# **Great Northern Hotel Arcade**

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Planning and Listed Building Consent Applications Structural and Materials Survey Report



Argent (King's Cross), London and Continental Railways and Exel

July 2006

# Report for Argent (King's Cross) Limited 5 Albany Courtyard

Dany Courtyard Piccadilly London W1J 0HF

**Structural and Material Investigation** 

Great Northern Hotel, King's Cross, London

January 2006 Report No. 22938

Report No 22938

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DOCUMENT CONTROL

| Document Title: | Structural and Material Investigation      |  |
|-----------------|--|--|
|                 | at   |  |
|                 | Great Northern Hotel, King's Cross, London |  |

The Client:

Argent (King's Cross) Limited 5 Albany Courtyard Piccad IIv London W1J OHF

STATS Limited has prepared this report in accordance with the instructions of Mr Richard Meier of Argent (King's Cross) Limited ("the Client"). This report is for the sole and specific use of the Client, and STATS shall not be responsible for any use of the report or its contents for any purpose other than that for which it was prepared and provided. Should the Client require to pass copies of the report to other parties for information, the whole of the report should be so copied, but no professional liability or warranty shall be extended to other parties by STATS in this connection without the explicit written agreement thereto by STATS.

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

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Report Reference Status of Report: Date of Issue: Page No.

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22938

Designation:

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3 of 6

Original issue: 3rd Jan 2006

**Barry Guildford** 

Associate Directo

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#### 1. INTRODUCTION

STATS Limited has prepared this report in accordance with instructions received from Mr Richard Meier of Argent (King's Cross) Limited.

STATS representatives visited the site during October 2005 in order to investigate selected materials used in the construction of the building and certain structural details.

The building opened in 1854 to be used as a hotel. The structure comprises a basement, ground floor and five upper floors and the construction is of load-bearing masonry, brick arch floors and iron beams and columns.

The building was vacant at the time of the investigation.

### 2. PURPOSE OF INVESTIGATION

It is understood that the building is to undergo refurbishment and structural alteration. The purpose of the investigation was to determine material properties and structural details to enable the Engineer to complete proposals and designs for the project.

# 3. EXTENT OF INVESTIGATION

The extent of the investigation was specified in the document 'Specification for Structural Investigation Works - Draft 3' compiled by Arup Consulting Engineers, with slight variations required during the site works phase of the project. The locations of the investigations are shown on floor plans presented in Appendix A of this report.

In addition to the structural and material property investigation works, an environmental assessment report was commissioned. This report details hazardous materials in the areas of investigation within the building and is issued separately as STATS Report 22938A (ENV).

# 4. METHODS

### 4.1. Structural Investigations

All structural investigations were carried out in accordance with STATS UKAS accredited site works procedures, where applicable.

The structural opening up works were carried out using hand-held percussive breakers. These were used carefully by trained and experienced personnel in order to limit unnecessary damage caused to building elements, in particular listed finishes.

Where necessary to obtain the structural information required, other tools and instruments were used, such as a level, a cover meter and an electric reciprocating saw.

### 4.2. Structural Material Sampling

All samples were extracted in accordance with STATS UKAS accreditation, using the following accredited procedures, where applicable:

- STP01 General instructions for site work
- STP03 Cover meter surveys
- STP05 Taking samples Core, Dust, Lump
- STP07 Recording site work samples

### 4.3. Laboratory Testing

### 4.3.1 Compressive strength of brick samples

Compressive strength was determined in accordance with BS 3921:1985, Appendix D for whole new bricks.

### 4.3.2 Mix Proportion analysis of mortar samples

The samples were dried at 105<sup>o</sup>C and on cooling were crushed, reduced by riffling and ground to pass a 150 micron BS sieve. The ground material was then chemically analysed by the methods specified in BS 4551-2:1998. The interpretation of the analytical data was made on the basis of calculations described in BS 4551-2:1998.

### 4.3.3 Material testing of metallic samples

Tensile testing of the metallic samples was carried out in accordance with BS EN 10002-1. Chemical analysis of the samples was undertaken using Flame AAS, Combustion (C+S) and Colourimetry.

#### 5. RESULTS

Floor plans showing the investigation locations are presented in Appendix A of this report. The results of the investigations are presented in Appendix B (diagrams, sketches and photographs of structural investigations) and Appendix C (laboratory certificates of test).

Tables 1,2 and 3, below, summarise the results of the laboratory testing carried out.

| Ref. | Type of wall   | Location              | Compressive strength<br>of brick (N/mm <sup>2</sup> ) | Mean brick compressive strength (N/mm²) |
|------|----------------|-----------------------|---|---|
| B4   |                | Grd floor             | 12.4  |   |
| B5   |                | Grd floor             | 9.3   |   |
| B6   | Cross wall     | Grd floor             | 18.9  | 14.6                                    |
| B10  |                | 1 <sup>st</sup> floor | 15.8  |   |
| B9   |                | 1 <sup>st</sup> floor | 16.8  |   |
| B2   |                | 3 <sup>rd</sup> floor | 9.5   |   |
| B8   |                | Grd floor             | 13.8  |   |
| B11  | Spine wall     | 3 <sup>rd</sup> floor | 5.6   | 8.3                                     |
| B13  |                | 3 <sup>rd</sup> floor | 7.5   |   |
| B15  |                | 4 <sup>th</sup> floor | 4.9   |   |
| B1   |                | 5 <sup>th</sup> floor | 6.6   |   |
| B3   |                | 3 <sup>rd</sup> floor | 17.3  |   |
| B7   | Perimeter wall | Grd floor             | 8.5   | 9.5                                     |
| B12  |                | 3 <sup>rd</sup> floor | 7.3   |   |
| B14  |                | 4 <sup>th</sup> floor | 7.8   |   |

### Table 1 – Compressive strength of Bricks

| Ref.   | Type of wall   | Location              | Mortar designation <sup>(1)</sup> | Mortar designation <sup>(2)</sup> |
|--|----------------|-----------------------|-----------------------------------|-----------------------------------|
| M1   | Perimeter wall | Grd floor             | iv/v                              | N/A                               |
| M2   | Cross wall     | Grd floor             | N/A                               | N/A                               |
| M3   | Cross wall     | Grd floor             | iii                               | iii                               |
| M4   | Cross wall     | 1 <sup>st</sup> floor | iv/v                              | iv                                |
| M5   | Perimeter wall | 3 <sup>rd</sup> floor | N/A                               | N/A                               |
| M6   | Perimeter wall | 5 <sup>th</sup> floor | iii                               | iii                               |
| M7   | Perimeter wall | 3 <sup>rd</sup> floor | iv                                | iv                                |
| M8   | Spine wall     | 3 <sup>rd</sup> floor | N/A                               | N/A                               |
| As specified in BS 4551-2: 1998: Table 4, assuming a cement sand mix |                |                       |                                   |                                   |

As specified in BS 4551-2: 1998: Table 4, assuming a cement:sand mix.

As specified in BS 4551-2: 1998: Table 4, assuming a cement:lime:sand mix.

#### Table 2 – Mix Proportions of Mortar

(2)

| Ref.       | Beam type      | Location              | Ultimate tensile<br>strength (N/mm <sup>2</sup> ) | Suggested iron type <sup>(1)</sup> | Weldability <sup>(1)</sup> & <sup>(2)</sup> |
|------------|----------------|-----------------------|---|------------------------------------|---|
| <b>S</b> 1 | Secondary      | 5 <sup>th</sup> floor | 149   | Flake graphite (cast iron)         | Poor  |
| S2         | Secondary      | 3 <sup>rd</sup> floor | 170   | Flake graphite (cast iron)         | Poor  |
| S3         | Transfer       | 1 <sup>st</sup> floor | 156   | Flake graphite (cast iron)         | Poor  |
| (1)        | Based on Jabor | story mioro ov        | amination and chamical                            | analysia                           |   |

Based on laboratory micro-examination and chemical analysis. (2)

Cast iron is known to be extremely difficult to weld successfully.

Table 3 – Metallurgy Test Results

# APPENDIX A

# FLOOR PLANS SHOWING INVESTIGATION LOCATIONS

(This appendix contains 8 pages, including this)



**STATS** Porterswood House Porters Wood St Albans Herts Tel. (01727) 833261 CLIENT: ARGENT (KING'S CROSS) LIMITED SITE: GREAT NORTHERN HOTEL TITLE: BASEMENT FLOOR PLAN PREP BY: GPM DATE: NOV 05 JOB NO: 22938 FIG NO: **A1** 



**STATS** Porterswood House Porters Wood St Albans Herts Tel. (01727) 833261 CLIENT: ARGENT (KING'S CROSS) LIMITED SITE: GREAT NORTHERN HOTEL TITLE: GROUND FLOOR PLAN PREP BY: GPM DATE: **NOV 05** JOB NO: 22938 FIG NO: A2



INVESTIGATION TO SOFFIT OF FLOOR LEVEL ABOVE

- INVESTIGATION TO TOP OF FLOOR LEVEL
- ---- INVESTIGATION TO WALL

NUMBERS INDICATE INVESTIGATION REFERENCE NUMBER

# Porterswood House Porters Wood St Albans Herts Tel. (01727) 833261 CLIENT: ARGENT (KING'S CROSS) LIMITED SITE: GREAT NORTHERN HOTEL TITLE: FIRST FLOOR PLAN PREP BY: GPM DATE: NOV 05 JOB NO: 22938 FIG NO: A3





- INVESTIGATION TO SOFFIT OF FLOOR LEVEL ABOVE
- INVESTIGATION TO TOP OF FLOOR LEVEL
- INVESTIGATION TO WALL

NUMBERS INDICATE INVESTIGATION REFERENCE NUMBER

# 57 Porterswood House Porters Wood St Albans Herts Tel. (01727) 833261 CLIENT: ARGENT (KING'S CROSS) LIMITED SITE: GREAT NORTHERN HOTEL TITLE: SECOND FLOOR PLAN PREP BY: GPM DATE: **NOV 05** JOB NO: 22938 FIG NO: A4





INVESTIGATION TO SOFFIT OF FLOOR LEVEL ABOVE

- INVESTIGATION TO TOP OF FLOOR LEVEL
- INVESTIGATION TO WALL

NUMBERS INDICATE INVESTIGATION REFERENCE NUMBER

# Porterswood House Porters Wood St Albans Herts Tel. (01727) 833261 CLIENT: ARGENT (KING'S CROSS) LIMITED SITE: GREAT NORTHERN HOTEL TITLE: THIRD FLOOR PLAN PREP BY: GPM DATE: NOV 05 JOB NO: 22938 FIG NO: A5



INVESTIGATION TO SOFFIT OF FLOOR LEVEL ABOVE INVESTIGATION TO TOP OF FLOOR LEVEL

INVESTIGATION TO WALL

NUMBERS INDICATE INVESTIGATION REFERENCE NUMBER

# Porterswood House Porters Wood St Albans Herts Tel. (01727) 833261 CLIENT: ARGENT (KING'S CROSS) LIMITED SITE: GREAT NORTHERN HOTEL TITLE: FOURTH FLOOR PLAN PREP BY: GPM DATE: NOV 05 JOB NO: 22938 FIG NO: A6



INVESTIGATION TO SOFFIT OF FLOOR LEVEL ABOVE

- INVESTIGATION TO TOP OF FLOOR LEVEL
- INVESTIGATION TO WALL

NUMBERS INDICATE INVESTIGATION REFERENCE NUMBER

# Porterswood House Porters Wood St Albans Herts Tel. (01727) 833261 CLIENT: ARGENT (KING'S CROSS) LIMITED SITE: GREAT NORTHERN HOTEL TITLE: FIFTH FLOOR PLAN PREP BY: GPM DATE: NOV 05 JOB NO: 22938 FIG NO: A7

# APPENDIX B

# INVESTIGATION RESULTS

(This appendix contains 59 pages, including this)

# **APPENDIX B CONTENTS**

| Investigation Ref. | Page Number | Remarks                                    |
|--------------------|-------------|--|
| 1                  | B2          | -  |
| 2                  | B3          | Investigations 2, 3 & 11 reported together |
| 3                  | B3          | Investigations 2, 3 & 11 reported together |
| 4                  | B7          | Investigations 4 & 13 reported together    |
| 5                  | B11         | Investigations 5 & 14 reported together    |
| 6                  | B13         | -  |
| 7                  | B14         | Investigations 7 & 15 reported together    |
| 8                  | B16         | Investigations 8 & 19 reported together    |
| 9                  | B19         | -  |
| 10                 | B20         | -  |
| 11                 | B3          | Investigations 2, 3 & 11 reported together |
| 12                 | B21         | Investigations 12 & 22 reported together   |
| 13                 | B7          | Investigations 4 & 13 reported together    |
| 14                 | B11         | Investigations 5 & 14 reported together    |
| 15                 | B14         | Investigation 7 & 15 reported together     |
| 16                 | B24         | -  |
| 17                 | B26         | -  |
| 18                 | B29         | -  |
| 19                 | B16         | Investigations 8 & 19 reported together    |
| 20                 | B31         | -  |
| 21                 | B32         | -  |
| 22                 | B21         | Investigations 12 & 22 reported together   |
| 23                 | B33         | -  |
| 24                 | B34         | -  |
| 25                 | B35         | Investigations 25 & 31 reported together   |
| 26                 | B36         | Investigations 26 & 32 reported together   |
| 27                 | B38         | -  |
| 28                 | B39         | Investigations 28 & 33 reported together   |
| 29                 | B41         | -  |
| 30                 | B42         | -  |
| 31                 | B35         | Investigations 25 & 31 reported together   |
| 32                 | B36         | Investigations 26 & 32 reported together   |
| 33                 | B39         | Investigations 28 & 33 reported together   |
| 34                 | B44         | -  |
| 35                 | B45         | -  |
| 36                 | B47         | -  |
| 37                 | B48         | -  |
| 38                 | B49         | Investigations 38 & 47 reported together   |
| 39                 | B51         | Investigations 39 & 46 reported together   |
| 40                 | B52         | Investigations 40 & 48 reported together   |
| 41                 | B54         | -  |
| 42                 | B55         | -  |
| 43                 | B56         | Investigations 43 & 44 reported together   |
| 44                 | B56         | Investigations 43 & 44 reported together   |
| 45                 | B58         | -  |
| 46                 | B51         | Investigations 39 & 46 reported together   |
| 47                 | B49         | Investigations 38 & 47 reported together   |
| 48                 | B52         | Investigations 40 & 48 reported together   |

1 BASEMENT To confirm that the secondary beam is supported by another iron beam or the brick wall.

# INVESTIGATION RESULTS

The iron beam in question is supported on a pad stone within the load-bearing brick spine wall. There is no iron beam embedded within the spine wall.



2, 3 & 11
GROUND FLOOR COFFEE ROOM/FIRST FLOOR
To confirm the first floor beam arrangement.
To establish beam details.
To establish the support details of main transfer beams and secondary beams.
To confirm whether any embedded iron columns exist under the transfer beams.

# INVESTIGATION RESULTS

The annotated record photographs presented on the following pages show the investigation findings with further details presented in the sketches on page B6.



General view of the coffee lounge room.



View showing a secondary beam supported by the main transfer beam.



View from first floor level showing the same two beams.



View showing the junction of the main transfer beam with the cross wall.



View from the first floor level showing the main transfer beam end in the spine wall.



**4 & 13** FORMER LOUNGE GROUND FLOOR/FIRST FLOOR To establish the transfer beam details. To confirm the existence of iron columns embedded in the brick wall at basement level. Additionally, to determine whether there is an iron column supporting the first floor transfer beam.

### INVESTIGATION RESULTS

The annotated record photographs presented on the following pages show the investigation findings with further details presented in the figure on page B10.



View of the first floor transfer beam from the ground floor. The investigation was limited to the extent shown in the photograph so that only limited damaged occurred to the ornate coving in this location.



Further view of the first floor transfer beam.



View proving the existence of a column at ground floor level beneath the first floor transfer beam.



View of the basement brick pier beneath the ground floor former lounge room.



View of the opposite basement brick pier beneath the former lounge room.



**5 & 14** GROUND FLOOR/FIRST FLOOR To establish the nature, dimensions and characteristics of the floor structures, including the floor beams.

# INVESTIGATION RESULTS

The following photographs show details of the investigation carried out and sketches with dimensions are presented on sheet B12



B11

| Porterswood House   |  |  |
|---------------------|--|--|
| Porters Wood        |  |  |
| St Albans           |  |  |
| Herts               |  |  |
| AL3 6PQ             |  |  |
| Tel. (01727) 833261 |  |  |

# STRUCTURAL INVESTIGATION RESULTS



**INVESTIGATION REF. 5 & 14** 

| Client:                   | Site:                | Date:<br>NOV 05  | Job No:<br>22938 |
|---------------------------|----------------------|------------------|------------------|
| ARGENT (KING'S CROSS) LTD | GREAT NORTHERN HOTEL | Prep. by:<br>GPM | Fig. No: B12     |

**6** GROUND FLOOR In the Lincoln Room, expose the brick in the vicinity of the door and determine whether a door lintel is present.

## INVESTIGATION RESULTS

The investigation revealed that there was no lintel present above this doorway. The brickwork above the door opening was constructed as an arch.

The chamfer in the brickwork has been constructed by breaking off the corners of the bricks to form the chamfer profile.



**7 & 15** GROUND FLOOR/FIRST FLOOR To establish the nature, dimensions and characteristics of the floor structures, including the floor beams.

# INVESTIGATION RESULTS

The following photograph shows details of the investigation carried out and sketches with dimensions are presented on sheet B15.



View shows the floor beam with floor joists above.

| Porterswood House<br>Porters Wood<br>St Albans<br>Herts<br>AL3 6PQ<br>Tel. (01727) 833261 | STRUCTURAL INVESTIGATION RESULTS |
|---|----------------------------------|
|   |                                  |



#### **INVESTIGATION REF. 7 & 15**

| Client:<br>ARGENT (KING'S CROSS) LTD | Site:<br>GREAT NORTHERN HOTEL | Date:<br>NOV 05  | Job No:<br>22938 |
|--------------------------------------|-------------------------------|------------------|------------------|
|                                      |                               | Prep. by:<br>GPM | Fig. No: B15     |

8 & 19 GROUND FLOOR COFFEE ROOM/FIRST FLOOR To determine the first floor corridor floor construction. To determine the corridor width between the brick piers at ground floor level. Additionally, to determine the first floor stair construction at the location of the change in floor levels.

### **INVESTIGATION RESULTS**

The annotated record photographs present on the following pages show the investigation findings with further details presented in the figure on page B18.



General view of ground floor corridor, leading to the 'coffee room'. The first floor level changes above the double-doors at the centre of this picture.



View of the other side of the double-doors, in the 'coffee room'. This area has a significantly higher ceiling level.



View of the change in floor levels at the first floor.



**9** GROUND FLOOR In the Newcastle Room, establish the thickness of the brick walls and inspect brickwork.

# INVESTIGATION RESULTS

The investigation determined the thickness of the walls, as shown below. The condition of the brickwork and the joint between the walls appeared to be sound, with no obvious defects.



**10** GROUND FLOOR In the Aberdeen Room, establish the thickness of the brick walls and inspect brickwork.

# INVESTIGATION RESULTS

The investigation determined the thickness of the walls, as shown below. The condition of the brickwork and the joint between the walls appeared to be sound, with no obvious defects.


**12 & 22** FIRST FLOOR AND SECOND FLOOR To establish the second floor transfer beam detail, including its support.

# **INVESTIGATION RESULTS**

The annotated record photographs presented on the following pages show the investigation findings with further details presented in the figure on page B23.



General view of the soffit of the flange plate of the second floor transfer beam.



Closer view of the two beams.



General view of the beam exposure from the second floor level.



**16** FIRST FLOOR To establish the floor construction around the first floor stair landing.

# INVESTIGATION RESULTS

The annotated record photograph presented below shows the investigation findings with further details presented in the figure on page B25.



B24



**17** FIRST FLOOR To establish the transfer beam details, including the end support detail. Additionally, to confirm the presence of an iron supporting column beneath the transfer beam.

# **INVESTIGATION RESULTS**

The annotated record photographs presented on the following pages show the investigation findings with further details presented in the figure on page B28.



The investigations were limited in this room so that only limited damaged occurred to the ornate coving present.



This view shows the iron column embedded in the pier of the spine wall.



This view shows the extent of the removal of the coving and ceiling in order to inspect the transfer beam



**18** FIRST FLOOR To establish the beam arrangement in Room 104.

### **INVESTIGATION RESULTS**

The beam arrangement and beam details are shown in the following photograph and the sketch presented on sheet B30.





FIRST FLOOR In the location shown in the photograph below, determine the corridor width between the brick piers. Additionally, expose the floor structure to determine its construction.

# INVESTIGATION RESULTS

The width of the corridor between the brick piers is shown below.

The floor structure in this location was a sandstone slab spanning between the spine walls.



B31

**21** SECOND FLOOR In the location shown in the photograph below, determine the corridor width between the brick piers.

# INVESTIGATION RESULTS

The width of the corridor between the brick piers is shown below.



(only a poor quality photograph available in this location)

23 SECOND FLOOR In Room 210, establish the thickness of the brick walls and inspect brickwork.

# INVESTIGATION RESULTS

The investigation determined the thickness of the walls, as shown below. The condition of the brickwork and the joint between the walls appeared to be sound, with no obvious defects.



B33

24 SECOND FLOOR In Room 210, establish the thickness of the brick wall and inspect brickwork.

# INVESTIGATION RESULTS

The investigation determined the thickness of the wall, as shown below. The condition of the brickwork and the joint between the walls appeared to be sound, with no obvious defects.



**25 & 31** SECOND FLOOR AND THIRD FLOOR To establish the construction details of the corridor floor.

### **INVESTIGATION RESULTS**

The details of the corridor floor slab are shown in the photograph below.



**26 & 32** SECOND FLOOR/THIRD FLOOR To establish the nature, dimensions and characteristics of the floor structures, including the floor beams.

# INVESTIGATION RESULTS

The following photograph shows details of the investigation carried out and sketches with dimensions are presented on sheet B37.



| Porterswood House   |  |  |  |
|---------------------|--|--|--|
| Porters Wood        |  |  |  |
| St Albans           |  |  |  |
| Herts               |  |  |  |
| AL3 6PQ             |  |  |  |
| Tel. (01727) 833261 |  |  |  |

# STRUCTURAL INVESTIGATION RESULTS





27 SECOND FLOOR In Room 212, establish the thickness of the brick walls and inspect brickwork.

# INVESTIGATION RESULTS

The investigation determined the thickness of the walls, as shown below. The condition of the brickwork and the joint between the walls appeared to be sound, with no obvious defects.



**28 & 33** SECOND FLOOR/THIRD FLOOR To establish the nature, dimensions and characteristics of the floor structures, including the floor beams.

# INVESTIGATION RESULTS

The following photograph shows details of the investigation carried out and sketches with dimensions are presented on sheet B40.



B39

STRUCTURAL INVESTIGATION RESULTS





**29** THIRD FLOOR In the location shown in the photograph below, determine the corridor width between the brick piers.

# INVESTIGATION RESULTS

The width of the corridor between the brick piers is shown below.



**30** SECOND FLOOR To establish the third floor beam arrangement in Room 302 (inspected from below).

# INVESTIGATION RESULTS

The beam arrangement is shown in the following photograph and the sketch presented on sheet B43.



This view shows the soffit of the flange plate of the exposed third floor beam.



**34** FOURTH FLOOR In the location shown in the photograph below, determine the corridor width between the brick piers.

# INVESTIGATION RESULTS

The width of the corridor between the brick piers is shown below.



**35** FOURTH FLOOR To establish the fifth floor beam arrangement above Room 403.

### INVESTIGATION RESULTS

The beam arrangement and beam details are shown in the following photograph and the sketch presented on sheet B46.





**36** FOURTH FLOOR In Room 416, establish the thickness of the brick walls and inspect brickwork.

# INVESTIGATION RESULTS

The investigation determined the thickness of the walls, as shown below. The condition of the brickwork and the joint between the walls appeared to be sound, with no obvious defects.



**37** FOURTH FLOOR In Room 416, establish the thickness of the brick wall and inspect brickwork.

### **INVESTIGATION RESULTS**

The investigation determined the thickness of the wall, as shown below. The condition of the brickwork and the joint between the walls appeared to be sound, with no obvious defects, except in a localised area where it appeared that some brickwork had been replaced. This patch of different brickwork appeared to be of poorer quality.



**38 & 47** FOURTH FLOOR/FIFTH FLOOR To establish the nature, dimensions and characteristics of the floor structures, including the floor beams.

# INVESTIGATION RESULTS

The following photograph shows details of the investigation carried out and sketches with dimensions are presented on sheet B50.



STRUCTURAL INVESTIGATION RESULTS



Fig. No:

B50



**39 & 46** FOURTH FLOOR AND FIFTH FLOOR To establish the construction details of the corridor floor.

### **INVESTIGATION RESULTS**

The details of the corridor floor slab are shown in the photograph below.



B51

**40 & 48** FOURTH FLOOR/FIFTH FLOOR To establish the nature, dimensions and characteristics of the floor structures, including the floor beams.

# INVESTIGATION RESULTS

The following photograph shows details of the investigation carried out and sketches with dimensions are presented on sheet B53.



| Porterswood House   |  |  |  |
|---------------------|--|--|--|
| Porters Wood        |  |  |  |
| St Albans           |  |  |  |
| Herts               |  |  |  |
| AL3 6PQ             |  |  |  |
| Tel. (01727) 833261 |  |  |  |

# STRUCTURAL INVESTIGATION RESULTS



#### **INVESTIGATION REF. 40 & 48**

| Client:<br>ARGENT (KING'S CROSS) LTD | Site:<br>GREAT NORTHERN HOTEL | Date:<br>NOV 05          | Job No:<br>22938 |
|--------------------------------------|-------------------------------|--------------------------|------------------|
|                                      |                               | <sup>Prep. by:</sup> GPM | Fig. No: B53     |

**41** FOURTH FLOOR In Room 418, establish the thickness of the brick walls and inspect brickwork.

# INVESTIGATION RESULTS

The investigation determined the thickness of the walls, as shown below. The condition of the brickwork and the joint between the walls appeared to be sound, with no obvious defects.



**42** FOURTH FLOOR In Room 418, establish the thickness of the brick wall and inspect brickwork.

### INVESTIGATION RESULTS

The investigation determined the thickness of the wall, as shown below. The condition of the brickwork appeared to be sound, with no obvious defects. The joint generally appeared to be sound, however there appeared to be some voidage in the mortar in the intersection between the external wall and the cross wall.



**43 & 44** FOURTH FLOOR/FIFTH FLOOR To establish the nature, dimensions and characteristics of the floor structures, including the floor beams.

# INVESTIGATION RESULTS

The following photograph shows details of the investigation carried out and sketches with dimensions are presented on sheet B57.


## STRUCTURAL INVESTIGATION RESULTS





#### INVESTIGATION REF. FLOOR (ACCESSED FROM): DESCRIPTION:

**45** FIFTH FLOOR In the location shown in the photograph below, determine the corridor width between the brick walls.

#### INVESTIGATION RESULTS

The width of the corridor between the brick walls is shown below.



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#### APPENDIX C

### LABORATORY CERTIFICATES OF TEST

(This appendix contains 8 pages, including this)



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# Compressive Strength of Clay Bricks BS 3921: 1985, Appendix D

## 22938 Great Northern Hotel, Kings Cross

STATS

| Client Details     |               |            |          |   |
|--------------------|---------------|------------|----------|---|
| Argent Group plc   |               |            |          |   |
| 5 Albany Courtvard |               |            |          |   |
| Piccadilly         |               |            |          |   |
| London             | :             |            |          |   |
| W1V 9RB            |               |            |          | _ |
| Contact Name       | Richard Meier |            |          |   |
| Order Reference    | 22938/GPM     | Order Date | 02/11/05 |   |
|                    |               |            |          | - |

| Sample Details |          | ·             |          |
|----------------|----------|---------------|----------|
| Sample Type    | Bricks   |               |          |
| Sampled By     | STATS    | Sampling Date | 31/10/05 |
| STATS Batch No | 4702     | No of Samples | 15       |
| Receipt Date   | 02/11/05 | Test Date     | 08/11/05 |

| Methods    |  |
|------------|--|
| Test       | Compressive strength was determined in accordance with     |
|            | BS 3921:1985, Appendix D for new whole bricks.             |
| Deviations | No deviations from the standard test method were employed. |

#### Results

The results are reported on page 2 of this certificate.

| Certification           | <b>a</b> |  |
|-------------------------|----------|--|
| Certificate prepared by | //       | Certificate reviewed by  |
|                         | /        | for a second sec |
|                         |          |  |
|                         |          | 11/10/2  |
|                         | ingel    |  |
| Clive Rayner            | ί -      | Fergus A Collie  |
| Senior Technician       |          | Director   |
| Testing by              | CR       | Certificate issue Date 09/11/05  |

The results given in this certificate relate only to those samples submitted and specimens tested and to any materials properly represented by those samples and specimens. Any opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

End of Certificate

| Test Results                                 |     |     |      |      |     |      |           |      |
|--|-----|-----|------|------|-----|------|-----------|------|
| Batch No:                                    | -   |     | _    | 47   | 02  |      |           |      |
| Client/Site reference:                       | B1  | B2  | B3   | B4 _ | B5  | B6   | <u>B7</u> | B8   |
| Compressive<br>Strength, N/mm <sup>2</sup> : | 6.6 | 9.5 | 17.3 | 12.4 | 9.3 | 18.9 | 8.5       | 13.8 |

| Batch No:  |      |      |     | 4702 |     |             |     |
|--|------|------|-----|------|-----|-------------|-----|
| Client/Site reference:                             | B9   | B10  | B11 | B12  | B13 | B1 <u>4</u> | B15 |
| Compressive<br>Strength, N/mm <sup>2</sup> :       | 16.8 | 15.8 | 5.6 | 7.3  | 7.5 | 7.8         | 4.9 |
| Mean compressive<br>strength - N/mm <sup>2</sup> : |      |      |     | 10.8 |     |             |     |



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# Mix Proportions of Mortar BS 4551-2: 1998

## 22938 Great Northern Hotel, Kings Cross

| Client Detalls     |               |            |          |   |
|--------------------|---------------|------------|----------|---|
| Argent Group plc   |               |            |          |   |
| 5 Albany Courtyard |               |            |          |   |
| Piccadilly         |               |            |          |   |
| London             |               |            |          |   |
| W1V 9RB            |               |            |          |   |
| Contact Name       | Richard Meier |            |          | • |
| Order Reference    | 22938/GPM     | Order Date | 02/11/05 |   |
|                    |               |            |          |   |

| Sample Details |          |               |             |
|----------------|----------|---------------|-------------|
| Sample Type    | Mortar   |               |             |
| Sampled By     | Client   | Sampling Date | 31/10/05    |
| STATS Batch No | 4702     | No of Samples | 8           |
| Receipt Date   | 02/11/05 | Test Period   | 15-18/11/05 |

| Methods    |  |
|------------|--|
| Test       | The samples were dried at 105°C and on cooling were crushed, reduced<br>by riffling and ground to pass a 150 micron BS sieve. The ground                               |
|            | 4551-2: 1998. The interpretation of our analytical data has been made<br>on the basis of calculations described in BS 4551-2: 1998 using the<br>following assumptions: |
|            | Soluble silica content of the cand $= 0.2.\%$  |
|            | Soluble silica content of the cement $= 20.2\%$  |
|            | Calcium oxide content of the cement = $64.5\%$   |
|            | Water of hydration = 23 %  |
|            | Bulk density of sand = $1675 \text{ kg/m}^3$   |
|            | Bulk density of cement = $1450 \text{ kg/m}^3$   |
|            | Bulk density of lime = 575 kg/ m <sup>3</sup>  |
| Deviations | No deviations from the standard test method were employed.   |

| Certification           |       |                                 |
|-------------------------|-------|---------------------------------|
| Certificate prepared by |       | Certificate reviewed by-7       |
| sA                      | le la | 16e                             |
| Ben Stainton            |       | Fergus Collie                   |
| Chemistry Technician    |       | Director                        |
| Testing by              | BJS   | Certificate Issue Date 22/11/05 |



#### DETAILS OF SAMPLES

| Laboratory<br>Reference | Mass<br>[g] | Description   |
|-------------------------|-------------|---|
| 4702/M1                 | 86          | Light Yellow / cream coloured mortar fragments with specks of unmixed lime. |
| 4702/M2                 | 44          | Light Yellow / cream coloured mortar fragments with specks of unmixed lime. |
| 4702/M3                 | 90          | Light Yellow / cream coloured mortar fragments with specks of unmixed lime. |
| 4702/M4                 | 77          | Light Yellow / cream coloured mortar fragments with specks of unmixed lime. |
| 4702/M5                 | 150         | Light Yellow / cream coloured mortar fragments with specks of unmixed lime. |
| 4702/M6                 | 121         | Light Yellow / cream coloured mortar fragments with specks of unmixed lime. |
| 4702/M7                 | 130         | Light Yellow / cream coloured mortar fragments with specks of unmixed lime. |
| 4702/M8                 | 156         | Light Yellow / cream coloured mortar fragments with specks of unmixed lime. |

#### RESULTS

#### **Determined Values**

| Sample Ref        | M1        | M2    | M3    | M4   | M5    | M6    | M7    | M8    |
|-------------------|-----------|-------|-------|------|-------|-------|-------|-------|
| Determined Values | % by mass |       |       |      |       |       |       |       |
| Insolubles        | 78.4      | 70.0  | 72.5  | 78.3 | 66.0  | 73.6  | 74.8  | 70.6  |
| Soluble Silica    | 2.14      | 0.89  | 2.70  | 1.85 | 2.45  | 2.36  | 2.12  | 2.05  |
| Calcium Oxide     | 8.86      | 15.04 | 11.68 | 9.99 | 16:40 | 11.96 | 11.82 | 14.34 |

### **Calculated Composition**

| Sample Ref  | M1              | M2   | M3     | M4     | M5     | M6     | M7     | M8     |  |  |  |  |  |  |
|---|-----------------|------|--------|--------|--------|--------|--------|--------|--|--|--|--|--|--|
| (a) assuming cement:sand mix % by mass on dry mass      |                 |      |        |        |        |        |        |        |  |  |  |  |  |  |
| Portland Cement   | 10.5            | 3.5  | 13.5   | 8.5    | 12.0   | 11.5   | 10.0   | 10.0   |  |  |  |  |  |  |
| Mortar designation<br>(BS 4551-2:1998:Table 4)          | iv/v N/A        |      | iii    | iv/v   | iii/iv | iii/i∨ | iv/v   | iv/v   |  |  |  |  |  |  |
| Approximate mix proportions: by volume                  |                 |      |        |        |        |        |        |        |  |  |  |  |  |  |
| Portland Cement   | 1               | 1    | 1      | 1      | 1      | 1      | 1      | 1      |  |  |  |  |  |  |
| Sand  | 7 to 9          | 23.2 | 5 to 6 | 7 to 8 | 5 to 8 | 5 to 8 | 7 to 8 | 7 to 8 |  |  |  |  |  |  |
| (b) assuming cement:lime:sand mix % by mass on dry mass |                 |      |        |        |        |        |        |        |  |  |  |  |  |  |
| Portland cement   | 10.5            | 4.0  | 14.0   | 9.0    | 12.5   | 12.0   | 10.5   | 10.0   |  |  |  |  |  |  |
| Lime  | 3.5             | 18.5 | 5.5    | 6.5    | 13.5   | 7.0    | 8.0    | 12.0   |  |  |  |  |  |  |
| Mortar designation<br>(BS 4551-2:1998:Table 4)          | N/A             | N/A  |        | iv     | N/A    | ili    | iv     | N/A    |  |  |  |  |  |  |
| Approximate mix proportions: by volume                  |                 |      |        |        |        |        |        |        |  |  |  |  |  |  |
| Portland Cement   | 1               | 1    | 1      | 1      | 1      | 1      | 1      | 1      |  |  |  |  |  |  |
| Lime  | 0. <del>9</del> | 12.3 | 1      | 2      | 2.7    | 1      | 2      | 3.0    |  |  |  |  |  |  |
| Sand  | 7.0             | 17.5 | 5 to 6 | 8 to 9 | 5.1    | 5 to 6 | 8 to 9 | 6.6    |  |  |  |  |  |  |



#### REMARKS

Samples 4702/M1 – 4702/M4 do not comply with the requirements in BS 4551-2: 1998 for a minimum sample mass of 100 g, samples 4702/M5 – 4702/M8 do comply with this requirement.

Comparison of measured cement and lime contents with Table 4 of BS 4551-2: 1998 indicates that samples 4702/M1, 4702/M4, 4702/M7 and 4702/M8 conform with mortar designations iv and v for cement:sand mortars. Samples 4702/M5 and 4702/M6 conform with mortar designations iii and iv for cement:sand mortars. Sample 4702/M3 conforms with mortar designations iii for cement:sand mortars.

Samples 4702/M3 and 4702/M6 conform with mortar designation iii for cement:lime:sand mortar while samples 4702/M4 and 4702/M7 conform with mortar designation iv for cement:lime:sand mortar.

Sample 4702/M2 does not conform with any designations for cement:sand or cement:lime:sand mortars within the table

Evidence of hydrated lime has been found in all samples. Comparison of the analytical results of soluble silica and calcium oxide indicates a source of calcium in addition to the cement. This excess may have come from :-

- (1) The aggregate
- (2) Lime added to the mix
- (3) A combination of these sources

The calculated compositions given in (a) and (b) overleaf represent the first two possibilities respectively.

For the third case it is not possible to calculate the mix proportions without further details, but the mix should be between (a) and (b).

The results given in this certificate relate only to those samples submitted and specimens tested and to any materials properly represented by those samples and specimens. Any opinions and interpretations expressed herein are outside the scope of our UKAS accreditation

Fnd of Certificate





Bodycote Materials Testing Ltd, No.1 Festival Units, Showground Business Park, Bridgwater, Somerset, TA6 6LS Tei: 01278 456888, Fax: 01278 453123

# **Test Certificate**

| STATS LTD                                      | REF No                       | B513203 : Issue      | 1 |
|--|------------------------------|----------------------|---|
| PORTERSWOOD HOUSE                              | Ord No                       | 30835/GPM            |   |
| PORTERS WOOD<br>ST ALBANS<br>HERTS<br>AL 3 6P0 | Date Tested<br>Date Reported | 09/11/05<br>09/11/05 |   |

Attn: GARETH MOORHEAD

# Item TENSILE STRENGTH, WELDABILITY AND IRON TYPE ON 3 SAMPLES S1, S2, S3(b).

## Specification - Not Applicable

| Tensile Test - EN 10   | 002+1  |  |                                     |                                 |                             |                   |     |                          |  |  |  |  |  |
|--|--|--|-------------------------------------|---------------------------------|-----------------------------|-------------------|-----|--------------------------|--|--|--|--|--|
|  | Dimensions<br>[mm]   |  | GL<br>[ma]                          | 0.20%PS<br>[N/mm <sup>2</sup> ] | UTS<br>[N/mm <sup>2</sup> ] | ¥E]               | #RA | Comments                 |  |  |  |  |  |
| 001:Axia]<br>002:Axia]<br>003:Axia]  | 5.00<br>10.02<br>5.06  | 19.63<br>78.85<br>20.10                      | 25<br>50<br>25                      | *<br>164<br>154                 | 149<br>170<br>156           | 1.0<br>0.5<br>1.0 | •   | See Below<br>S2<br>S3(b) |  |  |  |  |  |
| Item 01: S1<br>Broke befo  | re 0.2% Proof Stress   | value was reached.                           |                                     |                                 |                             |                   |     |                          |  |  |  |  |  |
| Micro Examination  | - Customer Requi   | rement                                       |                                     |                                 |                             |                   |     |                          |  |  |  |  |  |
|  | Position   | Details                                      | Comme                               | ents                            |                             |                   |     |                          |  |  |  |  |  |
| 004:Microstructural Ex<br>005:Microstructural Ex<br>006:Microstructural Ex | an N/A<br>am N/A<br>am N/A   | •  | See Below<br>See Below<br>See Below |                                 |                             |                   |     |                          |  |  |  |  |  |
| Item 04: S1<br>Medium qua<br>ferrite:pc<br>Item 05: S2                     | ntity of flake graph<br>arlite matrix contai   | nite 'rosettes' in a<br>ning phosphide euter | 50:50.<br>ctic.                     |                                 |                             |                   |     |                          |  |  |  |  |  |
| Fairly eve<br>ferrite: p<br>Item 06: S3(b)<br>Large grap                   | <ul> <li>Fairly even distribution of graphite flakes in a 30:70,</li> <li>ferrite: pearlite matrix containing grain boundary phosphide eutectic.</li> <li>S3(b)</li> <li>Large graphite flakes distributed in a predominantly ferrite matrix.</li> </ul> |  |                                     |                                 |                             |                   |     |                          |  |  |  |  |  |
| 6L   |  |  |                                     |                                 |                             |                   |     |                          |  |  |  |  |  |

| Che  | mic | al An; | ilys | is - Fl | am | ) AAS | ,Ca | ombus | tio | n (C+8 | 5},C | olour | ime | lry  |    |      |    |      |    |      |           |
|------|-----|--------|------|---------|----|-------|-----|-------|-----|--------|------|-------|-----|------|----|------|----|------|----|------|-----------|
|      | C   | [*]    | Si   | [%]     | Mn | [%]   | P   | [%]   | 5   | [%]    | Cr   | [%]   | Mo  | [%]  | Ni | [%]  | Cu | [%]  | Mg | [%]  | Comments  |
| 007: |     | 3.36   |      | 2.28    |    | 0.86  |     | 0.76  | 1   | 0.035  |      | 0.02  |     | 0.01 |    | 0.02 | <{ | 0.01 | <0 | .005 | S1        |
| 008: |     | 3.42   |      | 1.50    |    | 0.68  |     | 0.80  | - 1 | 0.049  |      | 0.01  |     | 0.01 |    | 0.02 | <( | 0.01 | <0 | .005 | S2        |
| 009: |     | 3.28   |      | 2.12    |    | 0.57  |     | 0.70  | (   | 0.057  |      | 0.01  |     | 0.01 |    | 0.02 | <( | 0.01 | <0 | .005 | <br>S3(b) |

## **Certificate Comments**

----- End of Text ------

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## **Test Certificate**

STATS LTD

Tested by

REF No

B513203 : Issue 1

TENSILE STRENGTH, WELDABILITY AND IRON TYPE ON 3 SAMPLES S1. S2, S3(b).

A. SAMPSON MET LAB SUPERMISON

S. SHARKEY & M.D.J. TAPP

For and on authority of Bodycote Materials Testing Ltd



This document has been prepared for Argent (King's Cross), London and Continental Railways and Exel by STATS

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