

# **SANDBERG**

**CONSULTING ENGINEERS**

INVESTIGATION    INSPECTION  
MATERIALS TESTING

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**REPORT 41378/G**

**PETROGRAPHIC EXAMINATION**

**OF**

**NATURAL STONE**

**WESTERN RANGE, WEST ELEVATION,**  
**CENTRAL BLOCK, GRIDLINE 15**

**KING'S CROSS**

Stonewest Ltd  
Lamberts Place  
St. James's Road  
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Surrey  
CR9 2HX

This Report consists of  
3 pages of text  
Table 1 of 3 sheets

For the attention of Mr James Kennett

12 January 2010

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**Reference :** Instructions from Mr James Kennett of Stonewest Ltd.

**1. INTRODUCTION**

We were requested to undertake a petrographic examination on natural stone in accordance with your instructions.

The purpose of the analysis was to identify the stone and provide an assessment of a potential matching source.

**2. SAMPLES RECEIVED**

The sample was received from Stonewest Ltd at Sandberg laboratories on 23 November 2009, as follows.

Sandberg Reference	Details & Advised Location	Sample details
G34946	Western range, West elevation, Central Block, Gridline 15	1 no. lump ; approx 580g

### 3. TEST METHOD AND RESULTS

The sample was subjected to petrographic examination in accordance with the methods described in BS 5930:1999<sup>1</sup>, ISRM<sup>2</sup> and BS EN 12407:2007<sup>3</sup>.

The sample was first subjected to macroscopical and low power stereoscopic microscope examination supported by simple physical and chemical tests.

A representative portion from the sample was used to prepare a large area thin section which was examined using an Olympus BH2 and Leica DM4500P high power petrological microscopes employing plane polarised and cross polarised light at magnifications up to x1000.

The detailed petrographic examination results are given in Table 1.

The sample was found to be orange-cream to pale beige with a very pale grey hue, medium grained dolomitic limestone.

The stone exhibited general structural, textural, compositional and colour similarities to examples of Gebdykes quarry, Jackdaw Crag quarry and Long Lane quarry.

The above matches for the submitted sample in terms of colour, appearance, and composition along with potential sources are detailed below.

Sandberg Ref.	Potential Source Similarities	Degree of Confidence in Match
G34546	<b>Gebdykes Quarry</b> [Grid reference SE 236 823] Some similarities in general structure, texture, composition and colour.	Possible
	or <b>Jackdaw Crag Quarry</b> [Grid reference SE 465 415] Some similarities in general structure, except that there was no oolitic texture present in the sample examined (G34546). Colour and general compositional similarities were observed.	Possible
	or <b>Long Lane Quarry</b> [Grid reference SE 514 148] Colour and general compositional similarities. Structure and texture generally different in the sample examined (G34546) as it was medium grained and not fine grained as found in this quarry.	Possible

The sample received was compared against archived petrographic data and thin sections. It is

<sup>1</sup> BS 5930:1999. Code of Practice for Site Investigation, Clause 44, Description and Classification of Rocks for engineering Purposes.

<sup>2</sup> Rock Characterisation Testing and Monitoring. International Society for Rock Mechanics (ISRM) Suggested methods. Petrographic Description of Rocks p.73, 1981 Edition.

<sup>3</sup> BS EN 12407:2007. Natural Stone Test Methods - Petrographic Examination.



therefore recommended that colour matching of the stone from the suggested potential sources with the material on site is carried out.

We would strongly recommend that the suggested source quarries are visited by an experienced geologist and samples are examined in detail with respect to compatibility of physical characteristics, durability and comparative performance. We would welcome the opportunity to assist in this process.

#### **4. REMARKS**

The stone matching was based upon the samples submitted. Stone sources may be expected to exhibit considerable lateral and vertical variations in composition and character over short distances and single samples are unlikely to be reliably representative of whole source areas or specific locations within these areas during continuing exploitation.

In addition, the above suggested quarries may have stopped operating or the new stone extracted may differ considerably in colour, texture and overall composition with that originally produced.

These results and comments conclude the testing requested to date. Please do not hesitate to contact us if we can be of further assistance.

Stonewest Ltd  
Lamberts Place  
St. James's Road  
Croydon  
Surrey  
CR9 2HX

For the attention of Mr James Kennett

DJE/Geoman/vb

For Sandberg LLP

D J Ellis  
Partner

12 January 2010

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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 logo 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.

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Table/Sheet

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Tested by / Date

PS/11.1.2010

## PETROGRAPHICAL EXAMINATION OF ROCK

BS 5930:1999, ISRM Method, BS EN 12407:2007

SAMPLE DETAILS			
Sample Reference	G34546	Client Reference/Site Mark	-
Sample Type, Source and Sampling Location Details:	Stone lump advised to be from west elevation, central block, gridline 15, King's Cross		
Condition on Receipt:	Dry	Sample weight, g :	580
Methods of Preparation of Specimens and Examination Procedures:	The sample was first subjected to macroscopical and low power stereomicroscopical examination supported by simple physical and chemical tests. A representative specimen from the sample was diamond-sawn and used to prepare a large area thin section which was examined under a high power petrological microscope.		
Any Other Details:	Specimen was taken across the sample. A large area thin section 50mm x 70mm was prepared.		

MATERIAL DESCRIPTION:	Orange-cream to pale beige with a very pale grey hue, medium grained calcarenite, moderately compacted, porous, dolomitic LIMESTONE. Very pale grey areas were sparry calcite infilling voids and cavities up to 3mm across.
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MATERIAL COMPOSITION:		PETROGRAPHICAL DETAILS <sup>n</sup>
COMPONENT	Volume % (estimated)	<p>The stone was crystalline with euhedral to anhedral calcite and dolomite crystals, ranging from 30µm to 300µm across and commonly 100µm in size, forming a crystalline background and occasional sparry calcite cement infilling voids and cavities. Empty irregular voids, unevenly distributed, were probably due to variable compaction of the stone.</p> <p>Sparry calcite cement infilled voids and cavities up to 3mm across and exhibited a very pale grey colouration, which was observed in the hand specimen.</p> <p>Brown iron and/or manganese oxide very fine material and sporadic granules less than 100µm across were present mainly distributed along grain boundaries.</p> <p>Quartz grains up to 150µm across were rarely observed.</p> <p>The stone was generally moderately compacted with occasional to frequent irregular voids less than 1mm and commonly less than 200µm across.</p>
Calcite and Dolomite	85	
Sparry calcite cement	15	
Iron oxide	<1	
Quartz	<<1	
TOTAL:	100	

UE = Undulatory Extinction. ND = Not Determined. NA = Not Applicable. NS = Not Supplied.

<sup>n</sup> Details mainly relate to components or features of possible engineering significance.



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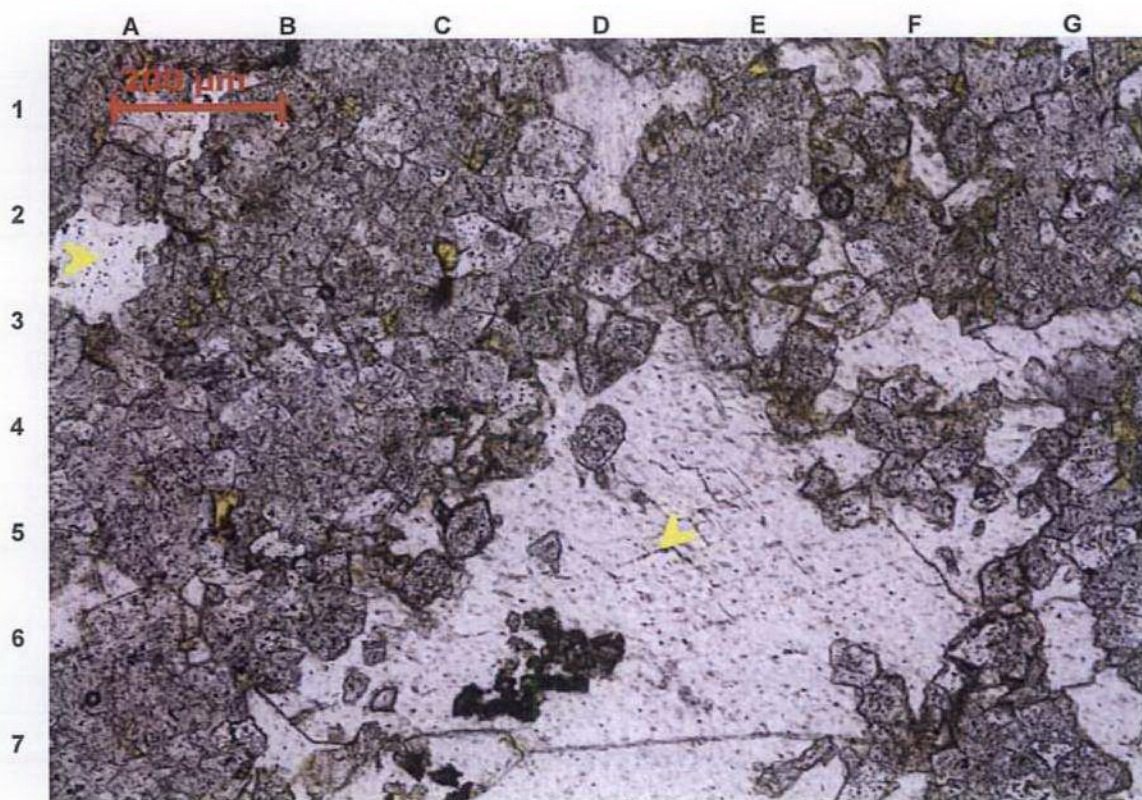
Table/Sheet

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Plate

1

## PETROGRAPHICAL EXAMINATION OF STONE - PHOTOMICROGRAPH



### Photomicrograph Details

Sandberg Sample Ref:	G34546	Client Ref/Site Mark:	Dolomitic limestone
Microscope Light:	Plane polarised	Objective Magnification:	x10

### Photomicrograph Description

General view of stone structure. Calcite and dolomite crystals form the stone framework, whilst sparry calcite cement (white areas with the yellow arrow) infill voids and cavities. Brown colouration is due to the dissipation of iron oxide along the crystal boundaries. Yellow small voids are infilled with fluorescent impregnating resin.



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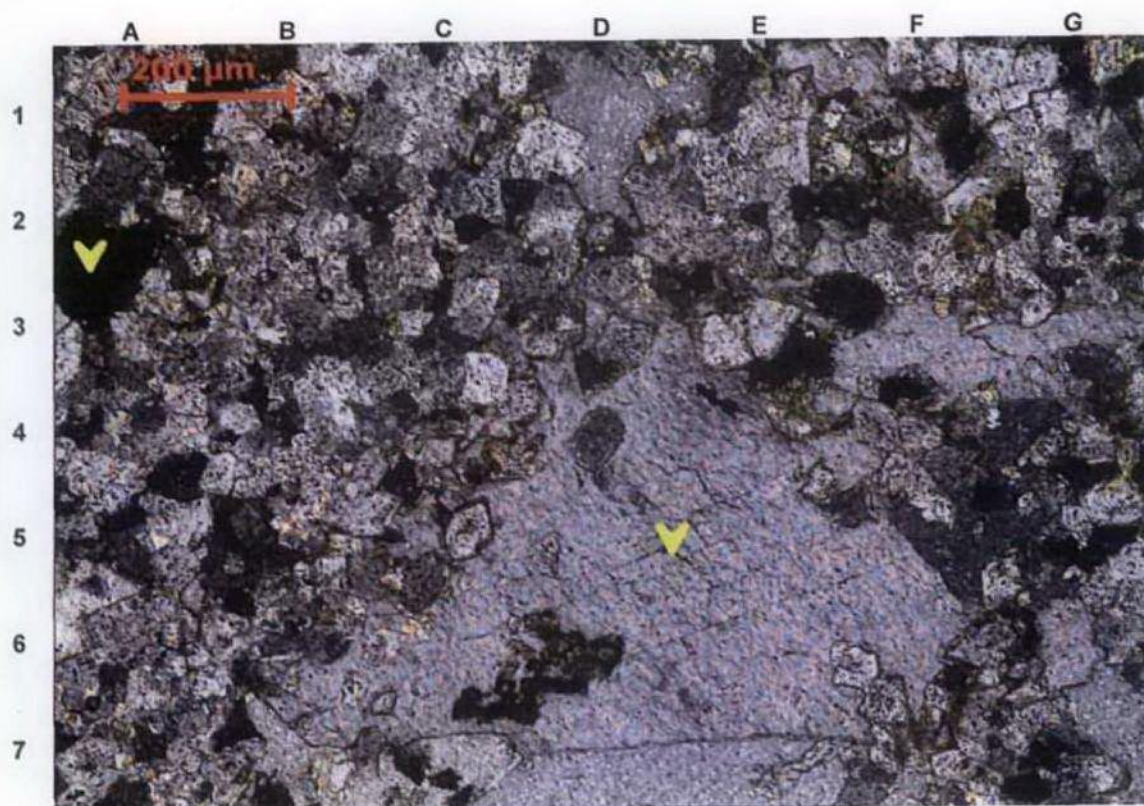
Table/Sheet

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Plate

2

## PETROGRAPHICAL EXAMINATION OF STONE - PHOTOMICROGRAPH



### Photomicrograph Details

Sandberg Sample Ref:	G34546	Client Ref/Site Mark:	Dolomitic limestone
Microscope Light:	Cross polarised	Objective Magnification:	x10

### Photomicrograph Description

General view of stone structure. Calcite and dolomite crystals form the stone framework, whilst sparry calcite cement (areas with the yellow arrow) infill voids and cavities. Area at A/2-3 is in optical extinction. Brown colouration is due to the dissipation of iron oxide along the crystal boundaries. Yellow small voids are infilled with fluorescent impregnating resin.

3.2.5 Sandberg Consulting Engineers Report no. 41378/G/1

- East Elevation Sills above Main Train Shed