

EVALUATION OF A PROPOSED
SAND BORROW SPECIFICATION
TO INCLUDE
THE PERCENTAGE PASSING THE 0.02 MM SIZE
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Final Report 90-4

Reporting On Work Plan 88-S-14

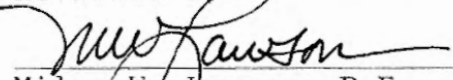
STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION

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ABSTRACT

The purpose of this report is to determine if the standard specification for Sand Borrow should be changed to limit the percent passing the 0.02 mm to three percent by weight. Gradation tests were performed on sixty samples of Sand Borrow taken in December, 1988 from sixty pits distributed throughout the State of Vermont. Based on the results of this study, the standard specification for Sand Borrow should not be changed.

INTRODUCTION

The purpose of this report is to evaluate a proposed change in the existing specification for Sand Borrow. Sand Borrow shall meet the following requirements, according to the existing specification:

<u>Sieve</u> <u>Designation</u>	<u>Percent by Weight Passing</u> <u>Square Mesh Sieves</u>
2 inches	100
1 1/2 inches	90-100
1/2 inch	70-100
No. 4	60-100
No. 100	0-20
No. 200	0-8

The proposed specification would limit the percent of particles finer than the 0.02 mm size to less than three percent by weight. Sieve and hydrometer analysis were performed on 60 Sand Borrow samples collected from pits throughout the state in December, 1988. The percent of samples which passed the existing

specification but failed the proposed specification was determined in order to evaluate if the proposed change was necessary.

LITERATURE REVIEW

In 1931 Casagrande implicated the significance of the percent of material finer than 0.02 mm on frost susceptibility. Casagrande observed no ice segregation in soils with less than 1.0 percent of grains finer than 0.02 mm; even when the ground water was as high as the frost line. According to Each, Mchatlie and Conner (1981), the best pavement performance occurs when the base and subbase layers contain less than three percent of material finer than 0.02 mm and less than six percent of particles finer than the No. 200 sieve. Conversely, poor performance may be expected when percentages exceed seven and eleven percent of particles finer than 0.02 mm and No. 200 sieve respectively. Vinson, Ahmad and Rieke (1986), indicated that to maintain good pavement performance, a maximum heave rate of 3 mm per day should be utilized. This maximum heave rate corresponds to a limit of 5.5 percent passing the 0.02 mm and to 6.7 percent passing the No. 200 sieve (0.074 mm). The limits of both studies are plotted on Figure 1 along with the data collected during this study.

MATERIALS AND PROCEDURE

Sixty samples of Sand Borrow were collected from sixty pits throughout the state. Sieve and hydrometer analysis were conducted on all samples in accordance with AASHTO T87 and AASHTO T88, respectively. Semi-log grain size distribution curves were constructed to obtain percent finer than the 0.02 mm grain size.

SUMMARY OF RESULTS AND DISCUSSION

The following table summarizes the sample results:

TABLE 1

	% Pass #200	% Pass 0.02mm	Ratio of % Passing 0.02mm/#200
Mean	9.3%	1.6%	0.19
Standard Deviation	7.9%	1.4%	-----
Total Range	2.3 - 45.7%	0.0 - 7.5%	0 - 0.49

The following observations were made from these results:

1. The percent of samples which exceeded three percent passing the 0.02 mm was found to equal 13%.
2. The percent of samples passing the existing specification for Sand Borrow but failed the proposed specification was found to equal two percent or one sample out of sixty.

Figure 1 presents the correlation between percent passing No.200 sieve and the percent passing the 0.02 mm. Of the sixty samples plotted in Figure 1, 14 samples are within the zone of poor performance, 24 samples fall within the zone of best performance with 22 samples located in the intermediate zone.

From Figure 2, eight samples failed the 0.02 mm criteria. Of these eight samples only one sample falls in the zone in which the sample passes the 1986 Specifications but failed the 0.02 mm criteria (zone "A"). The remaining seven samples fall in the "B" zone, in which the samples failed both the existing specification and the proposed specification.

The frequency distribution of the percent passing the 0.02 mm is shown in Figure 3. From this distribution, 87 percent of the samples had less than three percent passing the 0.02 mm. The frequency distribution for the percent passing the #200 sieve is shown in Figure 4. This distribution is skewed to the left with 87% of the samples having less than fifteen percent passing the No. 200 sieve.

From the ratio of percent passing the 0.02 mm to the percent passing the No. 200 sieve of 0.19 from Table 1, Sand Borrow can be expected to be frost susceptible if the percent passing the No. 200 sieve exceeds about sixteen percent ($3 / 0.19 = 15.8$).

CONCLUSIONS

1. Out of sixty Sand Borrow samples taken from sixty pits distributed throughout the State, only one sample passed the existing specification for Sand Borrow and failed the three percent passing the 0.02 mm criteria.
2. The average ratio of the percent passing the 0.02 mm to the percent passing the No. 200 sieve for Sand Borrow was found to be 0.19.
3. A Sand Borrow sample with more than approximately sixteen percent passing the No. 200 sieve can be expected to have more than three percent passing the 0.02 mm size.
4. A total of eighty-seven percent of the Sand Borrow samples tested contained less than three percent passing the 0.02 mm.
5. From the thirteen percent of samples which exceeded the 0.02 mm criteria, eleven percent of these samples failed the existing specification for Sand Borrow.

RECOMMENDATIONS

1. The 0.02 mm criteria should not be added to the existing specification for Sand Borrow.
2. Samples of Sand Borrow taken for construction quality control should be tested periodically each construction season to determine the percent passing the 0.02 mm size. This testing would provide a comparison with the results found in this study and provide data on sources not tested during this study.

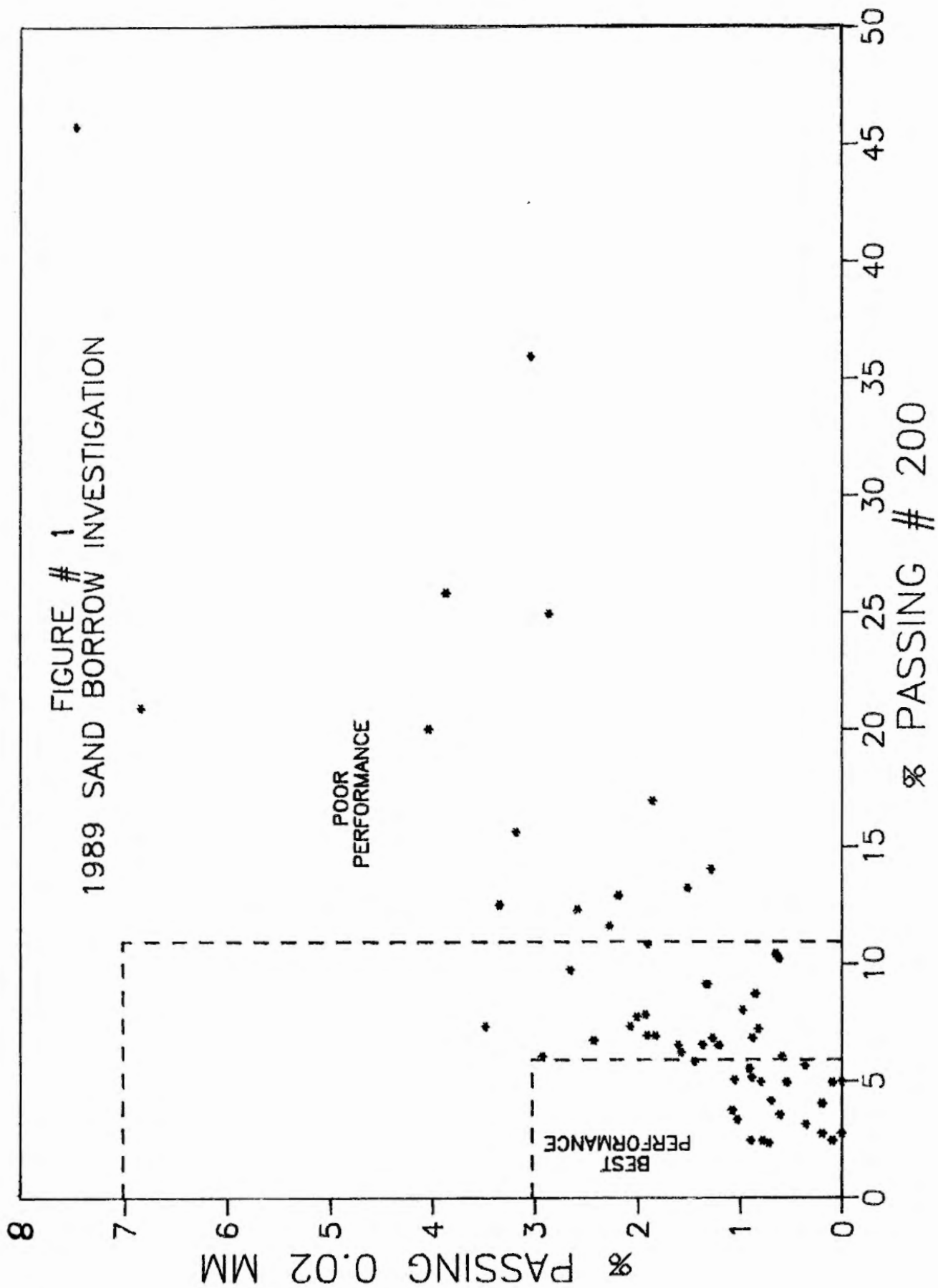


FIGURE # 1
 1989 SAND BORROW INVESTIGATION
 60 SAMPLES TAKEN IN 1989
 QUADRATE A PASSES 1986 SPEC. FAILS PROPOSED SPEC.
 QUADRATE B FAILS 1986 SPEC. FAILS PROPOSED SPEC.
 QUADRATE C GOOD MATERIAL PASSES BOTH SPEC.
 QUADRATE D FAILS 1986 SPEC. PASSES PROPOSED SPEC.

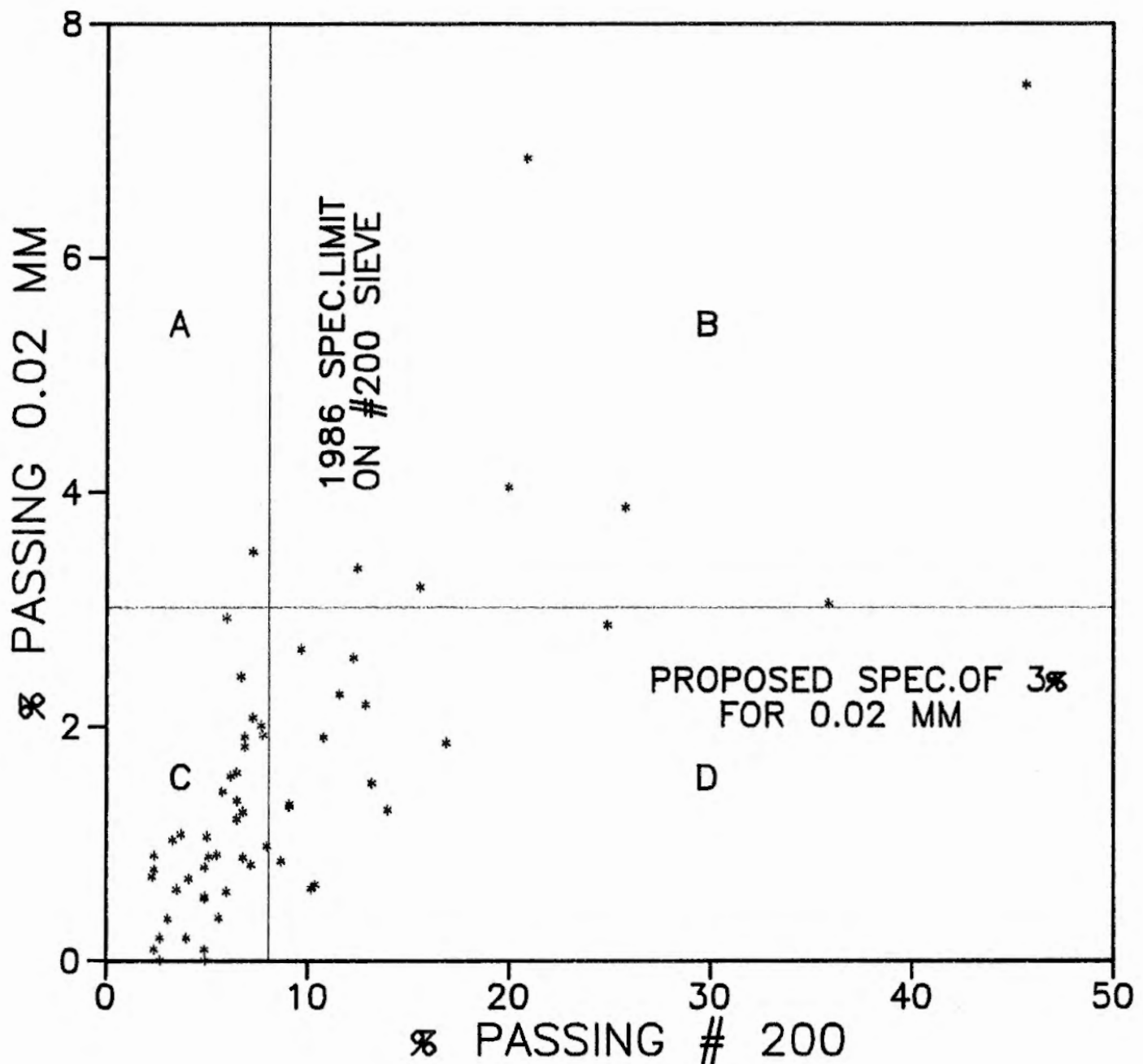


FIGURE # 3
 1989 SAND BORROW INVESTIGATION
 FREQUENCY DISTRIBUTION OF %
 PASSING 0.02 MM FOR 60 SAMPLES
 TAKEN IN 1989

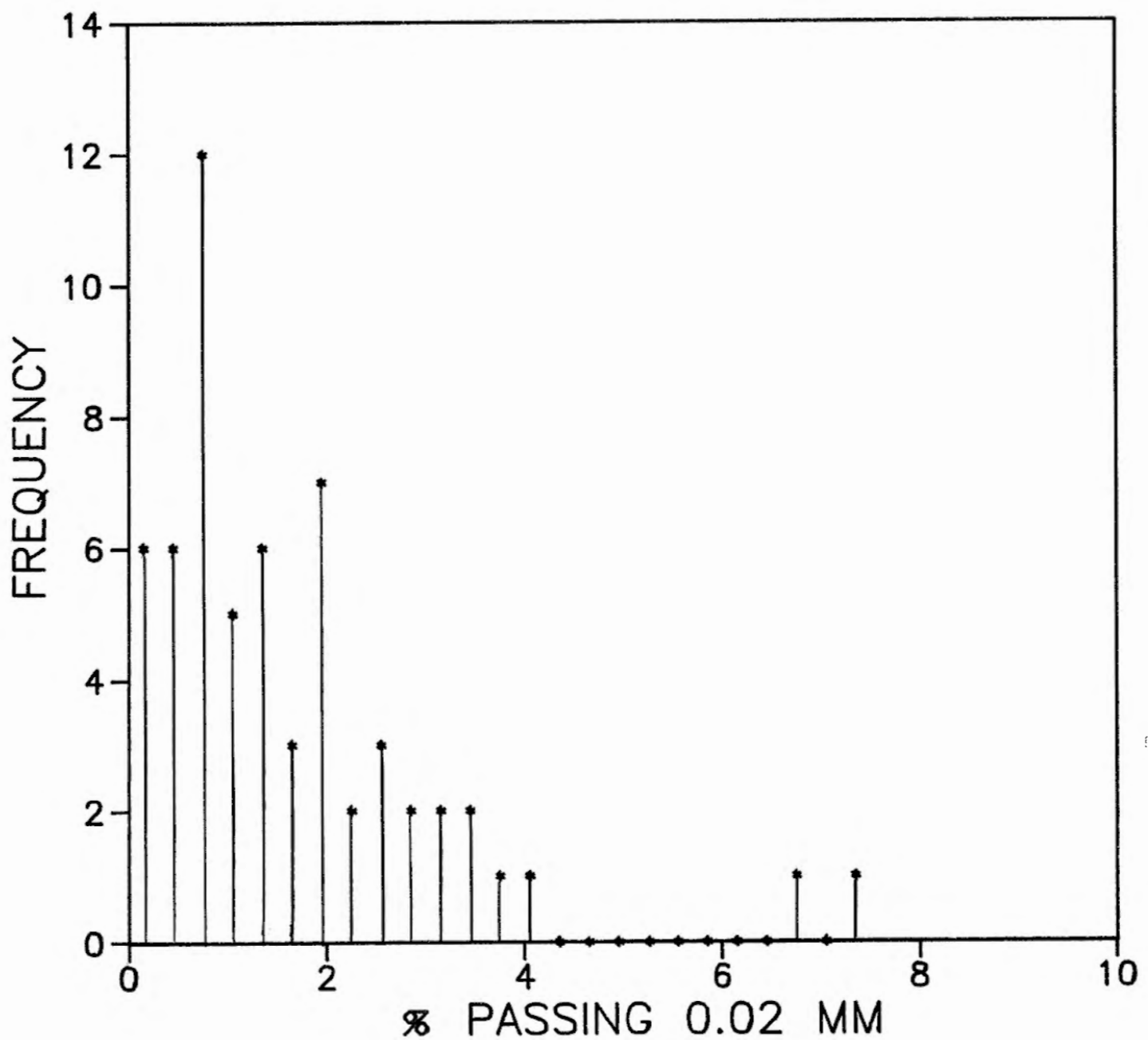
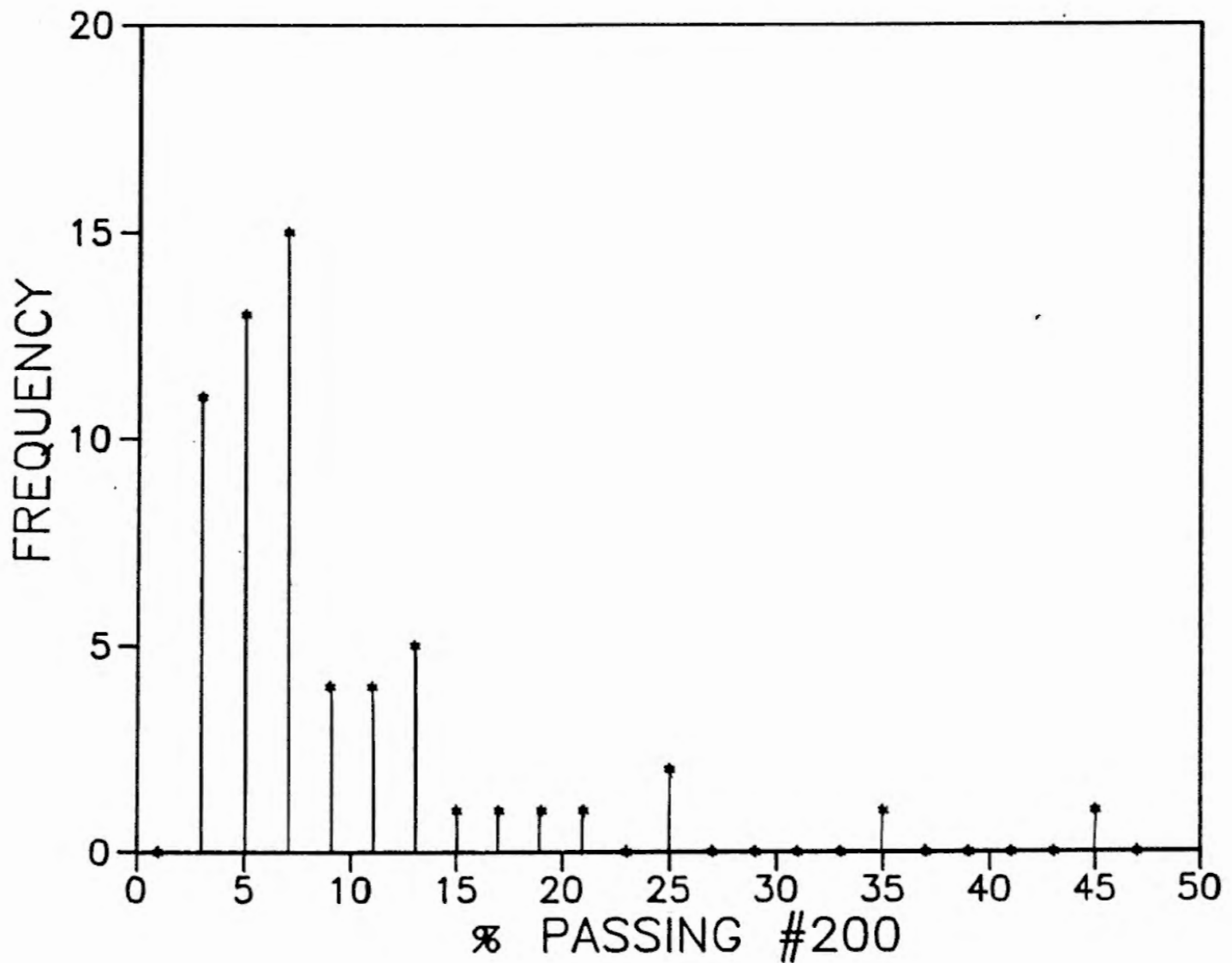


FIGURE # 4
1989 SAND BORROW INVESTIGATION
FREQUENCY DISTRIBUTION OF %
PASSING #200 SIEVE FOR 60
SAMPLES TAKEN IN 1989



References

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- Esch, D., McHattie, R. and Conner, B., "Frost Susceptibility Ratings And Pavement Structure Performance", in Frost Action And Risk Assessment In Soil Mechanics, Transportation Research Record 809, p. 27-34, 1981.
- Vinson, T., Ahmad, F. and Rieke, R., "Factors Important To The Development Of Frost Heave Susceptibility Criteria For Coarse-Grained Soils", 65th Annual Meeting of the Transportation Research Board, Washington, D.C., 28 p., 1986.
- McBean, A., Research Investigation 87-5, Vermont Agency of Transportation Research Report, 1987.

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISIONRESEARCH INVESTIGATIONWork Plan No. 88-S-14Subject PROPOSED CHANGE IN SAND BORROW SPECIFICATIONInvestigation Requested By GBA, AJM Date 11-7-88Date Information Required SPRING, 1989Purpose of Investigation TO DETERMINE IF SAND BORROW SPECIFICATIONS
SHOULD INCLUDE A MAXIMUM OF 3% FINER THAN
0.02 MM SIZE

Proposed Tests or Evaluation Procedure

- 1) Compile a list of sand borrow sources used in
the 1986, 1987 and 1988 construction season
- 2) Map the sources and determine which sources
will be sampled, based on geologic history
- 3) Sample sources
- 4) Run gradation, ^{SPECIFIC GRAVITY} and hydrometer tests to determine
% finer than 0.02 mm.
- 5) Compare these results with existing specs.
- 6) Write report

Proposal Discussed With GBA, AJM, DCB Projected Manpower Requirements ± 40 man-daysInvestigation To Be Conducted By Soils & Foundations SectionProposed Starting Date 11-28-88 Estimated Completion Date 3-1-89

Approval/Disapproval by Materials & Research Engineer

Comments by Materials & Research Engineer

Materials & Research Division
Agency of Transportation
Date Typed: