

CASE STUDY

INFILLING OF VIADUCT AND FORMATION OF EMBANKMENT BETHNAL GREEN, LONDON

This bulletin describes how a PFA/OPC grout was used to provide the support for a section of a 425m long viaduct carrying the busy Liverpool Street to Ipswich railway line in East London. The contract involved the construction of a 30 metre embankment, plus an additional 70 metres of infill between a retaining wall and a brick outer wall.



The viaduct consists of transverse cross girders spanning between a retaining wall on one side and a combination of brick outer walls interspersed with piers and arches and wrought iron girders and columns. The areas beneath the viaduct at one time provided space for 2 sidings serving the Mile End Goods and Coal Depot, which have since closed. See Fig (i).

The condition of the wrought iron work was such that replacement was necessary. As the space beneath the viaduct was no longer required, it was decided to replace the structure with an embankment. Realignment of the running tracks was then possible, with the bonus of an increased line speed.

However, the construction of an embankment by normal means was not considered possible. Long term speed restrictions would have been necessary to allow for settlement resulting from poor compaction due to low headroom, causing timetable alterations. Elaborate protection measures would have also been necessary to prevent damage to the supports. Formation of the embankment using a grouting method was therefore specified.

Siteworks Infill area

The open arches in the sidewall were bricked up and a crosswall was then constructed from the end of the sidewall to the retaining wall. A 12:1 PFA/OPC grout, was pumped in layers up to approximately 1.25 metres below the soffit of the cross girders. The remaining void was filled with a 6:1 PFA/OPC grout; the jack arches being filled under pressure using a CLM 4" pump.

Previously installed vent pipes ensured that all the entrapped air would be expelled.

Siteworks The embankment

The second stage of the contract involved the construction of an embankment under the decking. The embankment was constructed as follows:

- bags made of geotextile material were positioned to follow the toe of the embankment and filled with a PFA/OPC grout
- the space between the grout bags was filled with a PFA/OPC grout
- the first two operations were repeated up to the top, until eight layers were positioned, each layer being set back from the previous ones to form a batter
- the lower five layers were constructed using 12:1 PFA/OPC grout. The upper three layers were constructed using 6:1 PFA/OPC grout. See Fig (ii).

The infilling of the viaduct and the forming of the embankment was chosen in preference to a replacement structure because:

- the renewal or replacement of the structure would have caused unacceptable disruption to rail traffic
- the space below the tracks was no longer required and therefore, could be infilled
- the line speed could be increased by realignment of the tracks
- long term maintenance would be reduced
- the grouting solution offered economies in construction.

Why PFA?

1. The predominantly spherical shape of PFA particles enabled the grout to be pumped more easily. By varying the PFA/OPC ratio, a wide range of strengths can be obtained. This makes it possible to choose the most economical proportions of PFA/OPC to give the desired strength.
2. PFA/OPC grouts do not bleed as much as OPC only grouts. There was no excessive accumulation of bleed water and therefore no removal problems. Most of the water was taken up by cement hydration and evaporation. The bleed water in the grout bags was able to permeate through the geotextile material leaving the solids behind.

3. British Rail specified a method which would cause the least disruption to the railway line. No protection was necessary for the column supports due to the filling method employed, which obviated the need for compaction equipment and so ensured that they were never subjected to unbalanced lateral forces.

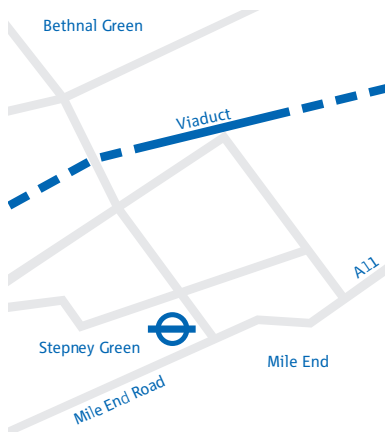
Quantities of grout used

12:1 mix-2600m³. 6:1 mix-1000 m³.
 Water/solids ratio between 0.4 and 0.6.

Comprehensive		
Strength	12:1	6:1
7 day	1.0 N/mm ²	1.75 N/mm ²
28 day	2.0 N/mm ²	4.00 N/mm ²

Other applications for this method of construction

- sea defence repair and construction
- cliff stability
- slope stability
- bund walls
- bridge abutments.



Acknowledgments

Client:
 Regional Civil Engineer (Eastern Region), British Rail, York

Main Contractor:
 J. Murphy & Sons Ltd. London

Grouting Sub-contractor:
 Wimpey Laboratories Ltd, Hayes



Injection pipe being connected to grout bag



Mass infill shortly after placing



Positioning of first grout bags

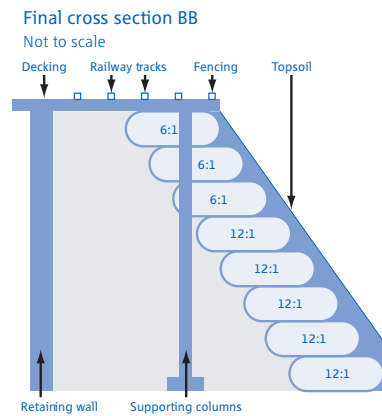


Fig (i).

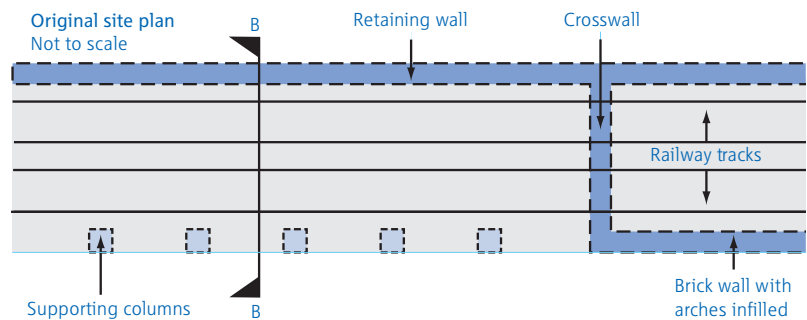


Fig (ii).

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