Engineers Report on Block Tests

Dwelling at Knowehead, Muff, Co Donegal (F93 AY10)

Project No 24/2628

4th March 2025

Wallace Doherty Consulting Engineers
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Maydown
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Document Verification Wallace Doherty

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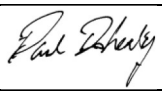
Signature				

Issue No				
Revision				
	Prepared by		Checked by	Approved by
Name				
Signature				

This report takes into account the particular instructions and requirements of our client and their representatives.
It is not intended for and should not be relied on upon by any third party.

Block Tests Report

Dwelling at Knowehead, Muff

CONTENTS

1. Introduction

Acting upon instructions received from Ms Deirdre Ferry, an external inspection of the dwelling at Knowehead, Muff was carried out on 4th Oct 2024. My brief was to visually inspect the external walls of building and identify locations where blockwork cores samples should be taken for testing the blocks in accordance with IS 465:2018+A1:2020. Following my inspection, I now wish to report as follows, subject these limitations:

- I have not inspected the building internally or parts of the structure that are unexposed, covered or inaccessible and I am therefore unable to comment that such elements are free from defect.
- My inspection does not purport to be a full structural survey of the property and is specifically limited to the condition of the blockwork samples taken from the walls of the property.

Photographs taken during my inspection are included in the Appendix A to illustrate locations where cores were taken. Laboratory reports and the chain of custody register are included in Appendices B, C and D.

2. Description of the Property

The property comprises a one and a half storey dwelling house situated on a private site approx. 1.0Km from the village of Muff. The walls are finished with roughcast render with raised precast concrete quoins at the corners (see photographs No 1,2, 3, 4 and 5). The dwelling faces southwest and has a duo-pitched slate covered roof with dormer windows to the front. The windows and doors are PVC with double glazed units except for the front door which is timber. The dwelling was in reasonable decorative condition at the time of my inspection.

There are a few minor render cracks throughout the walls of the property but no significant cracking externally that would normally be associated with houses constructed with defective blocks.

3. Commentary on Laboratory Test Results

5No Core samples were taken from and outer leaf of the cavity walls and 1No from the inner leaf of the rear wall. Details of the locations of the cores taken are shown by photographs (Photographs 1 to 6) and chain of custody record included in the appendices.

Compressive strength tests were carried out on a total of 4 No cores, all from the external leaf of the cavity wall. Strengths ranged from 12.9 N/mm^2 to 17.4 N/mm^2 with a mean strength of 15.4 N/mm^2. The minimum recommended strength for concrete blocks in low rise housing is 7.5N/mm^2 Compressive strengths in concrete block cores are highly variable due to a number of factors such as sample condition, sample extraction and inherent variability throughout the concrete aggregate masonry unit and also the small number of samples tested. However, the results from the tests carried out indicate that the blocks are of excellent compressive strengths.

Core 1 (A.G.I. 1) was initially selected for SEM analysis which was carried out by Sandberg Consulting Engineers. This core was found to contain a large mortar joint (see photograph No 6) and was subsequently deemed unsuitable and rejected. Core 6 (A.G.E. 6) was taken from the property on and sent to Sandberg for SEM analysis. This test determines the percentage of free mica, pyrrhotite, pyrite and iron sulphides taken from a small portion of the core sample. The free muscovite mica content was measured using X-ray

phase mapping techniques. Spot area analysis was used to determine the type of iron sulfide present within the concrete and also if any alteration has occurred.

The mean free muscovite mica content was found to be 4% in the sample tested. This is considered satisfactory and is classified as having a negligible effect on the durability of the blocks.

The effects of iron sulfides such as Pyrite and Pyrrhotite in the concrete blocks can be more damaging as they tend to cause alteration to the cement matrix. Pyrrhotite is more prone to alteration that Pyrite. The sample tested showed no trace of iron sulfides. Current guidance on the presence of iron sulfide in aggregates from IS 465:2018+A1: 2020 refers to IS EN 12620 for compliant aggregates which states that sulfur content should not exceed 1.0%. The total sulfur content in this sample was 0.1% which is well below the current limits.

4. Conclusion

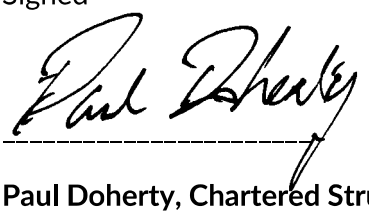
Based on the above laboratory test results on the core samples tested for compressive strength, mica content and the presence of sulfides, I would draw the following conclusions. The laboratory test result revealed that the mean mica content is 4% which is considered satisfactory under IS465. The blocks would be considered as 'Negligible Risk 'for mica degradation.

The sulfate levels in the cement paste were slightly elevated but this is not of any concern. As no iron sulfates were observed in the sample, there is no potential risk of for internal sulfate attack. According to the classification given in IS465, the block would be considered as 'Negligible' risk for iron sulfide degradation.

The compressive strengths of the samples tested were excellent at over 15N/mm^2 and well above the minimum recommended strength for blocks in housing.

It is therefore my opinion that if all the blocks in this dwelling are representative of the samples tested, the blocks are considered satisfactory.

Signed



Paul Doherty, Chartered Structural Engineer

on behalf of Wallace Doherty Consulting Engineers

Appendix A

Photographs

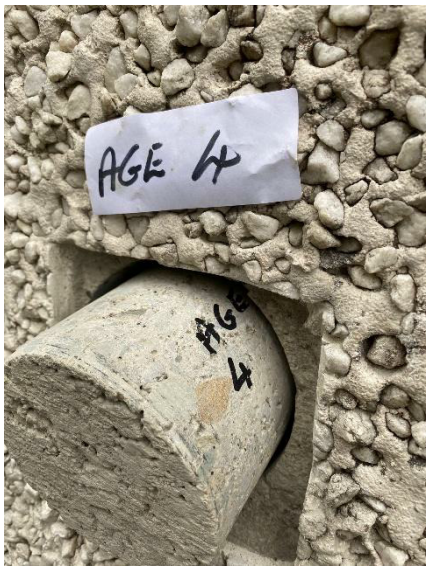
(Taken 4th & 8th Oct 2024)

Photograph No1 – View of front elevation showing location of Core Ref AGE 3 (red circle)

Photograph No2 – Part view of southeast facing elevation showing location of Core Ref AGE 2

Photograph No 3 – View of northwest elevation showing location of Core Ref AGE 1

Photograph No 4 – View of northwest facing gable showing location of Core Ref AGE 4



Photograph No 5 – View of northeast rear elevation showing location of Core Ref AGE 6

Photograph No 6 – View of internal wall showing location of Core Ref AGI 1. This core was deemed unsuitable for testing due to the presence of a mortar joint

Appendix B

Compressive Strength Report

Material Test Centre
• Construction Material Testing
• Site Suitability Assessments
• Building Energy Rating Assessments

26th November, 2024

Wallace & Doherty Consulting Engineers,
6F Carrakeel Industrial Park,
Maydown,
Derry
BT47 6SZ

Job No: 1227

Your Ref: 24-2628

Dear Sirs,

As requested, please find enclosed the compression test results for the concrete samples collected by us on the 25th October, 2024. All samples have been tested under the supervision of a qualified Engineer.

Sample Mark	**AGE 1**	**AGE 2**	**AGE 3**	**AGE 4**
Condition	Good	Good	Good	Good
Diameter (mm)	102	111	110	110
Length (mm)	101	102	101	102
Density	2270	2240	2320	2270
Method of Capping	Sulphur	Sulphur	Sulphur	Sulphur
Test Date	21/11	21/11	21/11	21/11
Time in water (Hours)	72	72	72	72
Test condition	Wet	Wet	Wet	Wet
Max. Load (kN)	142	125	152	147
Compressive Strength (N/mm^2)	**17.4**	**12.9**	**16.0**	**15.5**

Notes:
Site Details: Knowhead, Muff, Co. Donegal F93 AY1O

If you have any queries, please do not hesitate to contact us.
Yours Faithfully,

John Harkin

John Harkin
BSc CAPM MIEI
Material Test Centre

Appendix C

Sandberg

Laboratory Report

SANDBERG
CONSULTING ENGINEERS
INVESTIGATION INSPECTION
MATERIALS TESTING

Sandberg LLP
5 Carpenters Place
London SW4 7TD

Tel: 020 7565 7000
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email: mike.eden@sandberg.co.uk
web: www.sandberg.co.uk

Report - 78942/K

REPORT ON THE LABORATORY TESTING OF ONE CONCRETE BLOCK CORE
Test Suites B and C of IS 465: 2018+A1:2020
(Knowhead, Muff, Co Donegal, F93 AY10)
Project No. 24/2628/pd

Wallace Doherty Partnership Ltd
6f Carrakeel Industrial Park
Maydown
Derry-Londonderry
BT47 6SZ

This report comprises
Cover / contents page
5pages of text
Appendix A – Photographs – 1 page
Appendix B –Chemical analysis– 1 page
Appendix C – Chain of Custody – 1 page
Back page

For the attention of Paul Doherty

05 March 2025

SANDBERG
CONSULTING ENGINEERS
INVESTIGATION INSPECTION
MATERIALS TESTING

Sandberg LLP
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London SW4 7TD

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web: www.sandberg.co.uk

Report - 78942/K

REPORT ON THE LABORATORY TESTING OF ONE CONCRETE BLOCK CORE
Test Suites A, B and C of IS 465: 2018+A1:2020
(Knowhead, Muff, Co Donegal, F93 AY10)
Project No. 24/2628/pd

1 INTRODUCTION

One concrete block core was provided for analysis on 8 December 2024. Instructions to proceed with the analysis were given in a Wallace Doherty letter (reference 24/2628/pd dated 16 December 2024). The sample was subject to testing in accordance with IS 465: 2018+A1: 2020[1].

2 SAMPLE

The following sample was provided for analysis:

Lab. Ref.	Client Ref.	Core diameter / length, mm
K19762/1	AGE6 F93AY10	109/97-100

Photographs of the samples are presented in Appendix A.

[1] I.S. 465:2018+A1: 2020, Assessment, testing and categorization of damaged buildings incorporating concrete blocks containing certain deleterious materials and Amendment 1: 2020

3 TEST SCHEDULE

The following samples were scheduled for the following tests:

Lab. Ref.	Client Ref.	Test schedule				
		Test Suite A	Test Suite B			Test Suite C
		Simplified petrography	Detailed petrography	Total sulfur	Compressive strength	SEM analysis
K19762/1	AGE-6 F93AY10	-	-	1	-	1
Total		**0**	**0**	**1**	**0**	**1**

4 TEST METHODS

4.1 Test Suite B - Chemical analysis

The cement content and total sulfur were carried out in accordance with BS 1881-124:2015+A1: 2021[2], using the HTC method

4.2 Test Suite C - Scanning electron microscopy

In brief, the following work was carried out.

- A resin-impregnated polished surface was prepared from the sample.
- The polished surface was examined with a Hitachi SU3500 scanning electron microscope and chemical analyses were made of the polished surfaces using an Oxford Instruments AZtec energy-dispersive X-ray microanalysis system.
- The quantity of free muscovite mica in the cement matrix of the blocks was measured using X-ray phase mapping techniques to measure the mica content of the matrix.
- Analysis was used to determine the type of iron sulfide present within the concrete and any evidence of alteration.

5 RESULTS – TEST SUITE B – CHEMICAL TESTING

The detailed chemical testing is presented in Appendix B.

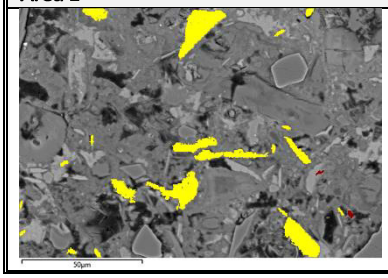
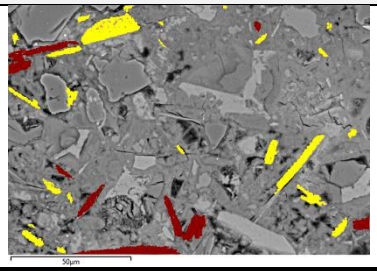
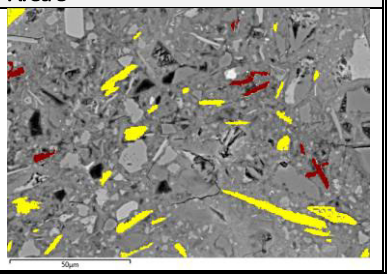
[2] BS 1881-124: 2015+A1: 2021, Testing concrete. Methods for analysis for hardened concrete.

6 RESULTS - TEST SUITE C - SCANNING ELECTRON MICROSCOPY – FREE MUSCOVITE MICA CONTENT

X-ray phase mapping techniques have been used to measure the free muscovite mica[3] contents of the block matrix. Example X-ray phase map obtained from the samples showing muscovite mica highlighted in yellow are shown below (biotite mica is shown brown):

Polished surface, backscattered electron image with superimposed X-ray phase map for muscovite mica (yellow) and biotite mica (brown). The scale bar represents 0.05mm.

Sample AGE6, F93AY10

Area 1	Area 2	Area 3
		

The result for measured free muscovite mica content of the block matrix is as follows:

Laboratory Reference	Client core Reference	Mean free muscovite mica content, vol. % of matrix, based upon three area analyses		Risk for mica degradation Note 1
K19762/1	AGE6 F93AY10	4	Area 1 = 5	Negligible
			Area 2 = 3	
			Area 3 = 4	

Note 1: Whether the free mica will adversely affect the durability of the block will depend on the exposure of the block to moisture. Cracked render, ineffective DPC's and leaking rainwater guttering are significant risk factors that can exacerbate the adverse effects of free mica on concrete block durability. Mica contents of >5% are considered potentially detrimental to concrete durability in blockwork exposed to moisture and frost. In-house experience shows that mica contents of >10% are most common in the more severely damaged properties Eden, M. A & Vickery, S. Investigating causes of deterioration in concrete blocks in Southern Ireland. 17th EMBAM Conference, Toronto, 2019

[3] The term "free mica" refers to separate muscovite mica flakes occurring within the cement matrix of the blocks. It should be noted that muscovite mica that is bound within rock fragments in the aggregate is not normally considered deleterious.

7 RESULTS – TEST SUITE C – SEM – IRON SULFIDE CONTENT

7.1 Types of iron sulfide

None observed within the sample.

7.2 Sulfate levels in the paste

A summary of the sulfate content in the cement within the samples is shown below.

Client ref.	Sulfur content of the block matrix expressed as SO_3, approximating to sulfate content, % by mass of cement	Sulfate levels relative to the normal range[4]	Evidence of secondary sulfate deposits within the cement matrix and air voids
AGE6 F93AY10	4.3 (ranging between 3.9% and 5.3%)	Slightly above the normal range, with a patchy distribution.	Small quantities of secondary ettringite observed within the cement matrix.

7.3 Comments on future potential for iron sulfide-related degradation of the block

A summary of the potential risk for iron sulfide degradation is shown below:

Client ref.	Risk for iron sulfide degradation	Comment
AGE6 F93AY10	Negligible	• No iron sulfides observed in sample, therefore there is no potential risk for ISA.

[4] The normal range for Portland cement-based concrete is 3 to 4% SO_3 by weight of cement.

8 SUMMARY OF TESTING

8.1 According to the classification given in IS 465, the block would be considered 'Negligible' risk for mica degradation.

8.2 According to the classification given in IS 465, the block would be considered 'Negligible' risk for iron sulfide degradation.

8.3 The chemical analysis of the concrete indicates a total sulfur content of 0.1%. The measured total sulfur indicates the sample contains iron sulfide grains and therefore the potential for ISA is 'Negligible risk'.

9 REMARKS

The report concludes the requested programme of testing. Please do not hesitate to contact us if we can be of any further assistance in this matter.

Wallace Doherty Partnership Ltd
6f Carrakeel Industrial Park
Maydown
Derry-Londonderry
BT47 6SZ

for GEOMATERIALS RESEARCH SERVICES
(part of Sandberg LLP)

Prepared by
Libby Fronda, BSc
Assistant Geologist

Reviewed by
Paul Bennett-Hughes, MGeol, FGS., C.Geol. EurGeol
Senior Associate

For the attention of Paul Doherty

05 March 2025

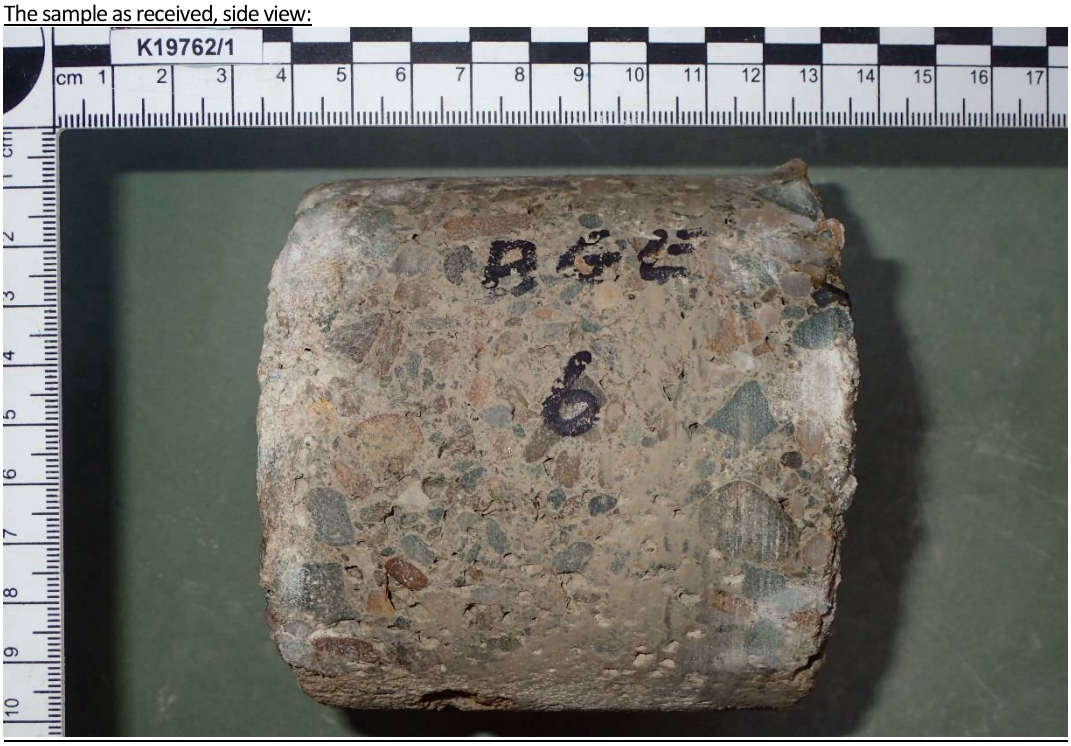
Samples can only be retained for a period of two months from the date of issue of the report unless we are instructed otherwise. Samples can be returned or retained for a further charge. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

APPENDIX A – PHOTOGRAPHS ILLUSTRATING THE SAMPLES AS RECEIVED

Figure A1

Sample K19374/1

The sample as received, side view:



The sample as received, outer view:

The sample as received, inner view:

APPENDIX B – CHEMICAL ANALYSIS

SANDBERG

Sandberg LLP
5 Carpenter's Place
Clapham High Street
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email: clapham@sandberg.co.uk
web: www.sandberg.co.uk

UKAS TESTING 0262

78942/K

Date of Receipt 08/01/25

Date of Test 17/02/25

Sheet No. 1 of 1

FILL MATERIAL ANALYSIS
Determination of Total Sulfur by High Temperature Combustion (HTC)

BS EN 1744-1: 2009+A1:2012

Sandberg reference	Water soluble sulphate, mg/l SO_4	Acid soluble sulphate, %SO_4	Total sulphur, %S	Total sulphur - sulphate sulphur %S
K19762/1	-	-	0.1	-

Client	Wallace Doherty Partnership Ltd 6f Carrakeel Industrial Park Maydown Derry-Londonderry BT47 6SZ	**Signed**	For Sandberg LLP
		Name	Paul Bennett-Hughes Mgeol, FGS, C.GEol. EurGeol
		Position	Senior Associate
Reference	Project: 24/2628/pd Sample: AGE6 F93AY10	**Date**	24th February 2025

Materials, samples and test specimens are retained for a period of 2 months from the issue of the final report.

Tests reported on sheets not bearing the UKAS mark in this report/certificate are not included in the UKAS accreditation schedule for this laboratory.

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

The results apply to the sample as received.

END OF REPORT

SANDBERG

APPENDIX C – CHAIN OF CUSTODY

Wallace Doherty Consulting Engineers

Project No. 24-2628

Wallace Doherty Cons
Unit 6F Carrakee

I.S. 465:2018 - Sample Register & Chain of Custody

Client/Owner :	Hugh & Deirdre Ferry	Technician(s) :	Declan Mc Laughlin	Sampling Date :	05th Oct 20
Address :	Knowhead, Muff, Co. Donegal F93 AY10	Chartered Engineer :	Paul Doherty	Sampling Method :	Dry core

Lab No.	Site Sample ref	Engineer Sample No.	Description of Material	Deposition						
				House elevation	Above/below DPC	>450mm below DPC	I (inner leaf) O (Outer leaf) S (Single leaf)	Damaged/Undamaged sample	Test required	Re
	A.G.E 1	A.G.E 1	100mm Ø block core	W	Above	No	O	Undamaged	Compression test	Soli
	A.G.E 2	A.G.E 2	100mm Ø block core	E	Above	No	O	Undamaged	Compression test	Soli
	A.G.E 3	A.G.E 3	100mm Ø block core	S	Above	No	O	Undamaged	Compression test	Soli
	A.G.E 4	A.G.E 4	100mm Ø block core	W	Above	No	O	Undamaged	Compression test	Soli
	A.G.I 1	A.G.I 1	100mm Ø block core	E	Above	No	I	Undamaged with mortar joint	SEM, Mica, Pyrrhotite content	Sol mo ren
	A.G.E 6	A.G.E 6	100mm Ø block core	N	Above	No	O	Undamaged	SEM, Mica, Pyrrhotite content	Soli

Samples taken by:	Declan Mc Laughlin	Company:	Deccore	Date:	05/10/2024, 13/1
Samples approved by:	Paul Doherty	Company:	Wallace Doherty Consulting Engineers	Date:	08/10/202

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This report shall not be reproduced, except in full, without the written approval of Sandberg LLP.

Where test results are given, the results and our conclusions relate only to the samples tested and apply to the sample(s) as received, except where sampling has been conducted by Sandberg LLP.

Materials, samples and test specimens are retained for a period of 2 months from the issue of the final report.

Tests reported on sheets not bearing the UKAS mark in this report/certificate are not included in the UKAS accredited schedule for this laboratory.

Opinions and interpretations expressed herein are outside the scope for UKAS accreditation.

End of report.