TEXAS TECH UNIVERSITY
Multidisciplinary Research *in* Transportation™

PROJECT SUMMARY

Texas Department of Transportation

0-6826: Research on Joint Sealant Materials to Improve Installation and Performance

Background

Infiltration of water into joints can cause corrosion of dowels and tie bars, as well as deterioration in the layers under the concrete slab. To prevent water and incompressible materials from entering joints, joints with proper layout are sawed and sealants are provided. To improve the performance of Portland cement concrete (PCC) pavement, it is important to keep the joint seals in a good condition so that water and incompressible materials cannot get into joints. There are three elements associated with joint seal performance: (1) proper joint design, (2) quality of joint seal materials, and (3) proper installations. Currently, joint design is dictated in the joint design standards, JS-14. Joint seal material quality is controlled by DMS-6310. Joint sealant installation is governed by Item 438. There are discrepancies between TxDOT requirements and actual practice, potentially compromising the effectiveness of joint performance. The discrepancies need to be identified and design standards or specifications revised, or field practices need to be modified.

What the Researchers Did

Researchers evaluated field performance of joint sealants in CPCD and CRCP. The sections selected encompass a variety of environmental conditions (wet-freeze, wet-no freeze, dry-freeze, and dry-no freeze), pavement ages, base types, and shoulder types. Joint types evaluated included all types of joints (transverse contraction joint, longitudinal warping joint, longitudinal or transverse construction joint, and bridge terminal joint), and the performance items of the sealant included adhesion failure, cohesion failure, evidence of pumping, joint faulting, and torn or missing sealant, as well as the amount of incompressible materials at joints. Researchers also contacted joint seal subcontractors to obtain their opinions on joint seal operations. Failure modes of joint seals and their effect on concrete pavement performance were also investigated. Researchers also evaluated field operations of joint sealant installations. The investigation items included joint geometry, cleaning operations, locations of backer rod, and shape factor of joint sealant. In addition, researchers installed gages at transverse contraction joints in two projects to evaluate joint movements as well as the effects of continued drying shrinkage of concrete on joint width increase. Researchers developed training materials for joint sealant installations.

What They Found

The findings from the extensive field evaluations and data analysis can be summarized as follows:

- It appears that the joint sealant performance period is much shorter than pavement design period, which is 30 years. On average, joint sealant performance period is less than 10 years. However, almost no re-sealing is done.

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Project Completed:
1-31-2016

- It is quite rare to observe pavement distresses that can be attributable to poor joint sealant condition. More specifically, there were test sections built with and without sealing so that the effects of sealing and no sealing can be evaluated. From a practical standpoint, there was no difference in pavement performance between the two sections.
- There is a discrepancy between TxDOT requirements and field operations, as follows:

  a. TxDOT Design Standards JS-94 or JS-14 do not require backer rod at longitudinal sawed contraction joint or longitudinal/transverse construction joints. However, joint seal subcontractors always installed backer rod in those joints without exception. They cited avoiding 3-face contact between sealant and concrete surfaces as a primary reason for installing backer rod.

  b. Different cleaning methods were used. TxDOT Spec Item 438 specifies the use of "approved method" for cleaning the joints, without specifying what the "approved method" is.

  c. TxDOT JS-14 allows only silicone material for joint sealant in concrete pavement. However, hot pour materials are routinely used for joint sealant in concrete pavement.
- Joint movements measured by gages installed indicate the following:

  a. Drying shrinkage of concrete increases joint width by 0.05-in within 10 weeks after construction.

  b. Total annual joint movements are in the range of about 0.025-in, which is equivalent to 0.069 in/in strain in the sealant material. Current TxDOT DMS-6310 requires 150 % extension at 24 hours, which is equivalent to 1.5 in/in strain. Accordingly, the current TxDOT requirement for extension of joint sealant material is more than adequate.

  c. Since the annual joint movements are quite small, in the range of 0.025-in, joint width at transverse contraction joints could be small. The current 0.375-in width is unnecessarily large, resulting in poor ride and space for incompressible materials.

  d. The effect of aging of sealant materials on long-term performance needs to be further investigated.
- Review of Item 438 revealed that there are areas that might need to be improved

What This Means

It appears that the condition of joint sealant does not have substantial effects on overall performance of PCC pavement in Texas. This finding is in line with the findings in several state DOTs, such as Wisconsin and Minnesota. However, joint sealing has its own merit, such as keeping incompressible materials out of the joints. Even though the performance period of joint sealant is in the range of 10 years, which means joint sealant cannot keep water from getting into joints once the pavement reaches 10 years of service, sealants still can keep the incompressible materials out of joints. Considering small joint movements, joint width at transverse contraction joints can be reduced to 1/8-in.

For More Information

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Keyword: Research