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State of California
Department of Public Works
Division of Highways
Materials and Research Department

April 6, 1965

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Mr. William C. Clark
Director of Public Works
City of Visalia
707 West Acequia
Visalia, California

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Dear Sir:

Submitted for your consideration is:

REPORT
ON
DEFLECTION STUDY OF
VARIOUS CITY STREETS
IN THE CITY OF
VISALIA, CALIFORNIA

Study made by. . . . . .Pavement Section
Under general direction of . . . . . .E. Zube
Work supervised by . . . . . .R. A. Forsyth
Report prepared by . . . . . .J. B. Hannon

Very truly yours,

JOHN L. BEATON
Materials and Research Engineer

Attach.
cc: LRGillis
CTLedden
WLWelch
JMDennen

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INTRODUCTION

Presented herein are the results of a deflection survey for various streets in the City of Visalia. This study was requested by Mr. William C. Clark, Director of Public Works for the City of Visalia, in a letter to Mr. J.L. Beaton, dated February 10, 1965.

On March 3, 1964, deflection measurements were obtained with the traveling deflectometer carrying a 15,000 pound axle load on the following streets:

Campus Drive	E. Acequia St.
Meadow Lane	E. Center St.
Kaweah Ave.	N.E. Second Ave.
W. Myrtle Ave.	Court St.
W. Laurel Ave.	N. Jacob St.
E. Laurel Ave.	Divisadero St.

These streets appeared to be a representative cross section of the Visalia City Street system. The structural sections consist of variable thicknesses of either oiled earth or a mixture of oiled earth and rock over the native soil. All streets tested had curbs and gutters.

Visual examination revealed that the surfaces of all streets except East Center Street were cracked. Several showed signs of instability in the form of rutting. East Center Street and East Acequia Street were constructed about two years ago over an underlying silt material. All of the other streets were constructed on a more stable material and vary in age from 1 to 7 years.

RECOMMENDATIONS

As shown by Table 1, deflection levels for all streets tested were unusually high, ranging from 0.051" to 0.105". This, in addition to the widespread visual distress and evidence of instability, indicates that a major repair is required even in consideration of the low volume of traffic utilizing the facility. The existence of curbs and gutters precludes the application of an overlay of sufficient thickness to correct this condition. In view of this, digout type reconstruction is indicated.

This department recommends that with the exception of East Center Street, all streets subject to this study be scarified to a depth of 0.70' and that the material to this depth be removed. It is further recommended that 0.50' Class 2 or preferably Class 1 aggregate base be placed, to be followed by 0.20' asphalt surfacing, bringing the street back to its original

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grade. Although the use of a cement treated base was considered for the digout section, it is believed the high levels of deflection on this project, coupled with the relatively low tolerable deflection limit for a cement treated base, make the use of a flexible section a more practical alternative in the particular case.

The basis of this recommendation is the assumption of a basic structural section weakness as indicated by the level of transient deflection and visual observations. The proposed digout treatment will meet basic R-value design criteria for a 5.5 traffic index based upon a basement R-value of 40 which is a reasonable assumption in view of the results of an earlier investigation for Road 06-Tul-10-Vis. (Contract 6QV148(2)). During this investigation basement soil R-values were found to vary from 40 to 70. It should be pointed out that this R-value information may not be representative of the entire project. Further testing is recommended so that appropriate changes in the proposed design can be made if indicated.

If the assumption of an R-value of 40 is found to be valid, the proposed section will constitute sufficient strengthening for the subject roadways to meet current R-value design standards. In addition, it is anticipated that the deflection levels will be reduced by from 50 to 60%, which, in view of an assumed traffic index of 5.5, should preclude fatigue cracking of the surfacing for an extended period of time.

Because of its excellent visual appearance, no reconstruction is recommended for East Center Street although the test section between the city limits and Burke Street produced a high evaluated deflection level. (0.085") Since this level of deflection substantially exceeds what we consider a tolerable criteria, we can only attribute the success of this section to a low traffic volume and its relatively short period of operation (two years). Future correction should be based upon deflection measurements taken shortly before proposed reconstruction since changes may occur within the structural section due to compaction of traffic and aging of the surfacing, which could have significant effect upon the deflection level and, thus, the degree of required reconstruction.

These recommendations are consistent with and derived from experience gained from past deflection studies.

ANALYSIS OF DATA

The criteria utilized for evaluation of pavement deflections originated as the result of a comprehensive deflection study which was made throughout the State from 1951 to 1955. The data represented readings from nearly 400 electronic gauge units on 43 different projects under a 15,000 lb. single

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axle load. The results of this work suggested limits (shown below) of the maximum tolerable deflection to preclude "fatigue" cracking during the design life of the pavement. These limits varied in accordance with the type of structural section.

Thickness	Type of Pavement	Maximum Deflection for Design Purposes (Tentative)
6 in.	Cement Treated Base (Surfaced with Bit. Pavement	0.012"
4 in.	Asphalt Concrete on Gravel Base	0.017"
3 in.	Aspahlt Concrete on Gravel Base	0.020"
2 in.	Asphalt Concrete on Gravel Base	0.025"

These values have been applied as guide criteria by the Materials and Research Department since 1955 for planning the reconstruction of existing roadways. They were, however, established, based on test data from roadways with a traffic index of approximately 9.0. For this reason, they may be somewhat conservative when applied to lightly traveled city or county roads. At the present time, limiting values are adjusted for low T.I. pavements, utilizing asphalt surfacing fatigue data.

More recent investigations have produced data as to the deflection damping characteristics of the various structural elements or layers including gravel base, cement treated base, and asphaltic concrete. Utilizing this information, it is possible to estimate the necessary thickness of surfacing or base required to reduce pavement deflections to tolerable limits.

The evaluated deflection level (Table 1) is the 80 percentile value for all deflection measurements taken in a given section. This value is used as the basis for design since it reflects the deflection characteristics of the roadway as a whole rather than isolating possible causes of distress indicated by averages through cut, fill, cracked, and uncracked sections.

The relatively low 5.5 T.I. used for design purposes in this study was determined from T.I. values obtained from the City of Visalia which ranged from 4.0 to 6.0. These variations from the 5.5 design T.I. are not great enough to effect significant change in the recommendations.

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TABLE I

Street and Limits	Existing X-Section	Lane	Deflection (Inches) Mean OWT	Mean IWT	Evaluated* (80% level)	Appearance
Campus Dr.btwn.Woodland Dr. & Verde Vista Drive	2" oiled earth	WBL	0.045"	0.054"	0.080"(29)**	Alligator cracking both wheel tracks.
Meadow Lane btwn.Woodland Drive and Mooney Lane	4" oiled Rock & earth	EBL	0.063"	0.068"	0.075"(37)	Alligator cracking throughout
Kaweah Ave.btwn.Central Ave. and Dollner Street	4" oiled Rock & earth	EBL	0.051"	0.066"	0.088"(31)	Mooney to Divisadero St., no cracks,high asphalt content. Divisadero to So. Giddings, alligator crk'ng.
W.Myrtle Ave.btwn.Oak Park St.& So.Jacob Street	4" oiled Rock & earth	EBL	0.039"	0.060"	0.079"(31)	So.Giddings to So.Conyer, intermittent alligator cracking. So.Conyer to Watson,uncracked,high asphalt content.
W.Laurel Ave.btwn.So. Encina & So.Court Street	4" oiled Rock & earth	EBL	0.069"	0.090"	0.098(33)	Continuous alligator cracking-rutting in wheel trks.
East Acequia Street btwn. Tipton Street and Clark Street	6" oiled	EBL	0.052"	0.057"	0.082"(34)	Intermittent short longitudinal & some alligator cracking w/rutting in wheel tracks.
East Center Street btwn. City Limits and Burke St.	6" oiled	WBL	0.056"	0.053"	0.085"(35)	Uncracked,good condition. Isolated distressed area in WBL near Burke Street.
N.E. Second Ave. btwn. Granite St.& Grape Street	4" oiled	EBL	0.055"	0.053"	0.063"(35)**	Alligator cracking throughout,rutting in wheel tracks

* The deflection that occurs in the range where 20% of the deflections are higher and 80% are lower.
** Number of individual deflection measurements.

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TABLE I (con't.)

Streets and Limits	X-Section	Lane	Deflection (Inches) Mean OWT	Mean IWT	Evaluated* (80% level)	Appearance
No. Court Street btwn. N.E. Fourth Ave. and N.E. Fifth Avenue	4" oiled	NBL	0.034"	0.042"	0.051"(31)	Continuous small longitudinal cracking and rutting in wheel tracks. Evidence of poor stability.
No. Jacob Street btwn. Houston Ave. & Allen Way	2.3" oiled	SBL	0.070"	0.082"	0.105"(70)	Badly alligator cracked. Some spalling.
Divisadero Street btwn. Grove Street and Sady Lane	4" oiled	NBL	0.053"	0.060"	0.075"(35)	Intermittent large areas of alligator cracking.

* The deflection that occurs in the range where 20% of the deflections are higher and 80% are lower.

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