

ABSTRACT

Application of mechanistic principles in the design of pavements is gaining popularity all over the world. Indian Roads Congress (IRC) has adopted a mechanistic approach for design of flexible pavements in India. Selection of appropriate layer moduli is an important component for the mechanistic design of flexible pavements. Among the various methods available for the estimation of layer properties, structural evaluation of pavements using Falling weight Deflectometer (FWD) is popularly used all over the world. Since a number of structural responses are measured by the FWD, it is possible to explain the structural behaviour of pavements more accurately.

IRC guidelines for design of flexible pavements recommend the use of different models for estimating the moduli of subgrade and granular layers. The main concern among the researchers in India in using the empirical relationships recommended by IRC is that there has not been any validation of the relationships for the specifications and construction practices adopted in India. Thus, it is essential to have adequate data for selection of realistic layer moduli appropriate for the conditions prevailing in India. Hence, a rational approach for predicting the pavement layer moduli is desirable for the analytical design of pavements.

Indian Roads Congress (IRC) recommends the use of Benkelman beam for design of flexible overlays. However this method does not permit a reliable prediction of the performance of pavements as only one deflection is measured under a static load where as a moving wheel of a vehicle applies a dynamic load on a pavement surface. A more rational approach is to carry out structural evaluation of in-service pavements by FWD and develop an overlay design methodology based on this. Keeping these requirements in view, the present research work aimed at the development a rational procedure for structural evaluation of in-service pavements and for design of overlays.

An extensive review of relevant literature related mostly to various methods of nondestructive testing of pavements, backcalculation techniques, models available for the estimation of pavement layer moduli and FWD based overlay design procedures has been made to seek direction for the present research work.

Though different types of FWDs are available commercially, the high cost of the imported FWDs is making it difficult for most of the agencies in India to use them. Hence, a low-cost FWD has been designed and fabricated for the evaluation pavements. Main salient feature of this equipment is that it is possible to apply a load of 100 kN with a pulse duration of

about 20 to 30 ms. The FWD is housed inside a vehicle for easy maneuverability. The performance of this equipment was found to be satisfactory.

A number of pavement sections with different surfacing thickness and condition were selected for detailed structural evaluation in different seasons in a year using the FWD. Some pavements constructed recently with the latest construction equipment and specifications were also evaluated.

BACKGAIIT, a Genetic Algorithm (GA) based program, was developed for backcalculation of effective moduli of pavement layers. The results were found to be highly satisfactory.

FWD evaluation was done on one pavement stretch having a cold mix recycled layer to estimate the moduli values before and after recycling. It has been observed that there is a significant improvement in the modulus values of the pavement layer after it was milled and recycled using cement and bituminous emulsion.

Based on the field evaluation, various models were developed for the estimation pavement layer moduli from different pavement parameters and the validity of some of the available models was examined. From the deflection data obtained from new pavements, elastic moduli of bituminous layers were obtained for different temperatures to evaluate the effect of temperature on the moduli. Temperature adjustment factor was developed for estimating the bituminous modulus in the range of 25 to 40° C. Based on FWD data, a design procedure for estimating thickness of bituminous overlay over flexible pavement has been proposed.

Key Words: Structural Evaluation, Falling Weight Deflectometer, Backcalculation, Elastic Modulus, Temperature, Seasonal Variation, Overlay Design