Establishing Joint Sealant Effectiveness

Background

Contraction joints (e.g. transverse joints) are used in concrete pavements to relieve tensile stresses resulting from shrinkage and warping of the concrete. These joints also accommodate limited expansion and contraction movement over the pavement life.

Longitudinal joints (e.g. hinge joints) are typically tied together with tie bars and provide for initial crack control as a result of volume change during the curing of the concrete.

Although joints have been used in concrete construction since between about 1900 and 1910, it was not until the 1960s that a theoretical basis for design of formed-in place sealants was developed. The design process employed a "shape factor" for the installation of poured in place sealant materials to achieve the best possible performance.

Reasons for Using Joint Sealants

Joints are sealed to prevent: (1) intrusion of incompressible materials such as sand, stones, gravel and other foreign materials from entering the joint; and (2) to limit or prevent infiltration of water into the pavement structure. Table 1 indicates the potential distresses that are believed to be mitigated or eliminated through the sealing of joints for each of these two causes.

TABLE 1 JOINT ASSOCIATED PAVEMENT DISTRESSES

Issues Resulting from Incompressibles	Issues Resulting From Water Infiltration
• Joint Spalling	• Base Erosion/Faulting/foundation support
• Pavement Blow Ups	• Increased Curling and Warping
• Abutment Encroachment	• Corrosion of Embedded Steel
• Slab Growth	• Concrete Durability Issues such as ASR, Freeze Thaw, etc.
• Change in Load Transfer	• Corner Cracking/Edge Support

Since longitudinal joints are typically tied together, issues with incompressibles are generally not a concern. Transverse joints, which handle movement from temperature change, are concerned with incompressibles.

Difficulties in Assessing Joint Sealant Performance

Since the use of sealed joints has been estimated to constitute between 2% to 7% of the initial pavement cost, in is important to determine the effectiveness of this feature over the pavement performance period. Since concrete pavements historically last significantly longer than their original design lives, it is important to not predict the long term performance based only on short term behavior. This makes assessment of the effectiveness of sealed joints difficult. For sealed joints to perform as intended they need to be: (1) properly designed, (2) constructed according to plans, and (3) maintained in accordance with the initial design plan.

A properly designed sealed joint requires materials that perform adequately in the specified joint geometry for the specified performance period. A properly constructed joint ensures that all design requirements and specifications are adhered to. A properly maintained joint requires that when the expected performance period has been met or deficiencies are noted prior to completion of the performance, that resealing of the joint is performed. Otherwise the sealed joint is not a performing as intended.

Approaches to Determining Sealant Effectiveness

To evaluate the effectiveness of sealed joints in California several approaches can be employed and are discussed in subsequent sections. However, it should be recognized that a proper evaluation needs to be data driven and directly related to pavement performance. This requires determination of what pavement performance properties should be evaluated and what tools should be used to evaluate them. The following approaches are ranked from most effective to least effective.

Pavement Management System: The most effective means for evaluating sealant performance is through the use of the pavement management system. If a mature PMS system is available, a long term assessment over varied geographic and environmental regions and traffic conditions can be obtained. Several distresses can be evaluated such as faulting, cracking, roughness, shoulder drop off, load transfer efficiency and corner and edge deflections. The PMS approach provides the most accurate assessment on a statewide basis available.

It should be noted, however, that changes in design procedures, construction practices, and maintenance policy should be considered when developing the plan on how best to mine the PMS data. That is, an ideal PMS system would include the ability to evaluate changes in specifications, maintenance policies, etc.

Evaluation of Designed Test Sections: Well designed, constructed, and evaluated test sections can be valuable in assessing sealant effectiveness. On a statewide basis it would be necessary to have a large number of such test sections which is often not the case. However, for the conditions represented by these location(s) similar to the designed experiment, this is a very useful tool. For this approach to be useful the same design and construction procedures as used in current designs should be sought out. It is also desirable that older experiments be considered so that early age performance is not being used to predict long term performance. This approach includes any reported relevant historical research which may have document test section performance.

Evaluation of Selected Pavement Monitoring Sections: If adequate PMS data is not available and an insufficient number of designed experimental sections exist, a designed experiment can be developed using selected existing roadway monitoring locations. The selected roadway locations need to address all the geographic, traffic, environmental, pavement age, and other necessary variables to properly assess the effect. Once the locations for the monitoring sections are determined, it then becomes necessary to conduct field evaluations to determine the extent and severity of the distresses reported within the PMS approach.

Accelerated Loading Facility (HVS)

A limited accelerated loading experiment could be conducted using the heavy vehicle simulator. Although this approach could not account for the interaction of time and environment, it may be possible to determine the impact of sealants on foundation support, etc. as a function of loading.

Interview of Agency Personnel

Agencies, municipalities and companies employ many knowledgeable personnel who spend their careers observing pavement performance. A well designed interview process of the existing and former personnel to document the collective memory would always be useful, even if other approaches are also used.

Independent of which approach is used to determine the pavement performance data, it is also useful to document the specification changes, materials changes, and maintenance practices/policies over time as these also contributed to the “actual” pavement performance. This provides a complete review of the factors which led to the impact of sealant effectiveness on pavement performance.