RESEARCH
Research Notes
Oregon Department of Transportation

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Measuring the Strain of the Road

The Oregon Department of Transportation (ODOT) recently reconstructed a section of Interstate 5 between Salem and Albany. In 2003, the northbound lanes were reconstructed with Portland Cement Concrete Pavement (PCCP). In 2005, the southbound lanes were reconstructed with Hot Mix Asphalt Concrete (HMAC). The initial pavement design for the southbound lanes followed normal ODOT design procedures. The original design called for 12 inches of HMAC to be placed over a rubbilized PCCP base; in some sections HMAC was placed over an aggregate base.

Overlooking the instrumentation site in the southbound lane of I-5 at milepost 239

Dr. James Lundy, of Oregon State University (OSU), recognized that the project might meet the criteria for using a perpetual pavement. OSU performed a mechanistic-empirical analysis of the fatigue resistance of the existing pavement structure. Various assumptions were made and the resulting design tensile strain was determined appropriate for construction.

To verify the assumptions made in the mechanistic-empirical analysis, 24 strain gages and 4 temperature sensors were placed in the asphalt pavement to gather data.

Study Objectives

This study will monitor the pavement structure to investigate if the assumptions used in a mechanistic-empirical design analysis are valid, or if adjustments are needed. The study will be assessing the reaction of the pavement structure to traffic loading; in particular, evaluating if the pavement structure is experiencing the stresses and strains assumed in the design process. Also, modulus testing of the pavement structure and the materials used for construction may provide a better foundation for future mechanistic-empirical designs.

Instrumentation Installation

Using NCAT report 04-01, "*Design and Instrumentation of the Structural Pavement Experiment at the NCAT Test Track*" as an installation guide, the strain gages and temperature sensors were installed in the pavement. A matrix of 12 strain gages was installed over the rubbilized PCC base, and a second matrix of 12 strain gages was installed over an aggregate base. The four temperature sensors were installed at depths of 2, 4, 6 and 8 inches. The layout for each set of strain gages was six longitudinal and six transverse, as seen in the following image. All of the strain gages were tested before and after installation to ensure proper data

collection. A weigh-in-motion site (two piezos and a loop) was also installed to record vehicle weights while the strain gages are collecting data.

Strain gage layout over the rubbilized concrete base

Strain Gage Details

The strain gages used for this project were, Asphalt Strain Gage ASG-152 from Constuction Technology Laboratories. The lead-in wires connected to the gages were prepared for installation by adding a protective nylon sheath to the first 12 feet to protect it from temperature and abrasion.

Strain gage with protective nylon sheath installed on the first 12 ft of the lead-in wire

Each gage was placed on a mastic mix consisting of a mixture of CSS-1 and aggregate passing the No. 10 sieve. This was done to prevent damage from the base rock and to hold the gage in the proper orientation during paving. Approximately 2 inches of HMAC was placed over and around each gage. Light compaction was performed by hand using a 1 ft sq. tamping plate. For the rubbilized concrete base, additional material was placed around the gages and a light rolling was performed prior to the paver passing over them. For the aggregate base, the trench was filled with asphalt and rolled.

Strain gage on build-up of mastic mix over the rubbilized concrete base

Placement of asphalt over the strain gages with light compaction to minimize gage movement during the paving

Completing the trench fill of asphalt over the strain gages on the aggregate base

Additional asphalt being placed over the gages prior to paving over the rubbilized concrete base

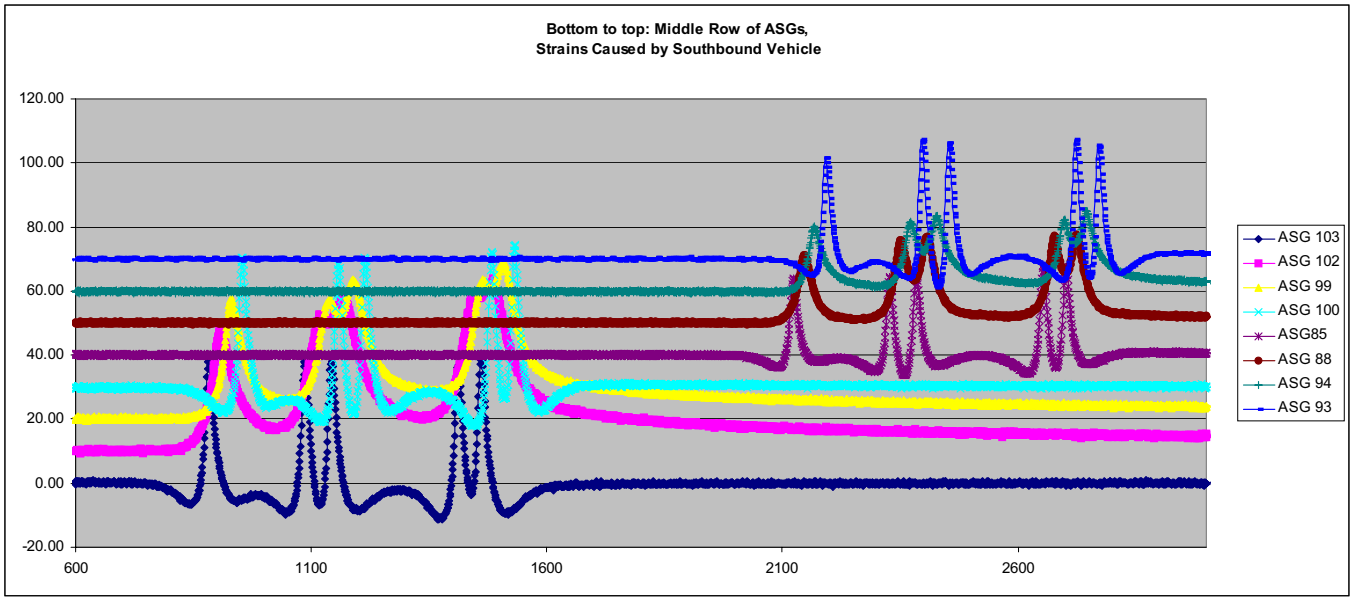
Placement of asphalt over the strain gages to minimize movement during paving over the rubbilized concrete base

Initial compaction of the asphalt over the strain gages prior to paving over the rubbilized concrete base

After the first lift of asphalt over the rubbilized concrete base. Notice that vibratory rollers were not used over the gages.

Testing

The strain gages were tested after all of the construction was completed. The following is a plot of a typical log truck, developed from the initial testing of the gages.



Implementation

Results from this study will be used to fine-tune future mechanistic-empirical pavement designs. Currently, the majority of assumptions used in the design process have not been validated.

For more information about this project, contact Norris Shippen at 503-986-3538, or via e-mail at *Norris.Shippen@odot.state.or.us*

Oregon Department of Transportation

Research Unit
200 Hawthorne Ave. SE, Suite B-240
Salem, OR 97301-5192

Telephone: 503-986-2700
FAX: 503-986-2844

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