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ANALYSIS OF MORTAR SAMPLES FROM THE OLD GRAMMAR SCHOOL, HULL, NORTH HUMBERSIDE.

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Summary

Analysis of mortar samples from the 17th century or later, Old Grammar School, Hull suggested five major phases of building.

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Potential Evidence

Investigation of cementitious materials cannot give any absolute dating information; it can give, however, useful relative dating data within a given structure. In principle it is assumed that, when building operations were commenced, sufficient supplies of aggregate, lime, etc were available from a common source. Hence, when mortars and concretes are examined, if there is a high degree of similarity in their constitution it is reasonable to assume a common constructional period. One problem that occasionally arises is the use of sieved aggregates. In such situations very similar results may be obtained for samples that are not contemporary. However, if a relatively large time period elapses between constructional features there is usually a detectable change in the nature of the aggregate.

It is possible, therefore, in conjunction with the excavational evidence, to decide which modifications to the parent structure are contemporary and hence outline the principle periods of building activity.

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 sieving the insoluble aggregate. The particle-size distribution can be diagnostic and may also help in recognising the geological source of the aggregate. Examination of the samples before and after analysis may provide information about the preparative practices of the builders ie whether the sand was sieved, washed, etc prior to use.

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

Analysis

Fifty samples were submitted for analysis. All samples were in good condition and showed little signs of leaching (ie loss of calcium salts). Their colours ranged from off-white to dark brown. Most samples contained small amounts (up to 5% of the observable area) of recarbonated lime fragments. These were most probably residues from the lime making process. Only sample R2(35k) contained "unusual" aggregate namely fragments of brick. No sample contained appreciable amounts of charcoal fragments suggesting that the lime had been produced in flare kilns.

The samples were initially dried at 110°C to a constant weight. Approximately 40g of dried material were treated with 4M hydrochloric acid to remove the acid soluble material, mainly calcium carbonate (the "lime" phase), 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 aggregate. All analyses were carried out in duplicate wherever possible. 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 and above) showed them to consist of sub-angular flints in the main accompanied by the occasional brick/tile fragment and small fragments of coal. The finer fractions were composed of sub-angular micaceous quartz sands. Samples from Groups G and H contained a high percentage of black fines, possibly crushed coal. The presence of such material would have been deliberate and most probably for decorative purposes.

Aggregate-size analysis suggested a series of building phases as summarised in the Table. Typical aggregate-size distribution curves are attached.

SITE	SAMPLE NUMBER	GROUP	MIX SAND : LIME
A	1, 3, 5, 7, 8	1	3.0 : 1.0
B	1, 5, 7, 8, 16	11	3.1 : 1.0
E	1, 2, 4, 6, 8	11	2.9 : 1.0
F	1, 2, 3, 4, 5	11	3.0 : 1.0
G	1(166), 1(98c), 2, 5, 6, 7, 8(54a), 8(35c), 9, 10	111	2.8 : 1.0
H	1, 2, 3, 4,	111	3.0 : 1.0
M	1, 7(30a), 7(386)	1V	2.7 : 1.0
N	1	V	3.1 : 1.0
P	1, 2, 3, 4, 5, 8, 9, 10	1V	2.8 : 1.0

Samples C2, D2, R2 and T1 gave no useful data.

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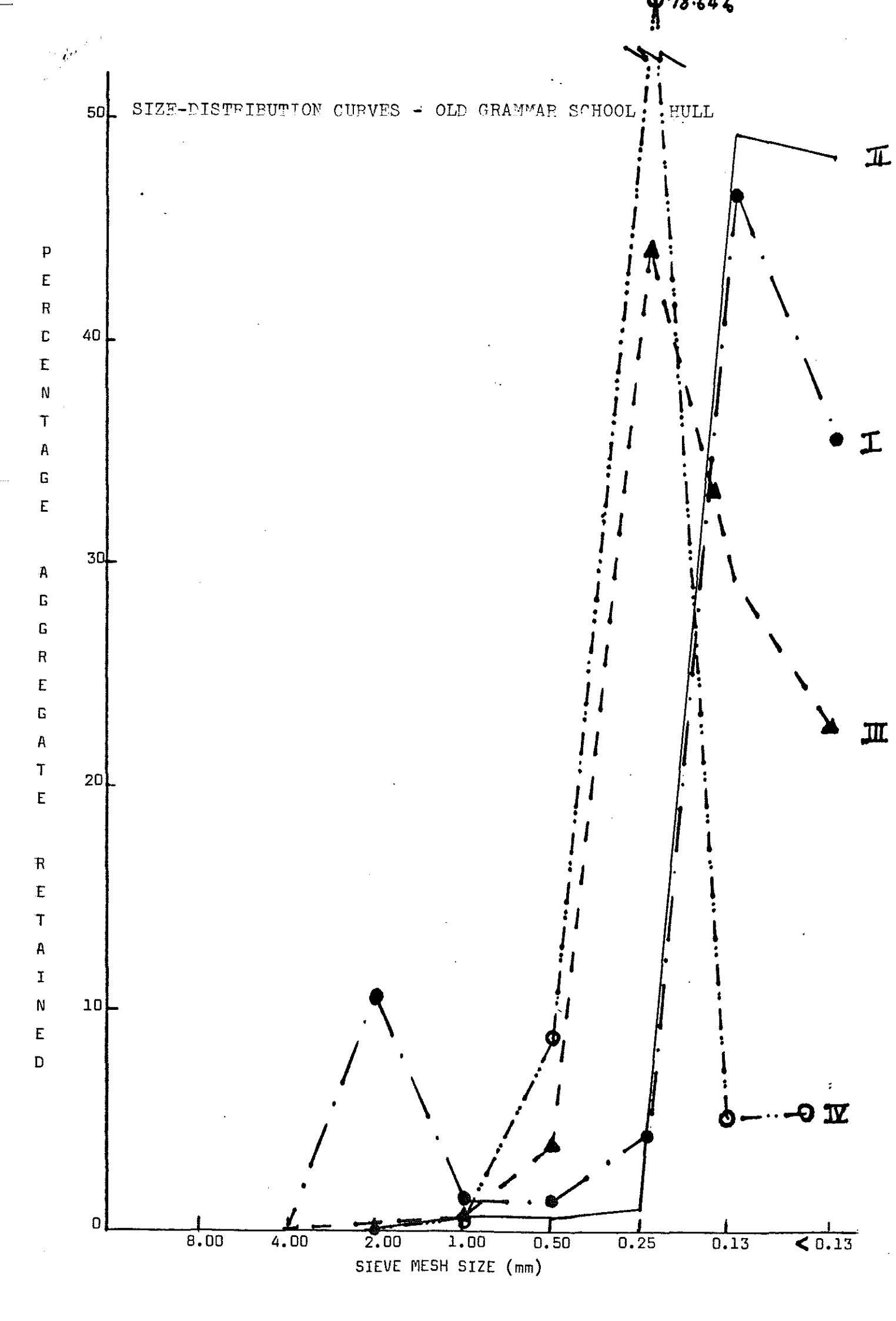
SIZE-DISTRIBUTION CURVES - OLD GRAMMAR SCHOOL, HULL
PERCENTAGE AGGREGATE RETAINED
50
40
30
20
10
0
8.00
4.00
2.00
1.00
0.50
0.25
0.13
< 0.13
SIEVE MESH SIZE (mm)
I
II
III
IV