CENTER FOR TRANSPORTATION INFRASTRUCTURE SYSTEMS
THE UNIVERSITY OF TEXAS AT EL PASO

Project Summary Report 1826-S
Project 0-1826: Evaluation of Environmental Conditioning System For
Predicting Moisture Damage Susceptibility of HMAC

Author(s): Vivek Tandon, PE, and Soheil Nazarian, PE

PROJECT SUMMARY REPORT

Evaluation of Environmental Conditioning System for Predicting Moisture Damage Susceptibility of HMAC

The existing laboratory tests have not been able to consistently identify the moisture susceptibility of AC mixtures. The most commonly reported drawbacks are a lack of quantitative pass/fail criteria and/or a lack of simulation of field conditions. The Environmental Conditioning System (ECS) was developed in the early 1990s to address the shortcomings of then-available methods. Advantages of the ECS system over the existing methods are that the traffic condition can be simulated, and the temperature can be controlled over a wide range to simulate the climatic condition of a given region.

The ECS system consists of the following

components:

- a fluid conditioning subsystem to maintain the saturation of the specimen,
- an environmental conditioning subsystem to maintain a desired temperature, and
- a loading subsystem to simulate traffic condition by applying a repeated loading on the specimen.

The material is considered moisture susceptible if after conditioning the circumference of the specimen increases by more than 2% or the resilient modulus of the specimen decreases by more than 20%.

What We Did…

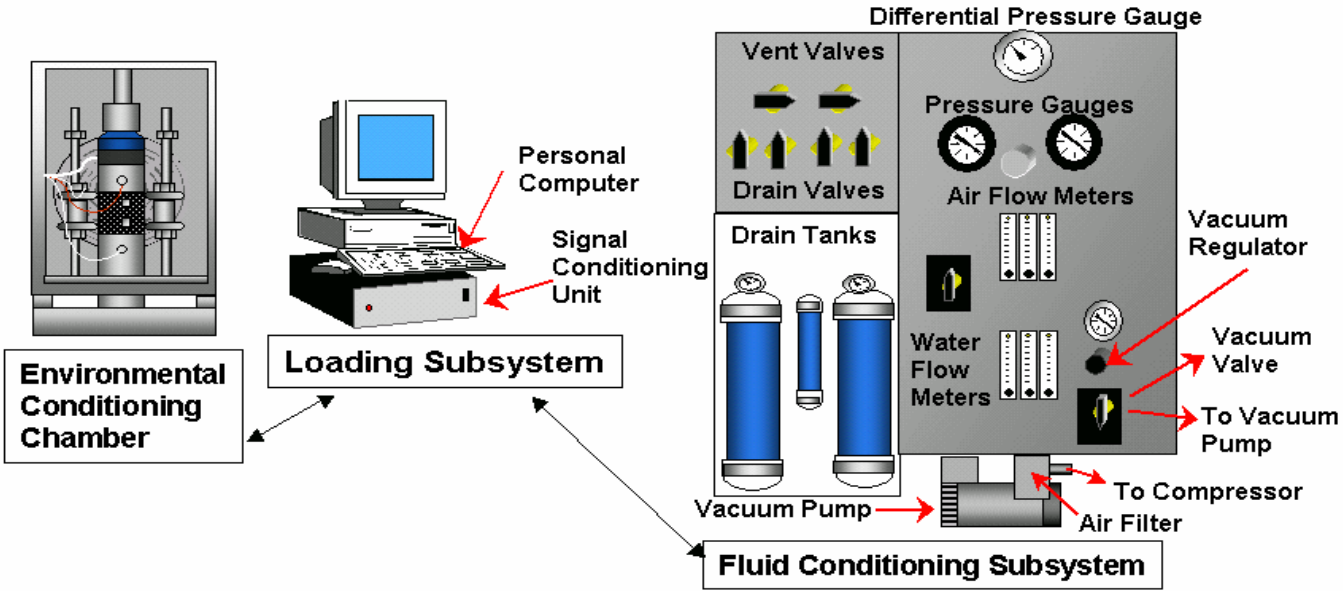
UTEP modified the original test protocol advocated by the Strategic Highway Research Program under TxDOT Research Project 0-1455. In this project, the new protocol was validated and the test procedure was further optimized. The general tasks associated with this research project, aside from technology transfer, were to:

1. validate the modified ECS test protocol,
2. accelerate the ECS test protocol, and
3. improve the ruggedness of the conditioning system.

What We Found …

Three unidentified AC mixes in three batches were sent to UTEP for validation purposes. To eliminate the chances of identifying the performance from raw materials, the binders, additives and aggregates were mixed before shipping to UTEP. After the appropriate tests were carried out, the results were reported to TxDOT for comparison. The predicted behavior from the modified ECS procedure and the anticipated field performances, in some cases, did not match. A post-mortem study was carried out to further investigate the causes of such discrepancy.

Raw aggregates and asphalt similar to those used in the blind study were shipped to UTEP. Triplicate specimens were prepared for each mixture according to the job mix formula provided using the suggested protocol. Each specimen was then subjected to the modified ECS tests to determine the applicability of the protocols. The protocol could successfully



predict the behavior expected from the mixtures in all cases.

The issue of differences in preparing specimens was then studied. The gradation and asphalt content of several specimens pre-mixed by TxDOT were determined. The overall gradation and asphalt content were quite consistent, demonstrating the care taken to provide a high-quality mixture. However, the gradations from most specimens did not follow the specified gradation.

This validation study indicates one of the limitations of any moisture susceptibility laboratory test that relies on mechanical properties. Since the modulus or strength of a material is dependent on parameters such as the gradation, AC content and air void content, any deviation from the job mix formula during construction or laboratory testing may favorably or unfavorably impact the moisture susceptibility of the mixture.

By rapidly reducing the temperature of the conditioning chamber to 60°F immediately after the completion of conditioning step, and several other simple timesaving steps, the testing period was reduced from 5 days to 2 days.

To improve the reliability and the long-term stability, the conditioning components of the ECS system were simplified and redesigned.

The Researchers Recommend …

The deliverables of this project are the following items:

- New guidelines and specifications for evaluating the moisture susceptibility of asphalt concrete mixtures in the laboratory.
- A test setup similar to the one developed at UTEP so that TxDOT can immediately implement the findings of this project to evaluate the usefulness and weakness of the test setup as a practical method.
- In our opinion, improvements are needed in the following areas before full implementation:
  - The impact of variation from the job mix formula on evaluating the moisture susceptibility of AC mixtures should be studied.
  - The pass/fail criteria should be fine-tuned by testing a variety of mixtures.
  - The protocol is not applicable to mixtures made with binders containing additives. This aspect of the methodology requires significant effort.

For More Details…

The research is documented in Report
1826-1F "*Modified Environmental Conditioning System: Validation and Optimization" (October 2001).*

Research Supervisor: *Vivek Tandon, P.E., The University of Texas at El Paso, vivek@utep.edu , (915) 747-6924*

TxDOT Project Director: *Ken Fults, P.E., Retired*

To obtain copies of the report, contact Laura Cocke, Center for Transportation Infrastructure Systems, (915) 747-6925, or email http://ctis@utep.edu. See our catalog on-line at http://cits.utep.edu

TxDOT Implementation Status
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Implementation of Project 0-1826 will be delayed until further validation of the testing protocol can be done. The uncertainty of the prediction capabilities of this test procedure requires further study. This new study will test several asphalt mixes representing the type of mixes used in Texas to evaluate the prediction capability of the new test procedure.
Contact: Dr. German Claros, P.E., Research and Technology Implementation Office (512) 467-3881, gclaros@dot.state.tx.us.

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