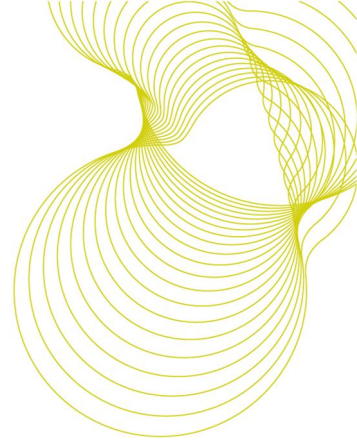
BS EN 12407:, Natural stone test methods. Petrographic examination

* Please note BRE is UKAS accredited for this test.

Tabulated data has been used to provide

BSEN 13501 – 1, Fire classification of construction products and building elements. Classification using test data from reaction to fire tests

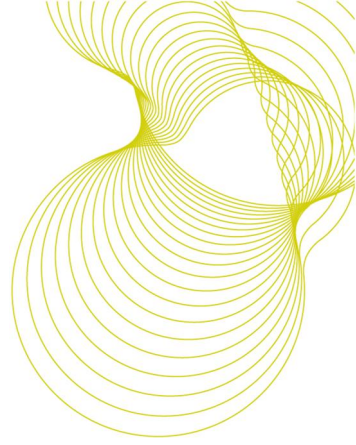
BSEN 12524, Building materials and products. Hygrothermal properties. Tabulated design values



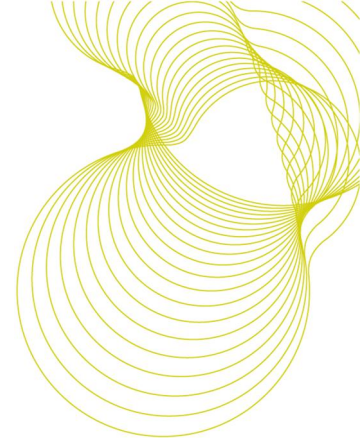
3 Test Results

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

Test	Standard	Value	Unit
Determination of Open Porosity	BSEN 1936	10.7	% by vol.
Apparent Density	BSEN 1936	2420	Kgm ⁻³
Water Absorption	BSEN 13755	4.2	% by mass
Compressive Strength (Lower expected value)	BSEN 772-1	48 (42)	MPa
Flexural Strength (Lower expected value)	BSEN 12372	6.7 (6.0)	MPa
Water Absorption by Capillarity	BSEN 772-11	62.7	g.m ² .s ^{-0.5}
Petrographic Examination	BSEN 12407	Biosparitic Limestone	
Design Thermal Conductivity	BSEN 12524	2.0	Kgm ⁻³
Specific Heat Capacity	BSEN 12524	1000	J(kg.K)
Water Vapour Resistance Factor dry	BSEN 12524	250	
Water Vapour Resistance Factor wet	BSEN 12524	200	
Reaction to fire (Declared value)	Without testing (see decision 96/603/EC, as amended)	A1	



4 Appendix A: Detailed Test Results for Ancaster Limestone



BSEN 1936: Determination of Open Porosity And Apparent Density

Name of Stone:	Ancaster	Petrographic Nature:	Limestone
Block No:	Data not supplied	Anisotropic Features:	Visible
Supplier:	Goldholme Stone	Country of Origin:	UK
Dimensions:	50 x 50 x 50 mm	Project Reference:	Data not supplied
Surface Finish:	Sawn	Preparation /Conditioning:	Prepared to BSEN 1936
Date Tested:	17/06/2013	19/06/2013	Tested by: Ian Rance

BRE No	Md	Mh	Ms	Apparent Density	Open Porosity
287818/13/04	g	g	g		
211	314.81	198.86	330.79	2380	12.1
212	319.41	201.71	332.55	2440	10.0
213	314.28	198.48	328.67	2410	11.1
214	311.71	196.88	326.28	2400	11.3
215	322.85	203.87	335.90	2440	9.9
216	311.93	197.99	324.53	2460	10.0
			Mean	2420	10.7

* The calculation of apparent density assumes the density of water to be 998Kgm⁻³ at 20°C
 Open Porosity is defined as the ratio of volume of open pores to the apparent volume of the specimen
 Apparent Density is defined as the ratio of the mass of the dry specimen to its apparent volume

Mean open porosity (%): 10.7

Mean apparent density (Kgm⁻³) 2420

Approved by:

Date:

25/07/2013

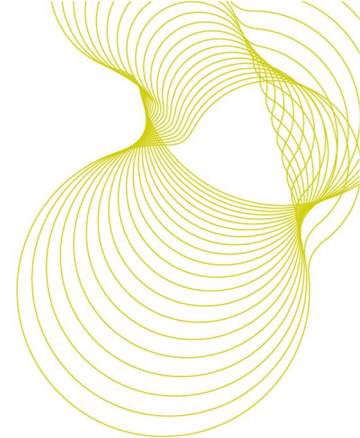
Name:

Geoff Ashall

Position:

Principal Consultant, Building Technology Group





BSEN 13755: Water absorption at atmospheric pressure

Name of Stone:	Ancaster	Petrographic Nature:	Limestone
Block No:	Data not supplied	Anisotropic Features:	Visible
Supplier:	Goldholme Stone	Country of Origin:	UK
Dimensions:	50 x 50 x 50 mm	Project Reference:	Data not supplied
Surface Finish:	Sawn	Preparation /Conditioning:	Prepared to BSEN 13755
Date Tested:	14/06/2013	21/06/2013	Tested by: Ian Rance

	Dry mass	Wet mass	Wet mass		
BRE No	1 hr md	48 hrs mi	72 hrs ms	Difference (ms-mi)	Water Absorption
287818/13/04				%	%
221	324.98	335.63	335.71	0.025	3.3
222	315.63	328.53	328.61	0.027	4.1
223	309.53	324.12	324.23	0.034	4.7
224	314.01	326.64	326.74	0.033	4.1
225	310.27	324.03	324.12	0.030	4.5
226	311.43	324.47	324.58	0.034	4.2

Mean 4.2

Mean Water Absorption of Sample: **4.2 (%)**

Approved by:

G. Ashall

Date:

25/07/2013

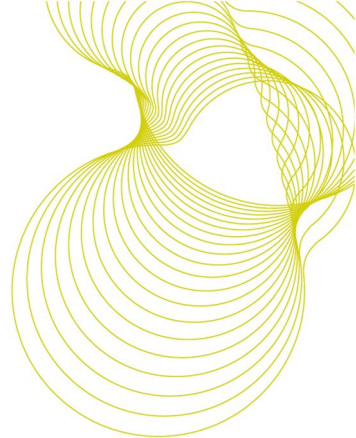
Name:

Geoff Ashall

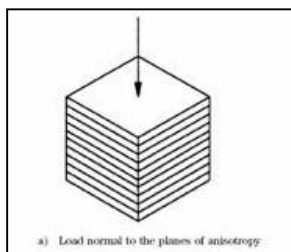
Position:

Principal Consultant, Building Technology Group



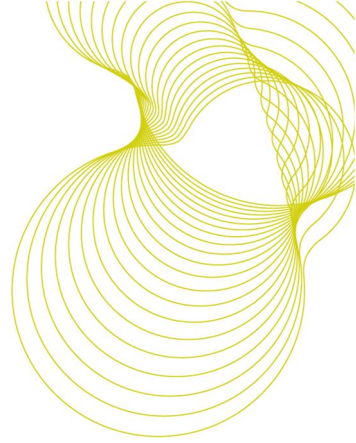


BSEN 772-1: Determination of Compressive Strength (Dry)

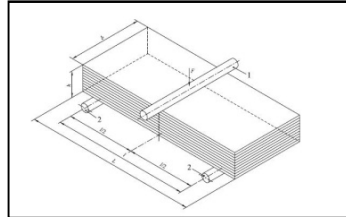


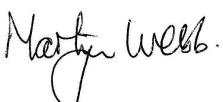
Name of Stone:	Ancaster		Petrographic Nature:	Limestone		
Block No:	Data not supplied		Anisotropic Features:	Visible		
Supplier:	Goldholme Stone		Country of Origin:	UK		
Dimensions:	70x 70 x 70 mm		Project Reference:	Data not supplied		
Surface Finish:	Sawn		Preparation /Conditioning:	Prepared to BSEN 1926		
Date Tested:	05/07/2013		Tested by:	Ian Rance		
	Load	Height	Mean	Mean	Failure	Comp.
BRE No	Rate		Length	Width	Load	Strength
287818/13/04	KPa s-1	mm	mm	mm	kN	MPa
171	600	73	70.7	71.0	236	47
172	600	73	70.7	71.0	251	50
173	600	73	70.7	71.0	239	48
174	600	73	70.7	71.0	211	42
175	600	73	70.8	71.0	261	52
176	600	73	70.7	70.9	229	46
177	600	73	70.7	71.0	256	51
178	600	73	70.5	71.0	228	45
179	600	73	70.6	71.0	253	50
180	600	73	71.0	70.9	249	49
					Mean	48
					St. Dev	3.1
					Co of var	0.06
					LEV	42
Approved by:			Date:	25/07/2013		
Name:	Geoff Ashall					
Position:	Principal Consultant, Building Technology Group					





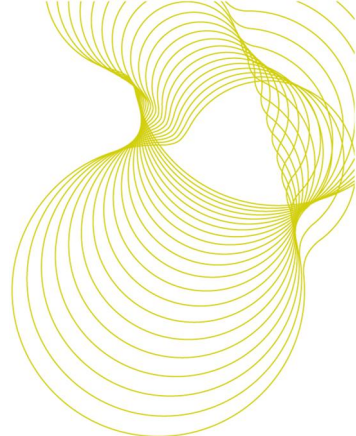
BSEN 12372: Determination of Flexural Strength under Concentrated Load



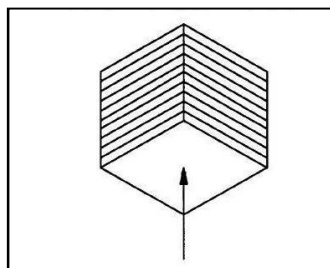
Name of Stone:	Ancaster		Petrographic Nature:		Limestone	
Block No:	Data not supplied		Anisotropic Features:		Visible	
Supplier:	Goldholme Stone Ltd.		Country of Origin:		UK	
Dimensions:	300 x 75 x 52 mm		Project Reference:		Data not supplied	
Surface Finish:	Sawn		Preparation /Conditioning:		Prepared to BSEN 12372	
Date Tested:	18/06/2013		Tested by:		Geoff Ashall	
	Load	Span	Width	Thickness	Failure Load	Flexural Strength
BRE no	Rate					
287818/13/04	MPa.s ⁻¹	mm	mm	mm	N	MPa
191	0.25	260	75.9	51.9	3350	6.4
192	0.25	260	76.1	51.5	3140	6.1
193	0.25	260	75.8	51.6	3590	6.9
194	0.25	260	76.0	52.2	3560	6.7
195	0.25	260	75.6	52.6	3780	7.1
196	0.25	260	75.6	51.6	3380	6.5
197	0.25	260	76.0	51.4	3320	6.5
198	0.25	260	75.7	51.5	3580	6.9
199	0.25	260	75.9	51.6	3770	7.3
200	0.25	260	76.2	51.6	3530	6.8
Approved by:  Name: Dr. Martyn Webb Position: Principal Consultant, Building Technology Group					Mean	6.7
					St. Dev	0.36
					Co of var	0.05
					LEV	6.0


0378





**BSEN 772-11 : Determination of Water Absorption Coefficient by Capillarity
Perpendicular to Bedding**



Name of Stone:	Ancaster	Petrographic Nature:	Limestone
Block No:	Data not supplied	Anisotropic Features:	Visible
Supplier:	Goldholme Stone	Country of Origin:	UK
Dimensions:	70 x 70 x 70 mm	Project Reference:	Data not supplied
Surface Finish:	Sawn	Preparation /Conditioning:	BSEN 1925
Date Tested:	07/07/2013	09/07/2013	Tested by: Ian Rance

	Width 1	Width 2	Water absorption *
BRE No			
287818/13/04	m	m	$\text{gm}^2\text{s}^{-0.5}$
251	0.0707	0.0710	52.6
252	0.0707	0.0700	64.7
253	0.0705	0.0710	59.9
254	0.0704	0.0709	69.4
255	0.0706	0.0710	69.0
256	0.0706	0.0708	60.9

*Calculated following procedure in note 1

Mean Water absorption:

62.7 $\text{g.m}^2\text{s}^{-0.5}$

Approved by:

G. Ashall

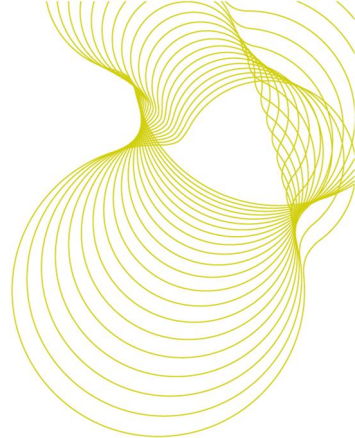
Date:

25/07/2013



Name: Mr Geoff Ashall

Position: Principal Consultant, Building Technology Group



**EN 12524:2000 Building materials and products -
Hygrothermal properties - Tabulated design values**

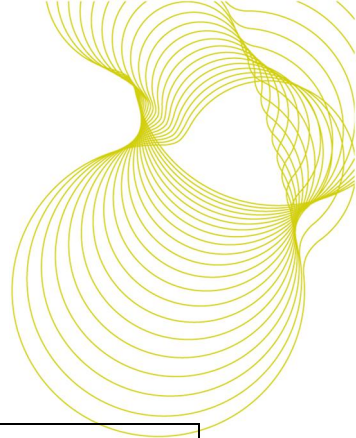
Name of Stone:	Ancaster
Block No:	Data not supplied.
Country of Origin:	UK
Supplier:	Goldholme Stone Ltd.
Date Assessed	25/07/2013
Petrographic Nature:	Limestone

Property	Value	units
Density	2420	Kgm-3
Design thermal conductivity	2.0	W/(mK)
Specific heat capacity	1000	J/(kgK)
Water vapour resistance factor dry	250	
Water vapour resistance factor wet	200	

Approved by: _____ Date: 25/07/2013

Name: Dr. Martyn Webb

Position: Principal Consultant, Building Technology Group



BS EN 12407 Petrographic Examination of Natural Stone

Sample Description

Name of Stone:	Ancaster	Petrographic Nature:	Limestone
Block No:	Not applicable	Anisotropic Features:	None
Supplier:	Goldholme Stone Ltd.	Country of Origin:	UK
Dimensions:	75 x 50 mm x 30 µm	Project Reference:	Data not supplied
Surface Finish:	Cut	Preparation /Conditioning:	Prepared to BS EN 12407
Date Tested:	17/07/13	Tested By:	Martyn Webb
Project no	287818-HCV059	Sample I.D Number	287818/13/04/117



Figure 1: Image of hand specimen, width of image approximately 50 mm

Results summary

Based on the mineralogy identified in thin section and the texture seen in hand specimen, the stone has been given the classification of **Biosparitic limestone**.

Final approved by:

Date: 18/07/13

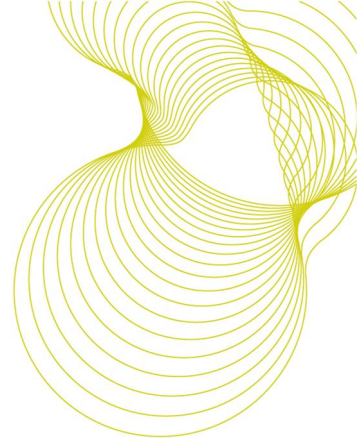
Name:

Geoff Ashall

Position:

Principal Consultant





Macroscopic Examination of 287818/13/04/117

In hand specimen the stone was buff-grey in colour with oolites and coarse fossil fragments clearly visible throughout (Figure 1), with elongate particles often showing alignment along their length. Occasional intraclasts were observed. The texture appeared quite dense in some areas, and all the constituents appeared to be contained within a colourless to white sparite cement.

The stone reacted vigorously to dilute hydrochloric acid, and water was only slowly absorbed in the water drop test.

There did not appear to be any evidence of weathering and/or alteration at this level of examination.

Microscopic Examination of 287818/13/04/117

In thin section the stone was composed of oolites, bivalves, gastropods, echinoderms and other undifferentiated fossil types (Figure 2), some measuring tens of millimetres in length. Most possessed micrite rims with sparite infilling, but some showed a fibrous habit (Figure 3). Intraclasts of oolite rich sediment were also present (Figure 4).

There was very little evidence of compaction, with constituents being relatively isolated and held within a coarsely crystallised sparite cement, some crystals were measured to be several millimetres across.

Very small grains of metallic/organic origin were present in some micritic components, and sometimes these showed very limited localised discolouration.

Staining with Alizarin Red S showed the constituents and cement to be composed of calcite.

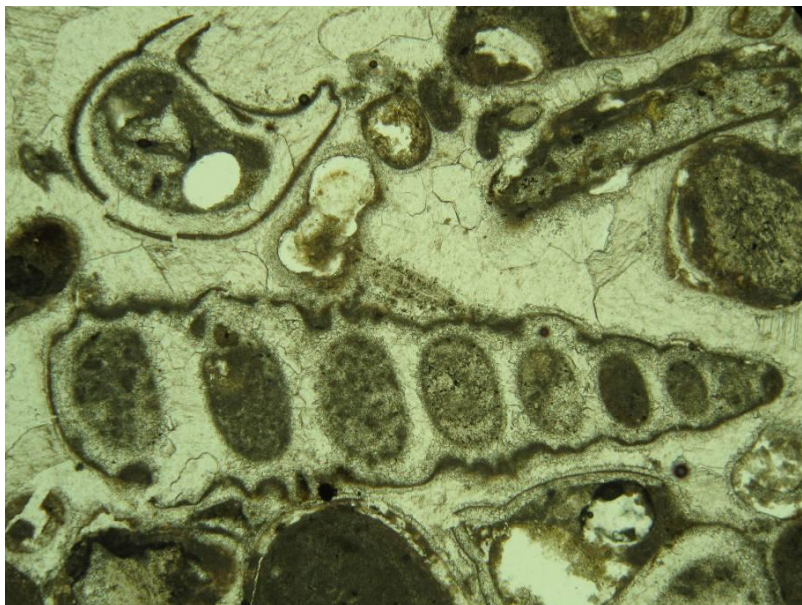


Figure 2. Typical fossil assemblage within sample 287818/04. Plane polarised light, magnification x50

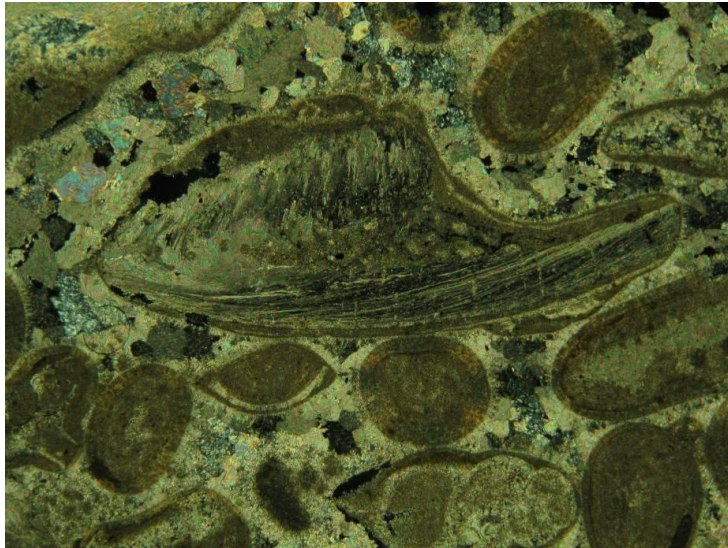
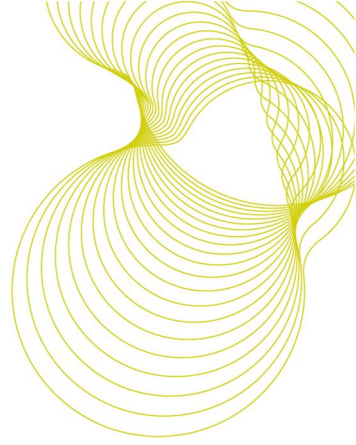


Figure 3. Typical appearance of a fibrous fossil fragment in sample 287818/04. Cross polarised light, magnification x50.

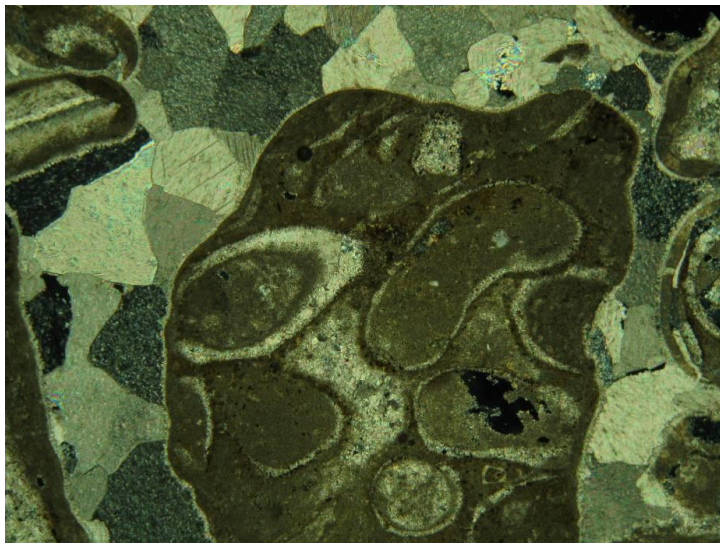


Figure 4. Intraclast particle and coarse sparite cement seen in sample 287818/04. Plane polarised light, magnification x 50.

Based on the mineralogy identified in thin section and the texture seen in hand specimen, the stone has been given the classification of **Biosparitic Limestone**.

=====REPORT ENDS=====