

King's Cross Station
London
Platform 8

Characterisation of a stone sample from
a plinth, together with
recommendations on replacement material

September 2009

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King's Cross Station London Platform 8

Characterisation of a stone sample from
a plinth, together with
recommendations on replacement material

SUMMARY

The sample of stone which was received for analysis is a relatively fine-grained and laminated sandstone, probably from the Rough Rock Flags of the Silesian 'Millstone Grit' of West Yorkshire. Although a large number of quarries were producing building stone from this horizon at the time when King's Cross Station was being built, the current range of materials is now extremely limited. However, it is considered that the stone sample is very close in composition to that known as Rawdon stone. Since building stone varies, even within a single quarry, it is possible that the present production is considered unsuitable from visual considerations, or a suitable block size is not available. In this circumstance, Witton Fell Fine Grit could be considered for use. It is recommended that suitable blocks are selected on site at the quarry in order to obtain the best colour and textural match with the original.

1 INTRODUCTION

King's Cross railway station was built by Lewis Cubitt in 1851-2 for the Great Northern Railway. Platform 8 is situated at the western end of the main platform complex, platforms 9 to 11 being a separate part of the station. In common with other parts of the station, both brick and stone were utilised in its construction. The work currently being undertaken at the site is part of the overall development of the King's Cross complex. Due to the historical importance of the buildings, it is important to ensure that any stone used for repairs is as close as possible to the original both in appearance and petrography. This will ensure that any potential adverse chemical or weathering reactions with the existing fabric are avoided. It is therefore necessary to characterise the original stone in order to identify a similar material which is currently available. This is achieved by petrographic analysis of samples of stone from the building.

2 SAMPLE FROM THE STONWORK

A sample of stone from Platform 8 was submitted by Stonewest Limited for analysis. The actual location of the stonework and the position from which the sample was obtained, are not known, although it was identified as being from a 'plinth'. It has been assumed, therefore, that the sample is representative of the stonework to be repaired. The sample is approximately 100 mm by 80 mm by 40 mm in size and appears to be degrading by delamination along depositional surfaces. There appears to be a little mortar on one surface. However there is no indication of soiling on any of the surfaces, suggesting that the sample was obtained from the interior of a block and is therefore largely unweathered.

3 ANALYSIS OF THE SAMPLE

The sample is fine-grained and is pale greyish orange in colour, about 10YR 7.5/3 on the Munsell® colour scale. The stone has a laminated appearance, possibly due to small variations

in the grain size of the clasts, or in the concentration of phyllosilicate minerals. Where the stone has delaminated, the resulting flat surfaces do contain concentrations of mica. The laminations are typically 6 mm apart.

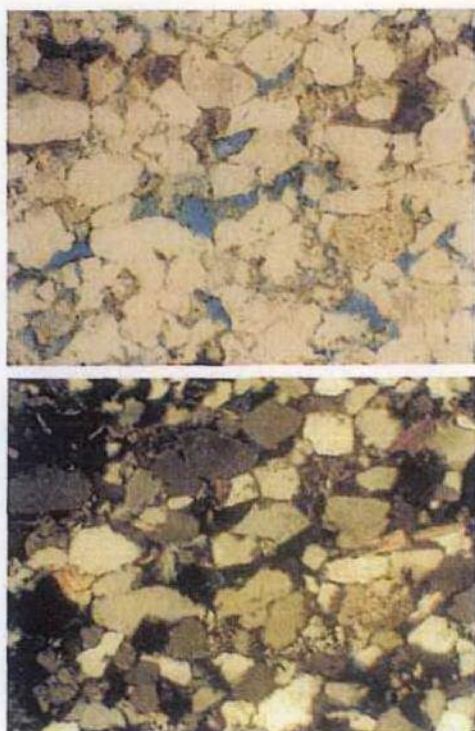


Figure 1. Photomicrograph of the sample of stone from Platform 8. Upper picture photographed in ordinary light, the lower picture is the same view in polarized light. The clear grains in the upper picture, which are various shades of grey in polarized light, are quartz. The finely composite grains, which are 'cloudy' in ordinary light, are metamorphic rock fragments. The porosity is shown in blue in the upper picture. Width of the pictures is 1.36 mm.

In thin section the stone is seen to be composed of sub-angular to sub-rounded clasts, typically about 175 microns in diameter. As is common in this type of sandstone, the sub-rounded particles tend to be the result of syntaxial mineral growth on original sub-angular grains. The particles consist of mainly of quartz, although some fine-grained metamorphic rock is also present. There are traces of feldspar and mica. At regular intervals throughout the stone this material grades into thin depositional layers where there is an increase in the content of biotite and bleached biotite mica. There is also an increase in the number of small quartz grains, typically 100 microns in diameter in these thin horizons. These are the laminations along which the stone splits. Some iron mineral, in the form of limonite, is present. Goethite occurs coating some of the clasts. However, this surface layer tends to be very thin, which accounts for the relatively pale colour of the stone. The stone is

only moderately compacted and there is no discernable matrix. This has resulted in a porosity of about 8%. The natural cement in the stone is silica often, as noted above, in the form of syntaxial rims which have grown out from individual clasts and merged to give the stone its structural strength. A photomicrograph of the stone is shown in Figure 1.

The petrography of this stone is typical of many of the sandstones found in the Silesian Namurian Series, previously known as the Millstone Grit, of the Carboniferous succession in West

Yorkshire. In particular the material bears a strong resemblance to the sandstone found at the top of the Namurian from north of Leeds to west of Huddersfield, which is known as the Rough Rock. This has been quarried extensively in the past, perhaps the most well known use being the construction of Saltaire. The stone varies from a massive coarse-grained material at the top of the sequence, to a fine-grained laminated stone in the basal Rough Rock Flags. The grain size of the stone decreases steadily from the uppermost beds downwards. In the past some of the quarries exposed most of the beds, providing a range of materials. The grain size and presence of laminations suggest that the stone from Platform 8 may have been obtained from the Rough Rock Flags.

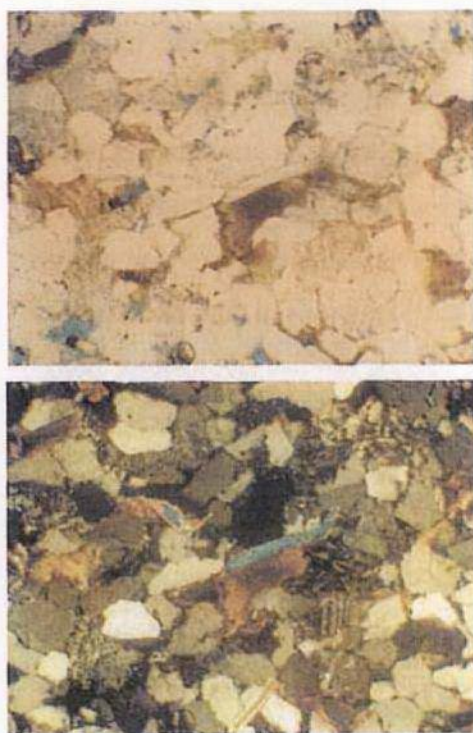


Figure 2. The similarity in the petrography of this sample of Rawdon stone with the stone from Platform 8, shown in Figure 1, is shown in this photomicrograph. The width of the pictures is 1.36 mm.

4 REPLACEMENT STONE

Despite the large numbers of quarries in the Rough Rock at the time the station was being built, the number of available sandstones from this horizon is now extremely limited. The few modern quarries still working the stone tend to extract material from a limited number of horizons and, as a result, the stone available has a restricted number of colours and textures. I am surprised that, although from a plinth, lower flagstone appears to have been used, rather than a more massive dimension stone from higher up the sequence. The flagstone currently available has limited bed height and it suggested, both from this point of view and from considerations of durability in a plinth, a non-flaggy type of Rough Rock is used.

The stones available from all the quarries which are currently working have been studied and petrographic comparisons made of these with the sample received from the station. The result suggests that the stone from Rawdon is likely to be the closest match. A photomicrograph of this stone is shown in Figure 2. It is suggested that you request samples from the supplier. The bed height and block length/depth which are required, which we do not have, should also be indicated to them in order to ensure that they can supply the correct size of block. The address of the company supplying the Rawdon stone is :

W E Leach (Shipley) Ltd
Apperley Lane Quarry
Apperley Lane
Rawdon
Leeds
LS19 7EG
Telephone : 0113 2502780
Facsimile : 01274 392127
The contact is Richard Isaac

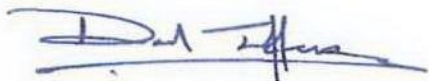
Should this stone not be available in a suitable size, or delivery be a problem, you might consider the use of Witton Fell Fine Grit. This is lighter in colour and comes from a different geological context. However, it would be chemically and mineralogical compatible with the sample from the plinth. There are two types of this stone available, the second type, which is coarse-grained, would not be suitable. The supplier is :

A D Calvert
Smithy Lane
Grove Square
Leyburn
North Yorkshire
DL8 5DZ
Telephone : 01969 622515
Facsimile : 01969 624345
Email : stone@calverts.co.uk

5 CONCLUSIONS

The sample of stone from Platform 8 appears to be typical of that found in the Namurian strata which occurs between Leeds and Huddersfield, in particular from an horizon at the top of the sequence known as the Rough Rock. The stone varies from a massive coarse-grained material at the top of the sequence, to a fine-grained laminated stone at the base, this variation being in the form of a steady decrease in grain size from the uppermost beds downwards. Although in the past some of the quarries worked most of the beds, thereby providing a range of materials, the few modern quarries still producing the stone tend to extract material from a limited number of horizons, resulting in a restricted number of colours and textures.

It is surprising that, although from a plinth, lower flagstone appears to have been used at the station, rather than a more massive dimension stone from higher up the sequence. It is suggested that a more massive stone is used in this situation and, from a study of all the available stones, consider the stone from Rawdon to be the closest match. Should this stone not be available in a suitable block size, or if delivery of a suitable Rawdon stone is found to be a problem, Witton Fell Fine Grit could be considered as an alternative. Due to potential variation in both stones, it is recommended that suitable blocks are selected on site at the quarry, in order to obtain the best colour and textural match with the original.



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3.2.3 Sandberg Consulting Engineers Report no. 41260/G

- West Elevation Cornices