

INVESTIGATION OF LIME TORCHING TO THE UNDERSIDE OF THE ROOF IN  
BAY 04 OF THE 1830 WAREHOUSE

SCIENCE AND INDUSTRY MUSEUM, MANCHESTER (SIM)

JOB NO. 210.58



THE SCIENCE MUSEUM GROUP

11 OCTOBER 2018

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## **1 INTRODUCTION**

### **1.1 AUTHORITY AND REFERENCE**

Hutton+Rostron Environmental Investigations Limited carried out an investigation of the underside of the roof structures in the 1830 Warehouse at the Science and Industry Museum (SIM) in Manchester on the 11th October 2018 in accordance with instructions received from Naomi Atherton by email dated 10th October 2018. Reference was made to drawings supplied by SIM, for the identification of structures. For the purpose of orientation in this report, the elevation facing Liverpool Road was taken as facing south

### **1.2 AIM**

The aim of this investigation was to inspect the 'torching' that has been applied to the underside of the roof slates in Bay 04 following the falling of some loose material

### **1.3 LIMITATIONS**

This survey was confined to the accessible structures. Structures were not examined in detail except as described in this report, and no liability can be accepted for defects that may exist in other parts of the building

The contents of this report do not imply the adoption of the role of Principal Designer by H+R for the purposes of the Construction (Design and Management) (CDM) Regulations 2015. No formal investigation of moisture distribution was made

### **1.4 H+R STAFF ON SITE**

Chris Whitfield  
Oliver Sharpin

### **1.5 PERSONNEL CONTACTED**

Suzanne McNicholas

## 2 OBSERVATIONS

### 2.1 BAY 04

- 1 Purpose of investigation: H+R were called out to inspect the underside of the roof in Bay 04 of the 1830 Warehouse, following falling of debris in the location of an exhibit forming part of the Manchester Science Festival. An inspection from the floor level using torchlight identified 6 no. areas where the 'torching'/'parging' to the underside of the roof finishes appeared to be in relatively poor condition. Following a close tactile inspection from a scaffold tower, loose torching was carefully removed, samples of which were taken for close examination by H+R
- 2 Background: Lime torching was traditionally used as a barrier against wind- driven rain, snow and draughts. It is applied directly to the underside of roof slates as a wet mortar between the battens. The application of torching effectively became obsolete following the introduction of building papers and bitumen roofing felts and is rarely found in post-1930's construction
- 3 Application: The existing torching is understood to have been applied following the last major refurbishment of the roof finishes c.1993. It is unknown whether torching had been applied beneath the slates prior to the refurbishment but it is quite possible given the buildings exposure and purpose i.e. for the dry storage of perishable goods. The torching could therefore have been seen as a 'conservation sensitive' reinstatement. However, the preparation of the mortar and its application are wholly inadequate and likely relate to a misinterpretation of the specification by an inexperienced tradesperson

### 2.2 MATERIAL ANALYSIS

- 1 Fibre inclusion: Examinations of fragments of loose mortar showed that although natural hair was used, it was very poorly distributed in the mortar. The hair has been inadequately distributed through the mortar and in the samples taken there were examples of both an insufficient quantity of hair and a 'clumped' inclusion of hair. Hair (or in recent years synthetic fiber) is added to the lime mortar to give the mix additional tensile strength and act as reinforcement in the bonding key. In best practice for lime mortar, hair is 'teased-out' of a bundle by hand into a forced-action type mixer
- 2 Aggregates: When viewed under a microscope it was evident that the aggregate/sand was very fine and homogenous. The inclusion of larger aggregate particles was only rarely found. In good practice, aggregate used for mortars and body plasters should be comprised of a variety of particle sizes, graded to improve the bulk density. It also appeared that the torching had been applied with successive coats. However, it could not be determined whether a 'key' had been made in the 'scratch' coat to aid bonding between coats. In conclusion, this all made for a very weak mortar and provides a cause for the failure observed
- 3 Binder: The binder was lime. Although there was an abundance of binder, manipulation showed that it was either uncured semi-hydraulic lime (this can occur as a result of rapid dehydration during application) or possibly even hydrated lime, used

incorrectly

### **2.3 BAY 01-03 & 05**

- 1      Roof: Cement based boards have been fixed above the rafters in Bays 01-03 & 05 concealing the battens and slates above. The introduction of a relatively impervious membrane provides a surface susceptible to condensation, leading to an increased risk of damp, metal corrosion, mineral deterioration and bio-deterioration. In this case, the rafters beneath the boards are likely to have been subjected to these conditions and this will be closely inspected during the upcoming survey of the roof structure

### 3 RECOMMENDATIONS

#### 3.1 BAY 04

- 1 Immediate response: Although the notable areas of loose torching were removed by H+R as a precaution, ahead of the opening of the Manchester Science Festival, protective sheeting should be applied directly beneath the 6 no. locations identified on the attached drawing. The roof over the 'exhibition box' beneath is directly beneath 4 no. of these locations and any falling debris is likely to collect above. However, there is the potential for debris to fall over the sides of the flat roof as it lands on the upper floor and bounces and we would therefore recommend that these areas are also protected
- 2 Long term response: Ultimately, further areas of torching that are currently 'sound' are likely to fail and the museum should expect similar instances of falling material in the future. It is therefore recommended that on the grounds of public safety all torching is carefully removed from beneath the roof slates. Furthermore, the torching will require removal ahead of the proposed refurbishment to the roof finishes in the near future. If necessary, a lime torching could be re-instated in the future following the refurbishment of the roof finishes and H+R can provide further guidance on an appropriate specification if required. Alternative vapour permeable materials are available that maintain weather-tightness and breathability which may be more appropriate upon refurbishment

# Appendix A



**Fig 1:**

Bay no. 4; showing a general view of the roof structure with lime torching applied to the underside of the slates between the slate battens



**Fig 2:**

Location no.1; showing area of damaged torching prior to tactile inspection. Torching has fallen in the past exposing the underside of the slate above



**Science and Industry Museum, Manchester - 1830 Warehouse**

Photographs  
11 October 2018  
Not to scale



**Fig 3:**

Location no.1; showing area of damaged torching following tactile inspection and removal of particularly loose material



**Fig 4:**

Location no. 2; showing slate visible above an area of missing torching. There was no loose material and it appears that this small area was missed during original application



**Science and Industry Museum, Manchester - 1830 Warehouse**

Photographs

11 October 2018

Not to scale

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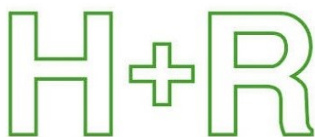
**Fig 5:**

Location no. 2; showing visible horse/  
goats hair above the slate batten



**Fig 6:**

Location no. 2; showing visible horse/  
goats hair above valley gutter timbers



**Science and Industry Museum, Manchester - 1830 Warehouse**

Photographs

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**Fig 7:**

Location no.3; showing area of damaged torching prior to tactile inspection. The torching here had recently fallen and that had instigated the need for this emergency inspection



**Fig 8:**

Location no.3; showing example of cracking failure through the torching



**Science and Industry Museum, Manchester - 1830 Warehouse**

Photographs  
11 October 2018  
Not to scale



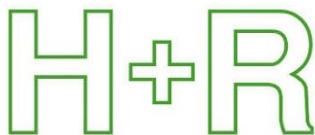
**Fig 9:**

Location no.4; showing area of damaged torching prior to tactile inspection



**Fig 10:**

Location no.4; showing area of damaged torching following tactile inspection and removal of particularly loose material



**Science and Industry Museum, Manchester - 1830 Warehouse**

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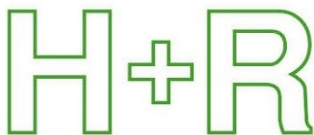
**Fig 11:**

Location no.5; showing area of damaged torching prior to tactile inspection. The torching had fallen and collected above the timber purlin



**Fig 12:**

Location no.5; showing area of damaged torching following tactile inspection and removal of particularly loose material



**Science and Industry Museum, Manchester - 1830 Warehouse**

Photographs

11 October 2018

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**Fig 13:**

Location no.6; showing area of damaged torching following tactile inspection and removal of particularly loose material



**Fig 14:**

Sample no.1 taken from location no.6; showing a representative example of loose torching that was removed. Note the lack of horse/goats hair and very fine, poorly graded mineral aggregate



**Science and Industry Museum, Manchester - 1830 Warehouse**

Photographs

11 October 2018

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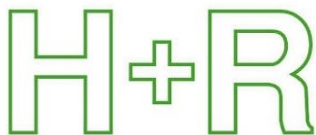
**Fig 15:**

Sample no.2 taken from location no.4; showing a representative example of loose torching that was removed. Note the 'clumped' distribution of animal hair



**Fig 16:**

Sample no. 2; showing micro view of animal hair. This may be a goat hair product



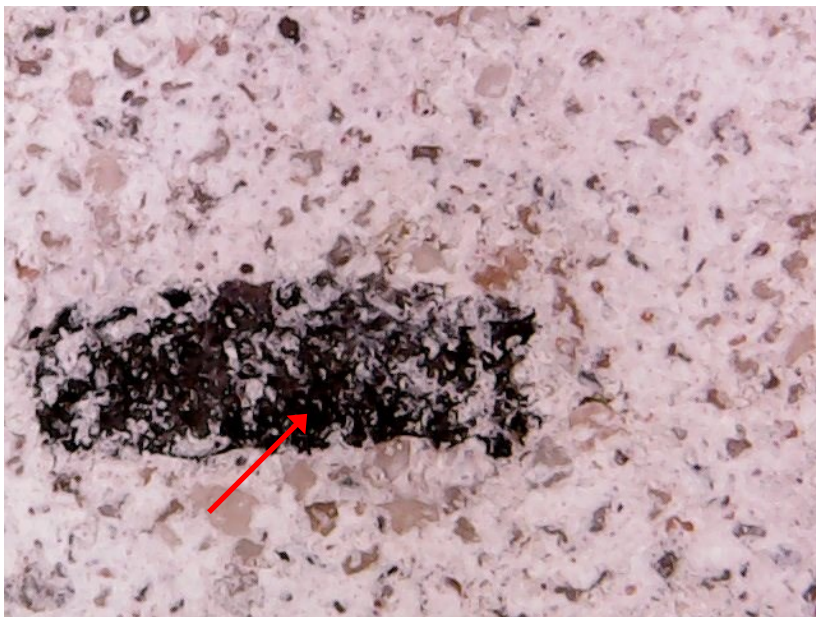
**Science and Industry Museum, Manchester - 1830 Warehouse**

Photographs  
11 October 2018  
Not to scale



**Fig 17:**

Sample no.3 taken from location no.5; showing what appears to be a multi-coat build up. Historic use of torching mortar is only in a single coat and the additional coats is likely an intention to 'plaster' the soffit to a smooth surface



**Fig 18:**

Sample no.3; showing micro view. Note the very fine and homogenous aggregate which made for a very weak mortar. Larger inclusions were only found very rarely



**Science and Industry Museum, Manchester - 1830 Warehouse**

Photographs

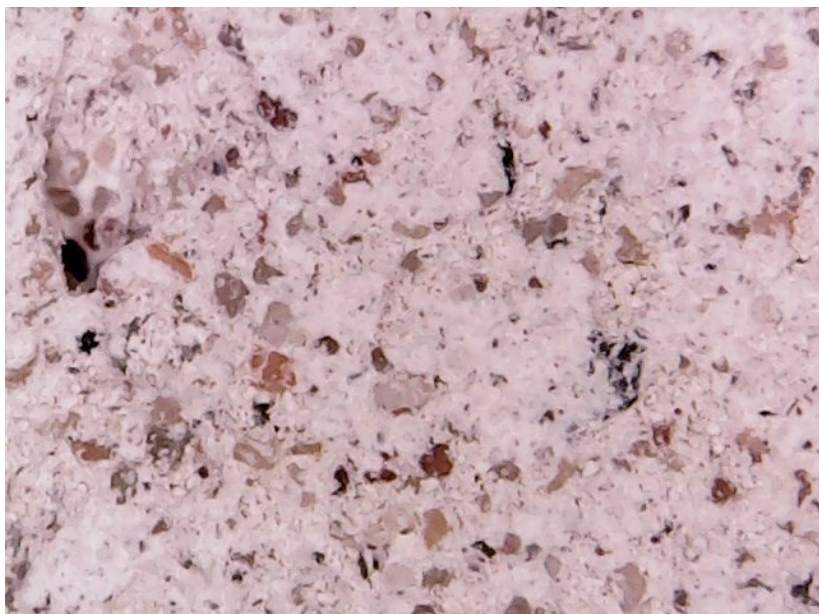
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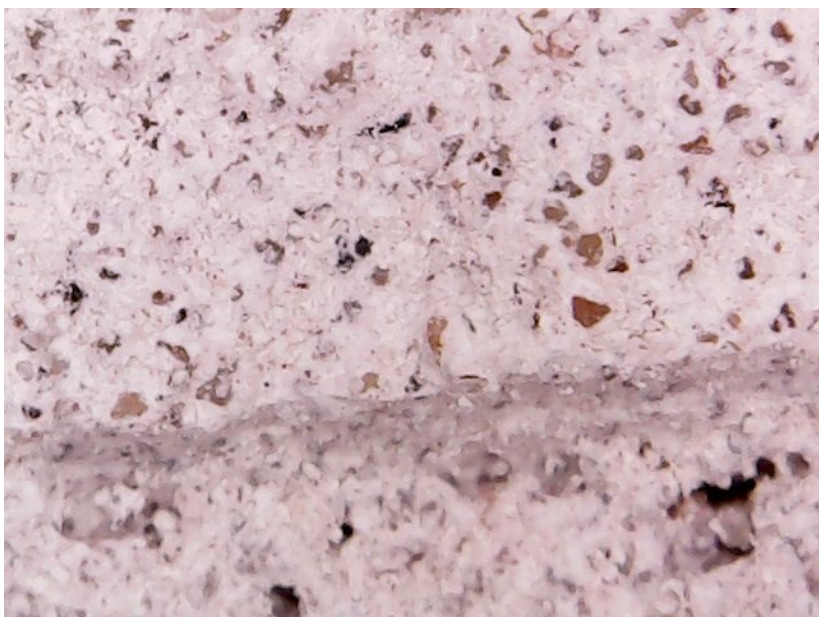
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**Fig 19:**

Sample no.3; showing micro view.  
Note the very fine and homogenous aggregate



**Fig 20:**

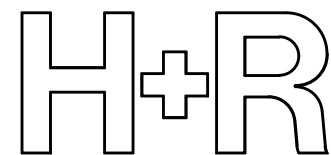
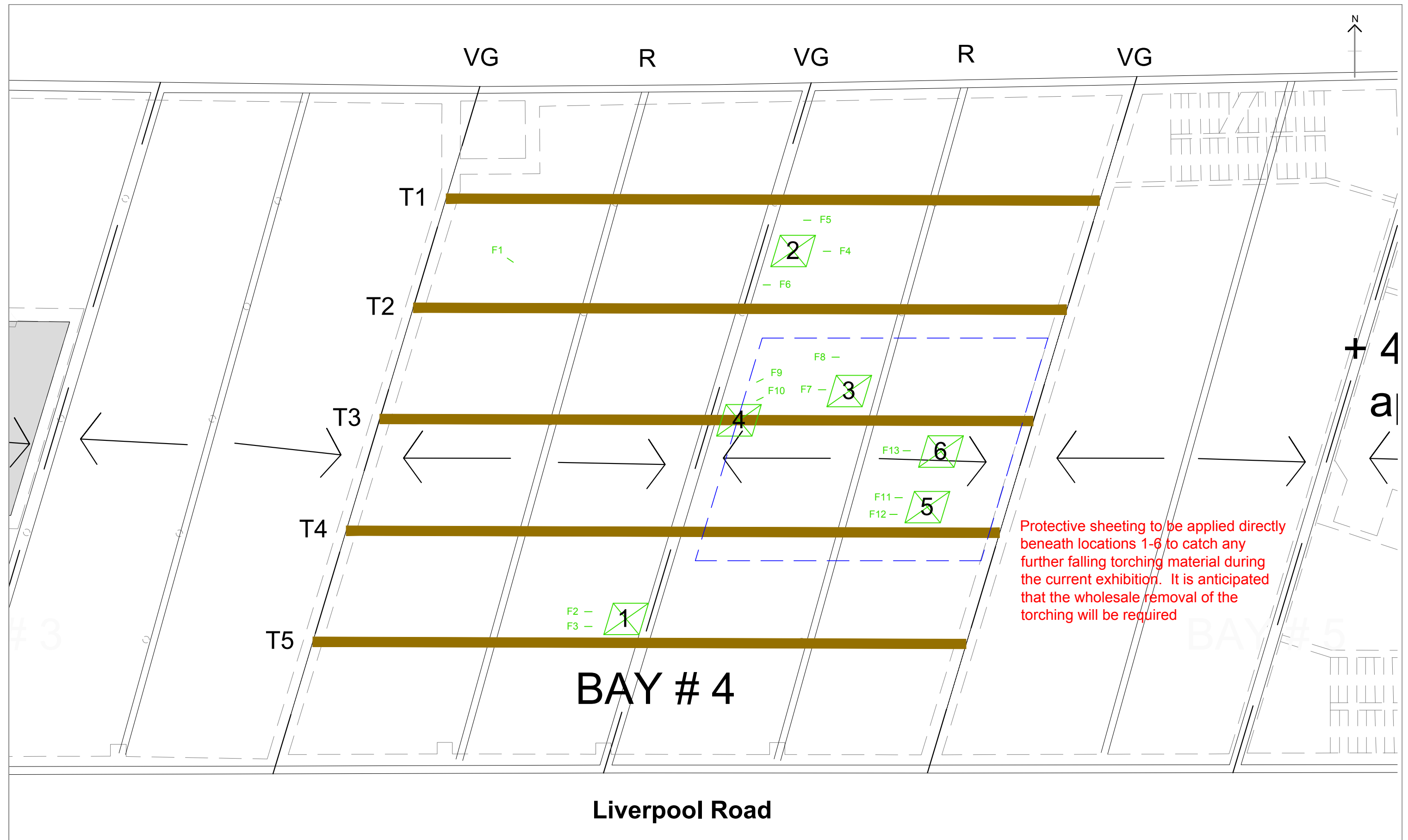
Sample no.3; showing micro view.  
Showing apparent interface between successive coats. From the sample view, it could not be determined if there had been any 'scratch'/'key' to aid bonding between coats



**Science and Industry Museum, Manchester - 1830 Warehouse**

Photographs  
11 October 2018  
Not to scale

## Appendix B



**Science and Industry Museum, Manchester - 1830 Warehouse**  
**BAY NO.4 UNDERSIDE OF ROOF**  
**11 October 2018**

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|             |    |                                           |
|-------------|----|-------------------------------------------|
| <b>Key:</b> |    | Area location number investigated         |
|             | T1 | Truss Number                              |
|             | R  | Ridge                                     |
|             | VG | Valley Gutter                             |
|             |    | Approximate footprint of exhibition 'box' |
|             |    | Photograph location                       |