

A Reliable Design of Asphalt Pavement from Structural Considerations

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A reliable asphalt pavement is the one where failure would occur as and when expected. Designing such a pavement is a difficult task. It is difficult because of the unpredictability associated with the performance of the pavement structure. A pavement structure is built with different layers. These layers are made up of different materials such as, aggregates, asphalt binder, soil etc., used either individually or, in mixture form. These materials show a complex engineering response which may be dependent on stress or temperature level, or, may vary with time. Thus, prediction of response of a pavement structure due to repeated random application of thermal and traffic load is not a trivial issue.

Unlike the basic design approach of common Civil Engineering structures, which are generally designed from ultimate load bearing considerations, a single application of a standard wheel load is not usually expected to cause failure to the pavement. It is the repetitions of the load which primarily governs the design, except, for instance, for thermal shrinkage cracking. These repetitions cause various types of damages to the pavement. It is important to know how many repetitions would initiate the damage and how the damage would propagate with repetitions. This makes prediction of pavement behaviour further difficult.

The concept of mechanistic-empirical pavement design is currently used in various guidelines. In this approach, the stress-strain values are estimated mechanistically from an idealized pavement structure. The repetitions that are expected to cause different types of failures are obtained empirically through performance equations. Fatigue, rutting, and low temperature shrinkage cracking are different types of asphalt pavement failures considered in mechanistic-empirical pavement design. Attempts are also made to include thermal fatigue and top down cracking into the design process. Substantial effort has been put to calibrate these performance equations from field data of in-service pavements or, from pavement test facility, so as to capture the effect of variations due to local climatic effect, construction practice, material property, and traffic loading behaviour.

Like in any engineering design, cost-effectiveness is also an important consideration in pavement design. Given the fact that various types of materials are used in asphalt pavement, it should be possible to optimize the design and suggest the combination of materials to be used for a specific pavement design problem. Even, the mix design requirements can be formulated based on the structural design.

Thus, the researchers are striving to reduce the empiricism in the asphalt pavement design process so that the design becomes more reliable and economical.