

MORTAR ANALYSIS REPORT

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ANALYSIS DATE	October 2025
SITE	Chetham School Of music Manchester
CLIENT	Bullen Conservation
DATE/ TAKEN RECEIVED	October 2025
CLIENT REQUIREMENTS	Mortar Analysis
LOCATION/ FUNCTION IN BUILDING	Building mortar
CONDITION OF SAMPLE RECEIVED/ COLLECTED	Loose& bound mortar

GENERAL COMMENTS/ SUMMARY

The nature of the binding matrix of the mortar sample and information gained from the analysis suggest that the mortar was probably made by volume from one part early Portland Cement, five parts hydrated lime, including much inert lime, and six parts fine quartz-based sand. The ash in the mortar comes from the lime and cement production process.

SUGGESTED REPLACEMENT MORTAR

Either a mix of 1 part OPC: 3 parts hydrated lime: 10 parts sharp sand, or a hydraulic lime-bound mortar.

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ANALYTICAL PROCEDURES

The selected material sample was dried, weighed, and examined by eye and under a binocular microscope at x 20 and x 35 magnification. The sample was crushed, and the binder was separated from the aggregate by dissolution in dilute hydrochloric acid. The relative proportions of binder (lime, cement, and gypsum) to aggregate were determined. Aggregate (and other acid-insoluble materials) characterisation was undertaken utilising sieve separation and further microscopic examination. The analysis and interpretation provide information on the composition and characteristics of the mortar sample(s) received. Assuming that the sample was generally representative of the mortar, the analysis will give a reasonable indication of the original materials and provide a basis for the specification of repair or replacement mortars.

If more detailed information is required (for example, for historical research purposes), more sophisticated analytical procedures can be undertaken to determine chemistry and mineralogical composition.

MORTAR EXAMINATION AND ANALYSIS

PROCEDURE	DESCRIPTION / COMMENTS	
PRELIMINARY EXAMINATION OF SAMPLE BY EYE	A fine-grained, dirty-brown mortar with many visible lime inclusions.	
EXAMINATION OF PREPARED SAMPLE BY BINOCULAR MICROSCOPE x20 MAG	The fine-grained binder-rich mortar has an open texture. The rich cream binder contains inert lime, quartz, and clinker ash.	

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ACID DISSOLUTION

PROCEDURE	DESCRIPTION ~ COMMENTS
10% HCL ACID DISSOLUTION	It is easy to crush. There was a very vigorous reaction upon dissolution.
FILTER GRADE (PORE SIZE) & TYPE	Whatman Type 1

AGGREGATE SEPARATION

BS SIEVE Mesh Size	Residue Retained in g's	Undissolved binder %	Aggregate excluding undissolved binder – gs*	Aggregate weight %	Comments	
4.75 mm	0.18	25	0.135	n/a	Alite binder residue and clinker ash	
2.36 mm	0.23	30	0.161	n/a	Alite binder residue, brick, quartz and clinker ash.	
1.18 mm	0.30	30	0.21	n/a	Alite binder residue, brick, quartz and clinker ash.	

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0.60 mm (600 μm)	0.95	15	0.808	n/a	Clear, pink and iron-stained quartz, and clinker ash.		
300 μm	8.97	5	8.522	n/a	Clear, pink and iron-stained quartz, and clinker ash.		
150 μm	0.28	10	0.252	n/a	Clear, pink and iron-stained quartz, and clinker ash.		
< 150 μm, including filter residue	1.40	50	0.7	n/a	Clear, pink and iron-stained quartz, and clinker ash.		

The quartz aggregate is all sub-rounded

*The aggregate weight is a proportion of the combined weight of lime and aggregate, the lime being lighter.

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AGGREGATE CHARACTERISTICS

The primary aggregate is quartz sand and inert lime.

Because sand and gravel aggregates are ultimately derived from the weathering of solid rock, most aggregates contain coarse-grained rock fragments and finer mineral grains. Weathering breaks down the rock fragments within the aggregate into the constituent minerals, resulting in smaller and rounder particles; chemical weathering breaks down unstable minerals, such as feldspars, into clays that may be washed away. Both processes eventually result in quartz-rich sand.

CONSTITUENTS OF ANALYSIS SAMPLE

<i>MATERIAL</i>	<i>WEIGHT (g)</i>	COMMENTS
A: DRY WEIGHT OF ANALYSIS SAMPLE	19.5	
B: DRY WEIGHT OF ALL INSOLUBLE	12.31	
C: DRY WEIGHT OF INSOLUBLE BINDER	1.52	
D: (B-C) DRY WEIGHT OF AGGREGATE	10.79	
E: (A-B+C)) DRY WEIGHT OF LIME & BINDERS	8.71	
F: DRY WEIGHT OF LIME	7.19	
OTHER		

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PROPORTIONS OF ANALYSIS SAMPLE

The sample proportions give aggregate and carbonated or set lime relative volumes within the weights recorded for each sieve collection.

CEMENTIOUS RESIDUE: FREE LIME: AGGREGATE

1: 4.7: 7

PROBABLE ORIGINAL MIX

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Sample analysis, interpretation and report carried out by: Dr Mark Womersley.
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