In House Research

NDOR Research Section

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Evaluation of Premature PCCP Deterioration in Nebraska Phase I

Nebraska Department of Roads

Research Project Title:
Evaluation of Premature Portland Cement Concrete (PCCP) Deterioration in Nebraska

Research Project Number:

Starting Date: 06/08/2003

Completion Date: 09/30/2003

Principle Investigators:

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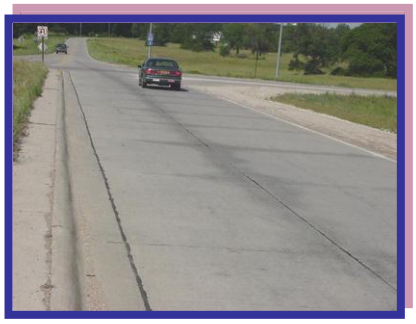

US-77 Van Dorn Street

Purpose of the Research Project:

Portland Cement Concrete (PCC) pavements are inherently durable and are expected to be relatively maintenance free during many years of service. Unfortunately, a number of pavement distresses can occur as a result of the interaction between the concrete and the environment in which it serve.

The Nebraska Department of Roads on District 1 has been experiencing premature distresses on some of its concrete pavement. In June of 2003, the Nebraska Department of Roads initiated the Research Project of Early Deterioration Pavement. The research project was focused on four locations US-136 Auburn, Nebraska, US-77 W. Rose Lincoln Bypass, 27 Street Interchange and 24th Street to 34th Street Lincoln, Nebraska.

Description of Project:

The investigation included: visual examination and distress survey of the cracked areas, extraction of cores for field and laboratory evaluation, and documentation of the distresses and fieldwork.

Objectives:
The primary objectives of this study were:

1. To identify and confirm the causes of the premature deterioration cracking observed at different locations in District 1.

2. To develop strategies to prevent recurrence of the problems

Tasks:

To accomplish the objectives of this investigation, the research project consists of these following tasks:

- Task 1: Visual inspection on US-136 Auburn, Nebraska, US-77 W. Rose Lincoln Bypass, 27 Street Interchange and 24th Street to 34th Street Lincoln, Nebraska to identify the possible causes of the premature deterioration in concrete pavement in NDOR District 1.

- Task 2: Conduct field and laboratory investigations of the sites to confirm the causes for the premature deterioration. The field investigation consists in the extraction of cores by station and lay out of the project for visual evaluation of the cracks. The laboratory evaluation consists in the evaluation of air void analysis on cores extracted in different location of the slab middle and adjacent to the joints. As well as, petrography examination for a positive identification of the distress in the concrete.

- Task 3: Analysis of the acquired data from the field investigation and analysis of the acquired data from the laboratory evaluation. As well as, analysis of the historical data from the mix matrix of the four projects.

- Task 4: Develop strategies to prevent this premature deterioration in concrete pavement.

- Task 5: Prepare final report to document the entire research project with conclusions and recommendations, which is in progress.

HYW 2

27th & I-80 Interchange

Summary of Conclusions:

The objectives of this project were to find the cause of the premature Portland Cement Concrete Pavement deterioration in Nebraska.

The analysis of the acquired data from the field investigation and analysis of the acquired data from the laboratory were evaluated and the major conclusions that can be drawn from this project are:

- The use of 47B Nebraska concrete pavement mix design with Class C fly ash as cementitious materials was a common denominator within concrete pavement mix.

- In general the visual inspection noted some part of the coarse aggregate shown some cracks from top to bottom, it was due to the used of coarse aggregate source that has 3% absorption, which attributed to the deterioration of the pavement. This was observed only in one of the four projects. The common observation was cracks surrounded the aggregate propagate through the paste.

- It was observed large entrapped air voids, low entrained air, as well as, segregation on some of the projects that allows to the conclusion that there were problems due to construction.

- From the results of the field survey and the compile data, it was concluded that the observed cracking was due for the low impermeable mix. As well as, ASR was found presence in gel deposits in or adjacent to the aggregate particles, reaction rims in the particles, and micro cracks that extend from these particles into the surrounding cement paste matrix of the concrete.

- It is important to notice that in the investigation was found problems with ASR and freeze and thaw. However, it was exhibit ASR in one of the core from Van Dour. This exhibit deterioration was present because when you have all ready micro-cracks on the paste with a dry mix. These micro-cracks allow water into the paste and potential alkali reaction will be present in the pavement.

- All concrete pavements investigate presented low air entrained and large entrapped air voids.

- Because of the consistency of low air in the projects investigated, it was evaluated air content at two project sites during construction. It was found that the total air content measure in the field with concrete been in plastic stage correlate with the results in the hardened concrete linear transverse analysis results. However, it was noticed that when analyzing air entrained only in the specimen was found 4% loss due to construction.

Recommendations for Future Research

- Visual and experimental investigation with pavement in Nebraska that not present deterioration
- Examine the percentage of Air content loss in concrete mixes in more detail.