

OFFICE MEMORANDUM

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MICHIGAN

DEPARTMENT OF STATE HIGHWAYS

September 15, 1973

To: R. C. Mainfort, Supervising Engineer
Soils and Aggregates Unit

From: J. H. DeFoe

Subject: Feasibility of Open Hearth Slag for Bases
Research Project 68 E-43, Research Report No. R-884.

The purpose of this memorandum is to present a summary of the findings of Research Project 68 E-43, Feasibility of Open Hearth Slag for Bases, including final condition observations of the Dearborn St test section. Project reports which have been published include:

1. Evaluation of Open Hearth Slag as a Highway Base Material, May 1970, Research Report No. R-739.
2. Further Evaluation of Open Hearth Slag as a Highway Base Material, July 1971, Research Report No. R-769.
3. Field Evaluation of Acid-Treated Open Hearth Slag Base Course, June 1972, Research Report No. R-817.

In October 1968 the Research Laboratory began this project for the purpose of determining the feasibility of continuing the use of open hearth and basic-oxygen furnace steel slags for base and subbase aggregates. The project was initiated after extensive heaving had been observed in slag-base medians constructed on the Fisher Freeway (I 75) in Detroit. Figure 1 shows a distressed area as observed in 1968 as well as the present condition of the same area.

Results of laboratory tests and field evaluation measurements were reported in May 1970 and July 1971 and can be summarized as follows:

1. Open hearth slag is subject to volume change due to chemical action and is more susceptible to frost heaving than 22A aggregate.
2. Acid treatment of the slag, proposed as a corrective measure by the producers, does not alleviate volume change caused by chemical action and appears to increase susceptibility to frost action.
3. Open hearth slag is variable in composition and inspection control is difficult under present conditions.

Although these laboratory and preliminary field tests indicate that the acid treatment does not benefit the slag to an appreciable degree, and might even be detrimental from a frost susceptibility standpoint, it was felt that sufficient field testing had not been performed to fully evaluate the acid-treated slag. At the request of M. N. Clyde, Testing and Research Engineer, a significantly large test section was constructed during October of 1971 in which an acid-treated slag base was compared with a base of standard construction using a modified 22A aggregate.

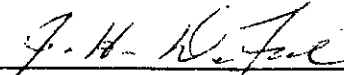
The test areas were located in and around a traffic island located at the interchange of I 75 and Dearborn St in Detroit. This site originally contained open hearth slag that had experienced severe distress and required reconstruction. Reference elevation points were carefully located and measured at the conclusion of construction so any horizontal or vertical movement of the control and slag sections could be measured periodically. Preliminary test results and field measurements were reported in June 1972.

Both volume change (at room temperature in the presence of moisture) and frost susceptibility tests were performed in the laboratory on samples of the slag and natural aggregates used in the Dearborn St test sections. Results of these tests indicate greater volume change for slag samples in both tests. The data, however, show changes in the volume of the slag samples to be much less than similar test values obtained from previous studies. In fact, slag expansion in this study, using newly produced acid-treated slag, was no greater than the values obtained with aged slag in the earlier studies. Because past laboratory tests have shown no improvement due to acid treatment the reduced volume change found in this study might be due to the use of aged slag which was present in the stockpile along with freshly produced slag. Field measurements also show, however, that volume change in the slag test area is greater than that in the natural aggregate section (a 22A material containing 10 percent loss-by-washing) and that this condition is duplicated by laboratory tests. Although there has been no severe heaving of the slag area as was found in some previous construction, the slag based portion of the test section has experienced greater elevation changes than those areas having a natural aggregate base. Average elevation changes over the duration of the evaluation are shown in Figure 2 for both aggregates. The present condition of the Dearborn St test section is illustrated in the photos of Figure 3 along with the condition prior to and just after reconstruction for comparison.

Performance of the Dearborn St test section along with the associated laboratory test results could provide the basis for acceptance testing of steel slags should the demand for such materials dictate. If the performance of the test area could be tolerated as a limiting condition then stockpiled slag could be sampled and tested for acceptance levels of volume change and

frost susceptibility using laboratory test results obtained in this study to set acceptance limits.

TESTING AND RESEARCH DIVISION



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JHD:bf



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Condition of median in 1969, two years after construction.

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Condition of the same section of median in 1973, six years after construction.



Figure 1. Distressed section of open hearth slag based median along the Fisher Freeway, I 75, Detroit.

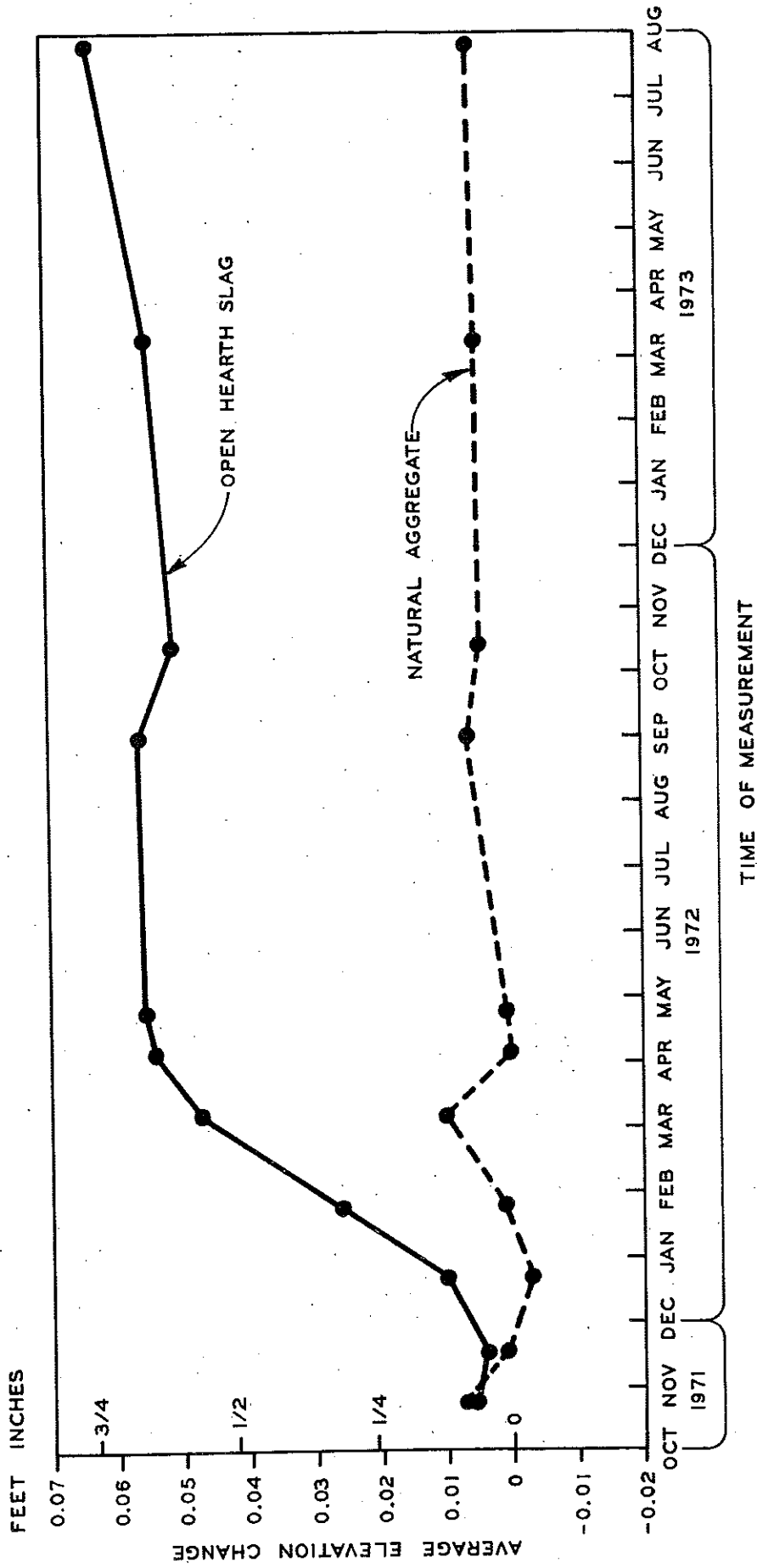
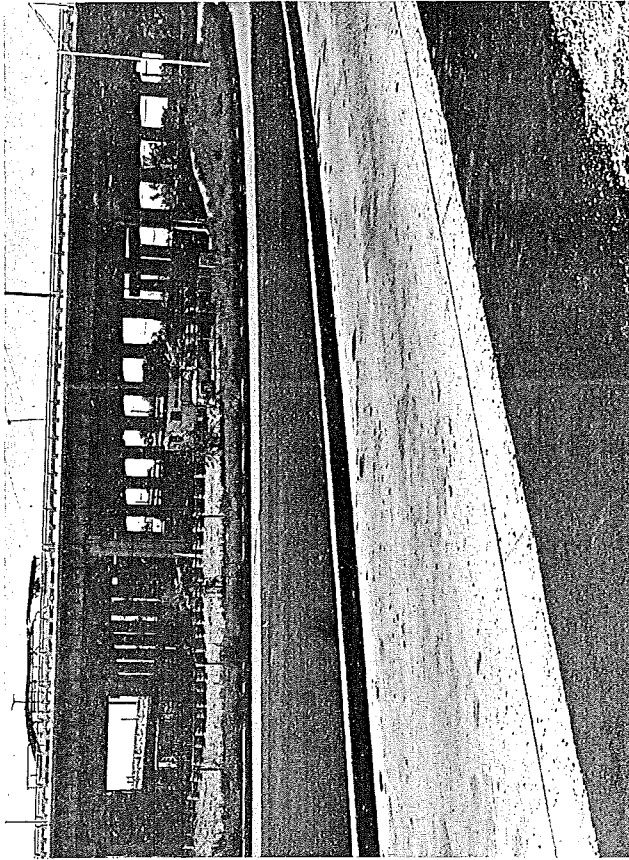


Figure 2. Elevation change of Dearborn St. test sections.

Condition of test section in 1969, two years after construction.

Test section immediately after reconstruction, 1971.



Reconstructed section after two years of service, 1973.

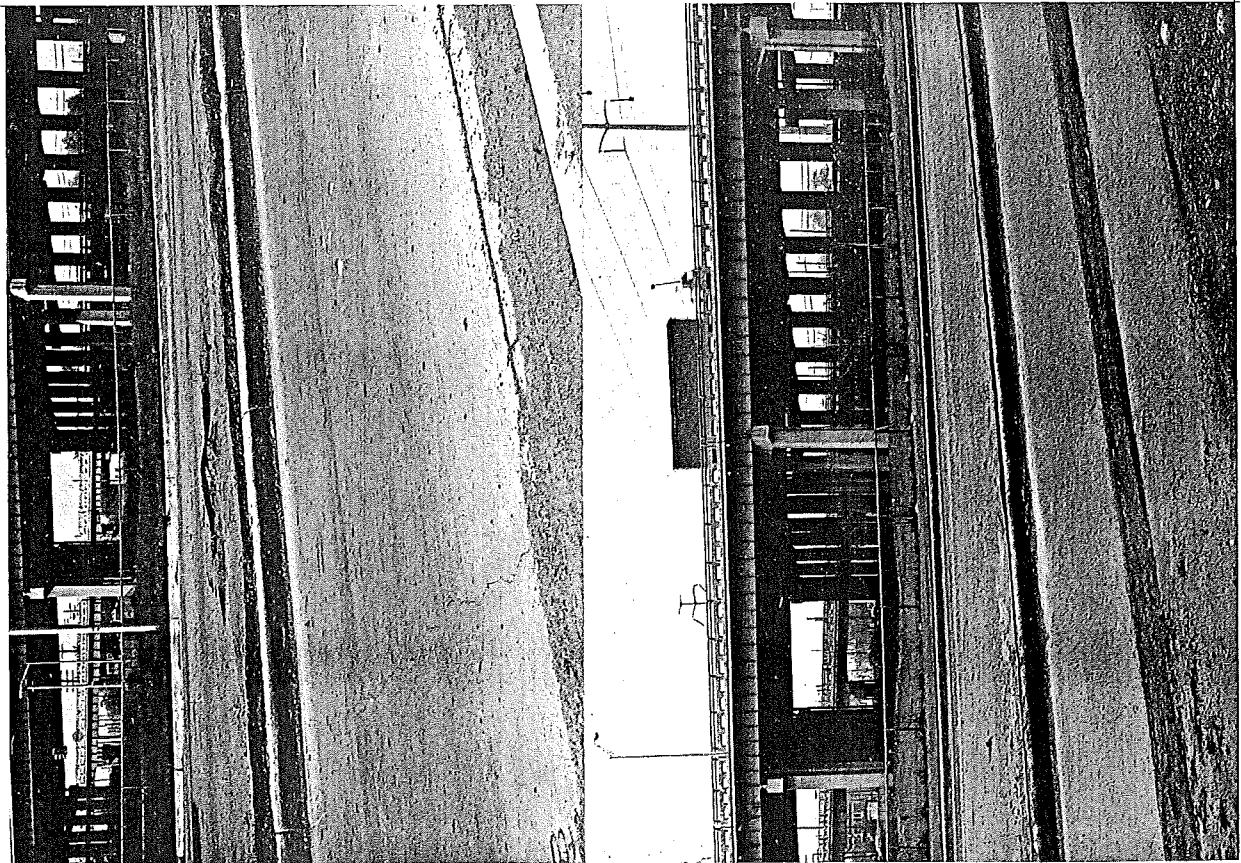


Figure 3. Condition of the Dearborn St test section.