BACKCALCULATION OF LAYERS MODULI USING FWD.

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1: INTRODUCTION.

Deflection measurement from Non-Destructive Testing is one of the most useful method of evaluating structural capacity of insitu pavement as well as backcalculating moduli of pavement components including the subgrade. In this paper authors show how the Dynamic Slab-Ground Theory (DSGT), which was developed by one of the authors, can be put into use to obtain layers moduli using FWD data.

2: BACKCALCULATION OF LAYERS MODULI.

In DSGT, deflection of the slab is considered to be a function of both slab and half space elastic moduli, E_1 & E_0 respectively, and slab thickness, H, when a periodic load $q=q_0\exp(ipt)$ acts as shown in the figure below.

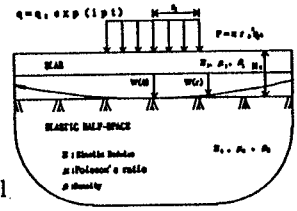

Fig. 1: DSGT model

Data, obtained from Nippon Hodo Construction Company, of deflection values for all sets of layers of known thicknesses of the pavement structure were used. Starting with the subbase(see fig. 2), a possible range of layer moduli for both subgrade and subbase, E_0 and E_1 respectively, was specified, and using DSGT computer program a set of layer moduli was obtained which gave similar deflection bowl to the one obtained from site (see fig. 3).

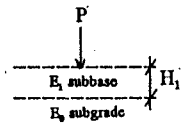

Fig. 2: TWO layers.

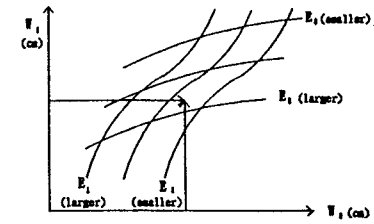

Fig.3: W_0 vs W_1 for various values of E_1 & E_0

Having known values of E_1 and E_0, we were then in a position to analyze three layers i.e subgrade, subbase and base course(see fig. 4). E_1 was used as an equivalent modulus for a combined course of subbase and base. A possible range of equivalent layer thickness was specified and again using DSGT computer program, equivalent layer thickness was obtained, (see fig.5), which gave a similar deflection bowl to the one on site. Subtracting the known thickness of the subbase, we obtained equivalent base thickness. Knowing the relationship between thickness and elastic modulus for a given deflection bowl,(see fig. 7) the actual base course modulus was estimated.

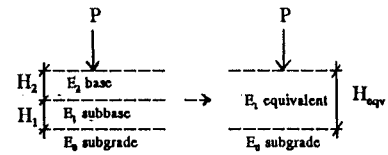

Fig. 4: THREE layers.

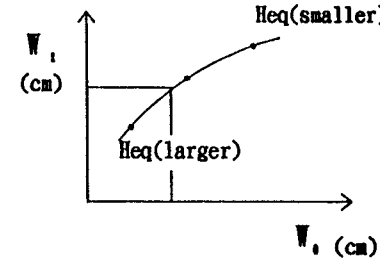

Fig.5: W_0 vs W_1 for various thicknesses given E_1 & E_0

The same procedure used for three layers was applied in the case of four layers (see fig. 6), i.e subgrade, subbase, base and surface courses whereby the surface course modulus was estimated (see fig. 7).

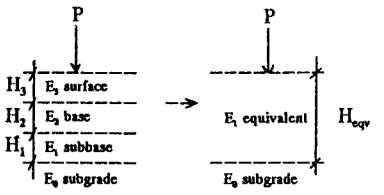

Fig. 6: FOUR layers.

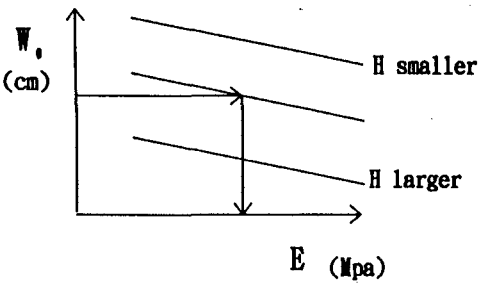

Fig. 7: E1 vs W0 for various thicknesses

3: OVERLAY THICKNESS DESIGN.

One use of pavement overlay is to remedy structural deficiencies which affect the load carrying capabillity of the pavement structure. DSGT computer program was used to backcalculate subgrade resilient modulus, M_r, effective equivalent elastic modulus, E_1, and effective thickness, TA, of a full depth AC pavement structure. Using Kentuky design chart and data from Kentuky, required pavement structure thickness was obtained taking into consideration ESAL for a 12yrs design period, and CBR (M_r. was converted into CBR). Overlay thicknesses were then obtained by subtracting effective thickness from the required thickness. These were then compared with values obtained using AASHTO design method (See figures below).

4: CONCLUSION.

DSGT method provides a promising way of backcalculating layers moduli and also is closely compared to AASHTO overlay design method.

5: REFERENCE.

AASHTO Design guideline.