Acceptable concrete pavement thickness tolerance

What we Did This research was conducted with four different phases as follows: Review of current thickness tolerance limits for concrete pavements in Texas and other states. Sensitivity analysis of concrete pavement thickness based on various models such as the AASHTO model, mechanistic distress prediction model, and fatigue failure models. Investigation of field variability of concrete pavement thickness and accuracy of NDT devices. Determination of acceptable thickness tolerance. The thickness tolerance Pavement thickness Design life Thickness tolerance PROJECT AASHTO equation Design life Allowable loss of life Design thickness Allowable loss of life Allowable design life AASHTO equation Allowable thickness Figure 1: Thickness Tolerance Determination with AASHTO Equation Thickness tolerance Project Summary Report 0-4382-S mechanistic models.

The concept of determining pavement thickness sensitivity to pavement Pavement stress life by using the AASHTO equation is illustrated in Figure 1. The pavement design life can be obtained from the Stress level pavement design thickness by using the Fatigue failure equation AASHTO equation. Then, an allowable Design life loss of the pavement life is selected, and the allowable design life is obtained by Allowable loss of life subtracting the allowable loss of life Allowable design life from the design life.

The correspondFatigue failure equation ing allowable pavement thickness can then be obtained by using the AASHTO Allowable stress level equation inversely, and finally the thickness tolerance for the allowable loss of Allowable stress life can be obtained by subtracting the allowable thickness from the design Westergaard equation thickness. Allowable thickness The concept of etermining pavement thickness sensitivity to pavement life by using the fatigue failure equations Thickness tolerance is similar, as shown in Figure 2.

Another Figure 2: Thickness Tolerance Determination concept for finding pavement thickness with Fatigue Failure Equations sensitivity to pavement life is based on limits and corresponding penalties distresses such as cracks and punchouts. should be related to the loss of pavement If a pavement with a thickness deficiency life caused by the thickness deficiency. does not induce more cracks as compared Three different pproaches have been with the plan pavement, the thickness used to find the relationship between deficiency can be acceptable with this the pavement thickness deficiency and concept.

To predict crack and punchout the loss of pavement design life. The formations, a mechanistic model, CRCPfirst is based on the change in present 10, has been used. serviceability index (PS') to predict the pavement life, which includes the What We Found AASHTO pavement life prediction The findings of this research are as equation. The second is based on the follows: fatigue failure, hich includes a number The current thickness tolerance limits of fatigue failure equations.

The third is are independent of the design pavebased on distresses such as cracks and ment thickness. If the same thickness punchouts, which can be predicted by Pavement thickness Westergaard equation deficiency is established for different design thicknesses, the contractor for the pavement with a thicker thickness should pay higher a penalty because the penalty is determined as a percentage of the contract price corresponding to the deficiency and the contract price for the thicker pavement is generally more expensive than that for he thinner pavement. The sensitivity analysis of the pavement thickness based on the AASHTO design equation to predict the pavement life shows that the tolerance increases as the thickness increases for a given percent allowable loss of design life. The relative (percent) tolerance remains almost constant when the pavement thickness is greater than about 10 inches. The tolerance increases as the elastic modulus of concrete decreases or the modulus of subgrade reaction increases.

The relationship between the tolerance (both absolute and relative) and the percent llowable loss of life is almost linearly proportional. The thickness sensitivity analysis based on various power fatigue failure equations shows that the absolute tolerance increases and the relative tolerance remains almost constant as the pavement thickness increases for a given percent allowable loss of design life. The tolerance is affected little by the concrete elastic modulus and the modulus of subgrade reaction.

Both the absolute and relative tolerances increase as the percent allowable loss of life increases, and the relationship is 2 Thickness = 6 in. Tolerance (in. Tolerance (in.) AASHTO 1. 51 0. 50 Thickness = 12 in. = 18 in. Power formula Linear formula 10 20 30 LOSS of life 50 Figure 3: Relationship between Thickness Tolerance and Loss of Pavement Life -2- Mean crack spacing (ft) 86420 radar (GPR) system, a non-destructive testing device, generally slightly overestimates the pavement thickness.

The relative average error of the measurement is about 2% of the pavement thickness. The Researchers Recommend The findings from this research clearly indicate that the current thickness tolerance limits can be loosened for thicker pavements. It is recommended that the thickness tolerance limits be dependent on the design thickness and the linearly proportional relationship between the tolerance and the design thickness be used.

The payment adjustments should be dependent on the thickness deficiency and the linearly proportional relationship between the payment adjustment and the thickness deficiency may be used beyond the no-penalty tolerance limit. Several approaches would be acceptable for determining the payment adjustments to the thickness deficiency. One would be to use the current thickness deficiency adjustment table for 10-inch pavement, with the relative tolerance limits used for other pavement thicknesses, because the current thickness tolerance was developed when the pavement thickness was mostly less than 10 inches.

Then, a proposed thickness deficiency adjustment table can be obtained as shown in Table 1 . 3 6 9 12 15 18 21 Pavement thickness (in.) Figure 4: Sensitivity of Crack Spacing to Thickness Deficiency almost linear. The thickness sensitivity study based on various linear fatigue failure equations shows that both the absolute and relative thickness tolerances increase ith increasing the pavement thickness for a given percent allowable loss of life.