

ENVIRONMENTAL

Our Ref: ST/5801

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26 January 00

Dear Mrs Richardson

Re: Inspection of Fill Materials Beneath Floors – 30 Castle Road, Redcar

We confirm that, in accordance with recent verbal instructions, we have carried out an inspection of fill materials beneath floors at the above property.

For this purpose two boreholes were drilled through floors in the property, in the lounge at the front and in a bedroom at the rear. Logs arising from these boreholes are attached and descriptions of the fill materials are included on the logs.

At both borehole positions the fill materials present consisted mainly of shale. A sample of the shale was subjected to partial chemical analysis with the following results.

Moisture (As Received)	7.0%
Acid-soluble sulphates (expressed as SO ₃)	0.47%
Total Sulphur	0.60%
= SO ₃	1.50%
Acid-soluble calcium	1.84%

Description and Physical Characteristics

The sample was graded in size up to 60mm. Compared with many other examples of Cleveland shale, the material was relatively hard and non-laminated. The majority of the pieces on breaking exhibited grey or brown coloured fractured surfaces. Cracking took place in random directions with no tendency to split into laminations. No crystals of gypsum or any deposits of jarosite (an oxidation product of iron pyrites) were observed.

ST5801 letter 2501

Observations

The use of certain types of Cleveland shale as fill materials beneath concrete floor slabs or oversite concrete has resulted in damage due to expansion in the shale. The expansion arises from two causes. Firstly, due to the oxidation of finely divided iron pyrites (iron disulphide) in the shale; some of the oxidation products occupy a greater volume than the original iron pyrites, thus causing expansion. Secondly expansion may occur due to the growth of crystals of gypsum (calcium sulphate) within the shale, especially between the laminations which are forced apart. The calcium sulphate is formed as a result of the reaction between sulphuric acid, one of the final products of the oxidation of iron pyrites, and acid-soluble calcium in the shale. The oxidation of iron pyrites is promoted by the access of air and moisture and the latter also enables the calcium sulphate to migrate and crystallise.

This sample, when compared with many other examples of Cleveland shale which have been found to be the cause of floor heave, exhibited important differences:-

- (a) The total sulphur content and hence the ultimate maximum sulphate content assuming complete oxidation did occur, is lower than has been found in most other cases where failure occurred.
- (b) The material is harder, relatively massive and free from laminations. The probability of iron pyrites being oxidised is consequently lower and the conditions for growth of gypsum crystals in the body of the stones are much less favourable.
- (c) There was no evidence that oxidation was taking place; the acid-soluble sulphate content is low, no jarosite was detected and there were no signs of splitting.

The results of this examination show that the fill, as represented by the sample, should prove to be stable. In the unlikely event of expansion occurring this should be very limited in extent and is not likely to be on a scale where significant damage would result.

We must point out that the opinions given in this report are based on information revealed at the borehole positions. We can not accept any responsibility if conditions elsewhere beneath the floors in this property differ from those encountered in the boreholes.

Yours sincerely

A handwritten signature in dark ink, appearing to read 'J. M. Overy'.

J. M. Overy
Technical Director

Enclosures Floor Log & sulphate results

WSP ENVIRONMENTALTEST RESULTS

Site: 30 Castle Road, Redcar

WATER SOLUBLE SULPHATE CONTENT OF SOIL

Sulphate determinations carried out in accordance with BS1377 Test No. 9 on a 2:1 Water/Soil extract.

<u>Borehole Number:</u>	<u>Depth (mm)</u>	<u>Sulphate Content g/litre</u>
2	140 – 470	0.398

SITE ADDRESS:- 30 Castle Road, Redcar

DATE OF TEST:- 10/01/00

BOREHOLE NUMBER: 1	LOCATION: Lounge (Front)
0	Concrete
120	Fill – Shale and ash
450	Soft dark brown clay
600	Boring suspended

BOREHOLE NUMBER: 2	LOCATION: Bedroom (Rear)
0	Concrete
140	Fill – Shale and ash, some broken bricks
470	Soft dark brown sandy clay
600	Boring suspended

<u>Remarks:</u>	Damp Proof Membrane:
All depths in mm	D.P.M. present in both positions