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Summary

Analysis of ten mortar samples suggested four phases of building activity.

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ANALYSIS OF MORTAR SAMPLES FROM ROMAN ALCESTER (AM Nos. 8650669-78)

Analysis of mortars, concretes and plasters does not give absolute dating evidence. No period apart possibly from Roman military material used a unique recipe. The gravel:sand:lime ratios employed for various building tasks in the past were much the same as those used today. At best analysis can give only relative dating evidence, ie which walls are likely to be contemporary with each other. Even here interpretation usually depends on the use of sand, gravel etc having quite distinct characteristics.

Chemical analysis will provide two basic pieces of information. First it will provide the weight of acid insoluble aggregate and secondly the amount of lime probably used in the original mixture. Additional information may be obtained by seiving the insoluble aggregate. The particle-size distribution can be diagnostic and may also provide help in recognising geological sources of aggregate. Examination of the samples before and after analysis may provide information about the preparative practices of the builders ie whether the sand was seived, washed etc prior to use.

Microscopic examination of the seived material may give useful data as it is possible to assess the shape of the quartz grains and the quantity (and nature) of non-quartz inclusions.

Certain problems must be borne in mind when carrying out analyses. For instance the use of shell or chalk/limestone aggregates can give rise to misleading data as these will disappear in the acid treatment phase.

This can be overcome to some extent by careful visual examination of the sample prior to the chemical analysis. The use of secondary aggregates such as crushed tile or building stone can also give rise to anomalous data especially in the size and character of the finer fractions. Additionally one assumes that the mixing process prior to building was reasonably thorough and thus the final products were relatively homogeneous. In practice, however, this may not always have been the case. Secondary building processes such as repointing can also give rise to anomalies.

ANALYSIS

Ten samples were submitted for analysis. Most were in good condition and showed little sign of leaching out of calcium salts. Samples 464 and 806 were degenerate. 504 contained a small fragment of shell. 455 contained a few fragments of wood. The majority of the samples had the usual yellow-buff colouration, although 504 and 619/0/3 were decidedly darker and appeared to contain powdered charcoal. No sample contained large fragments of chalk/limestone but all contained small quantities (up to 10% of visual area) of up to 2 mm white, mainly angular fragments. These were most probably calcium carbonate pieces left over from the lime burning process.

The samples were initially dried at 110 ^{o}C to a constant weight. Approximately 100 g of dried material were treated with dilute hydrochloric acid to remove the acid soluble material, mainly calcium carbonate, and thus reduce the sample to its insoluble aggregate. This aggregate was filtered off, thoroughly washed and dried to a constant weight. It was then passed through a series of standard sieves and the various quantities retained noted. In order to facilitate inter-sample comparison the raw data were converted into percentages of the total insoluble aggregate. All analyses were carried out in duplicate with the exception of 455, 471 and 504, where too little material was available. Where duplicate analyses were carried out the mean values were used for the comparisons.

Examination of the coarse aggregates (ie particle size 2.00 mm) showed them to consist of well rounded pebbles and flint fragments. 471 and 806 contained 1 or 2 brick/tile fragments. The finer aggregates were composed in the main of sub-angular quartz. The finer fractions were found to exhibit an orange/brown colouration, with the exception of 550, 810 and 820/1, which had a more pronounced dark brown colour. Also 504 and 619/0/3 showed a much greyer colouration which appeared to be due to powdered charcoal. As no coarse particles of charcoal were noted in these samples prior to analysis, this suggests a deliberate addition possibly for decorative purposes.

Aggregate-size analysis suggested four phases of building (see Table 1). With the exception of group D, all contained relatively high percentages of fine (ie < 0.13 mm) fraction. Such percentages would normally make the mortar/cement relatively ineffective in load bearing situations. However, several of the samples also exhibited a high percentage of calcium carbonate (ie lime in the original mix) and were thus most probably associated with plastering or other decorative treatment. As such systems are not load bearing the high percentage of $<$ 0.13 mm aggregate would not be detrimental. However, such an explanation cannot be afforded to those samples containing more 'normal' levels of carbonate. In these cases the high levels of fine material suggest poor preparation of the sands prior to use.

TABLE 1

GROUP	SAMPLE NUMBER	A.M.LAB NUMBER	SOLUBLE PERCENTAGE	APPROXIMATE MIX GRAVEL:SAND:LIME	USE?
A	455	8650669	26.1	2: 3 : 1	M/C
A	464	8650674	33.7	0.5:3.6 : 1	M
A	504	8650671	96.3	0:0.1 : 1	P
A	508/1	8650672	24.8	6: 3 : 1	C/M
A	806	8650675	40.0	1.3:1.5 : 1	M
B	619/0/3	8650673	98.1	0:0.1 : 1	P
C	471	8650670	60.3	0.1:0.5 : 1	P
C	810	8650677	81.9	0.3:0.2 : 1	P
C	820/1	8650678	63.5	0.1:0.4 : 1	P
D	550	8650676	14.0	4: 2 : 1	C/M

P: Plaster M: Mortar C: Concrete

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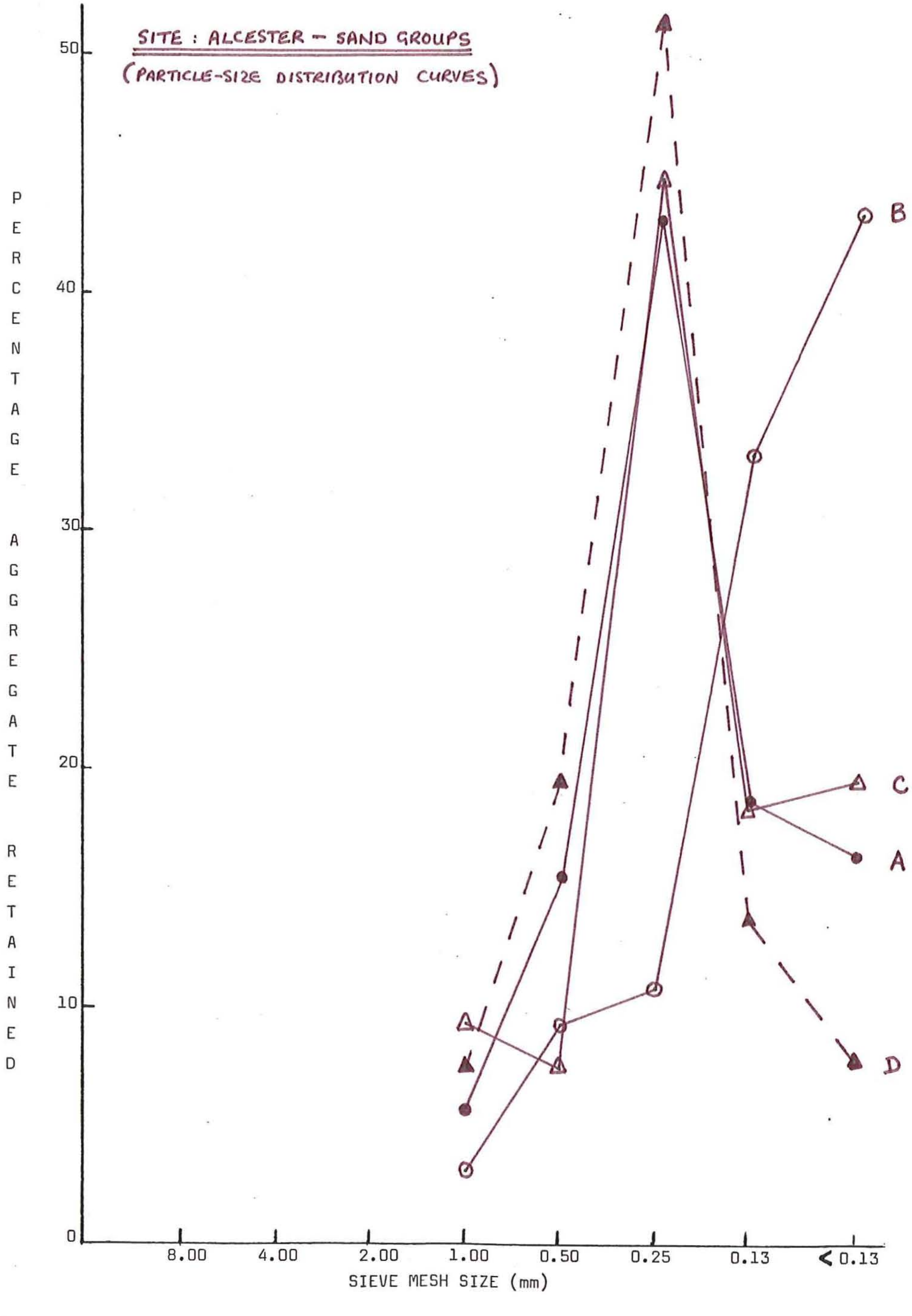
SITE : ALCESTER – SAND GROUPS
(PARTICLE-SIZE DISTRIBUTION CURVES)
PERCENTAGE AGGREGATE RETAINED
50
40
30
20
10
0
8.00
4.00
2.00
1.00
0.50
0.25
0.13
< 0.13
SIEVE MESH SIZE (mm)
A
B
C
D