EXECUTIVE SUMMARY

Discrepancy of design overlay thicknesses based on Dynaflect deflection data taken before and after the overlay construction were found in the current ODOT overlay design procedure. The current procedure sometimes indicates substantial additional pavement thickness is needed right after the overlay construction. This discrepancy is more severe on rigid and composite pavements than on flexible pavements.

Step-by-step evaluation of the current ODOT overlay design procedure has identified several sources of errors. In particular, the practice of using spreadability to back calculate existing pavement moduli for both flexible, rigid, and composite pavements could lead to substantial errors. The current procedure assumes the spreadability would increase when pavements are strengthened by overlays. Instead, spreadability values actually decrease after asphalt overlay construction on five out of the eight pavement sections tested. As a consequence, the calculated effective thicknesses of the existing pavements are not accurate.

A new procedure for designing overlay on rigid and composite pavements has been developed. The proposed new procedure employs a simple, direct back calculation scheme, similar to the one used in the 1993 AASHTO Guide for Pavement Design, to calculate pavement elastic modulus and modulus of subgrade reaction for an existing two-layer system. The curves and equations in the 1993 AASHTO Guide were developed for deflection data collected using the Falling Weight Deflectometer device and cannot be directly used for the deflection data from Dynaflect. Similar curves and equations based on the same theory of Losberg (1960) are derived for this study so that Dynaflect data can be used. The back calculation method yields unique and stable back calculation results.

The proposed design procedure differs from the 1993 AASHTO Guide by eliminating the need to subjectively estimate existing AC layer modulus. The 1993 AASHTO Guide requires such subjective estimation because of difficulties in back calculating modulus of AC layer in a composite pavement. In the proposed

procedure, however, effective modulus of the whole composite pavement is back calculated from Dynaflect deflections. From the verification results, this back calculation procedure seems to perform quite well. Moduli of pavement and subgrade seem to compensate each other, therefore, may not have significant effect on final thickness design.

An important innovation in the proposed procedure is a method for determining effective PCC thickness of existing pavement. Unlike the current method, the old composite pavement is compared with a new composite pavement with identical thicknesses to determine the proportional relationship between the old and new composite pavements. Based on the equal-rigidity concept, a exponential of 0.333 rather than 0.44 is used in the calculation of this proportion. With the help of an empirical relation between new AC and PCC thicknesses, the effective PCC thickness of the old composite pavement can be determined.

Another new feature of the proposed procedure is the application of statistical analysis in determining design overlay thicknesses. The overlay thickness is calculated for each deflection data point and the design overlay thickness is determined based on the mean, standard deviation of overlay thickness at each location and the specified reliability level. This statistical approach is employed to deal with the high variability of pavement deflections.

The verification study shows that the proposed new procedure for rigid/composite pavements works very well with hypothetical pavement cases. For actual pavement sections, the results from the new procedure are better than those obtained from the current ODOT procedure.

For overlay design on flexible pavements, a separate procedure, which is a modified version of the procedure recommended in the 1993 AASHTO Design Guide to allow use of Dynaflect deflection readings, is adopted. Design overlay thickness is determined based on statistical analysis of overlay required at every sample location. The results of this new procedures are shown to be better than or as good as that of the existing ODOT procedures.