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Zube, E.; Tueller, D.O.

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Division of Highways
Materials and Research Department

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16. ABSTRACT
An interim report on a statewide flexible pavement performance and deflection study is presented. Data representing the present status of various projects comprising a total of 25 different structural sections with varying levels of traffic and pavement deflection are briefly discussed. Charts and tables are also presented. Studies to evaluate pavement performance, deflection attenuation properties of various roadway materials and radius of curvature of various highway pavements by the Dehlen "curvature meter" are also discussed. Contrary to the findings presented in the last interim report, pavement deflections continue to decrease after the pavement has reached an age of four years probably due to traffic compaction and AC curing. It is reported that preliminary computer analyses indicate that accumulative 5000 pound equivalent wheel loadings are the most significant variable in predicting pavement distress.

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Flexible pavements, pavement deflection, pavement evaluation, pavement performance

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November 2005, Division of Research and Innovation

HIGHWAY RESEARCH REPORT

STATEWIDE FLEXIBLE PAVEMENT PERFORMANCE AND DEFLECTION STUDY

INTERIM REPORT

68-36

STATE OF CALIFORNIA

TRANSPORTATION AGENCY

DEPARTMENT OF PUBLIC WORKS

DIVISION OF HIGHWAYS

MATERIALS AND RESEARCH DEPARTMENT

RESEARCH REPORT

NO. M & R 633128

Prepared in Cooperation with the U.S. Department of Transportation, Bureau of Public Roads December, 1968

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STATE OF CALIFORNIA—TRANSPORTATION AGENCY

RONALD REAGAN, Governor

DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
MATERIALS AND RESEARCH DEPARTMENT
5900 FOLSOM BLVD., SACRAMENTO 95819

December 1968
Interim Report
M & R No. 633128
D-5-5

Mr. J. A. Legarra
State Highway Engineer

Dear Sir:

Submitted herewith is a research interim report titled:

STATEWIDE FLEXIBLE PAVEMENT
PERFORMANCE AND DEFLECTION STUDY

ERNEST ZUBE
Principal Investigator

RAYMOND A. FORSYTH
AND DON O. TUELLER
Co-Investigators

Assisted by
Joseph B. Hannon

Very truly yours,

JOHN L. BEATON
Materials and Research Engineer

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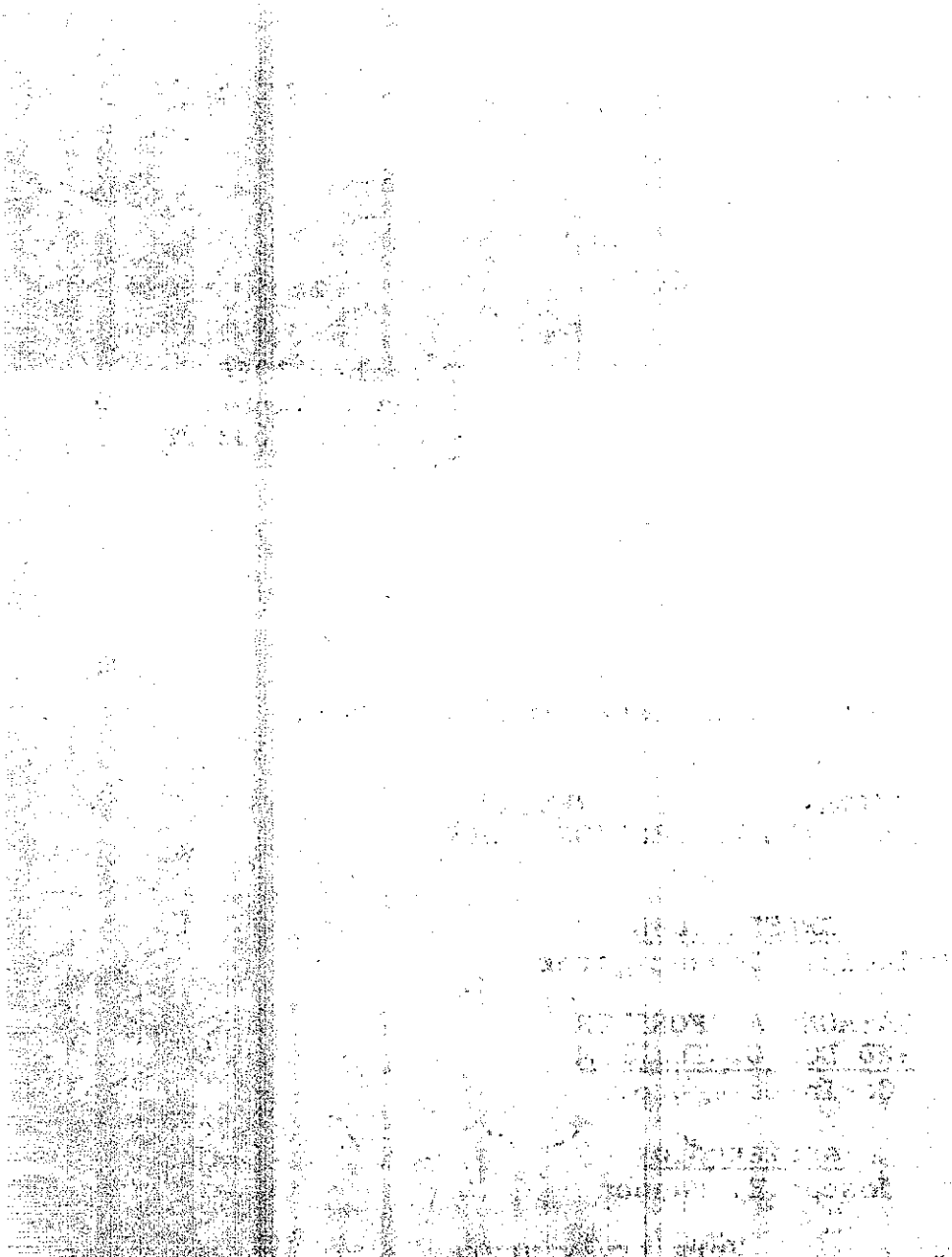

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REFERENCE: Zube, E., Tueller, D. O., Forsyth, R. A. and Hannon, J. B., "Statewide Flexible Pavement Performance and Deflection Study", State of California, Department of Public Works, Division of Highways, Materials and Research Department, Research Interim Report 633128, December, 1968.

ABSTRACT: An interim report on a statewide flexible pavement performance and deflection study is presented. Data representing the present status of various projects comprising a total of 25 different structural sections with varying levels of traffic and pavement deflection are briefly discussed. Charts and tables are also presented. Studies to evaluate pavement performance, deflection attenuation properties of various roadway materials and radius of curvature of various highway pavements by the Dehlen "curvature meter" are also discussed. Contrary to the findings presented in the last interim report, pavement deflections continue to decrease after the pavement has reached an age of four years probably due to traffic compaction and AC curing. It is reported that preliminary computer analyses indicate that accumulative 5000 pound equivalent wheel loadings are the most significant variable in predicting pavement distress.

KEY WORDS: Flexible pavements, pavement deflection, pavement evaluation, pavement performance.

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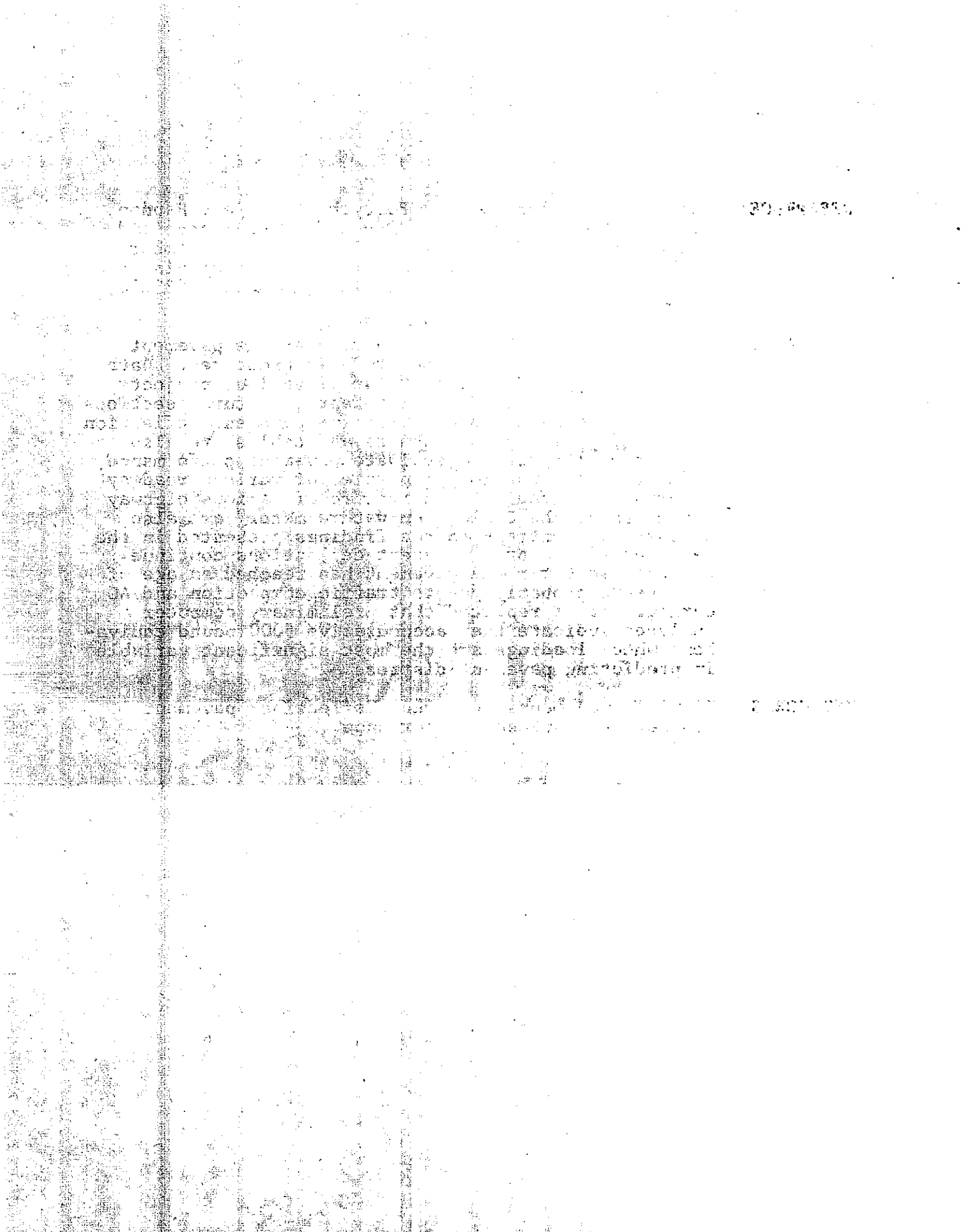

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ACKNOWLEDGEMENT

This paper is based on data collected during a research project financed by the U. S. Department of Transporation, Federal Highway Administration, Bureau of Public Roads. The opinions and findings expressed in this publication are those of the authors and not necessarily those of the Bureau of Public Roads.

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6. " " " 03-Sac-99
7. " " " 03-Yol-99
8. " " " 04-Nap-121,29
9. " " " 05-Mon-101
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INTRODUCTION

Since the last interim report,[1] the scope of this project has been expanded to include "Statewide Flexible Pavement Study" (432398). This study was proposed for inclusion because it would prove beneficial by eliminating administrative and report duplication. Although the objectives differ somewhat, the investigational procedures are much the same and involve the same laboratory personnel. This phase of the study will provide information on the quality of structural section materials as well as evaluate design and construction procedures and relate these factors to pavement performance.

Approval for enlargement of this project was obtained on December 20, 1966.

The purpose of this report is to present the results of testing and data collection since the last interim report dated August 1966.

FINDINGS

1. Contrary to the findings presented in the last interim report, deflection levels continue to decrease after the pavement has reached an age of four years. This is presumably due to additional curing of the AC surfacing and additional traffic compaction. However, the rate of decrease in deflection level is considerably less than that of the first four years. Increases in deflection level are suggested in areas of block cracking where additional moisture has entered the structural section.

2. Preliminary computer analyses during this interim period of data from one test section from each of five of the Traffic Index-Deflection projects suggests that accumulative 5000 pound equivalent wheel loadings are the most significant variable in predicting distress, second is the hardness of the recovered asphalt binder in terms of penetration and third the pavement deflection.

TRAFFIC INDEX-DEFLECTION PHASE

At the present time this study involves 20 different projects throughout the state plus a series of streets in the City of

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Woodland, California. Since the last interim report the following projects or test sections have been eliminated from this phase of the study:

	Project	Remarks
3)	03-Gle-162 (64-14T13C6)	Overlayed with 0.08 foot asphalt concrete blanket in 1967 and dropped from study.
4A)	03-Sac-99 (60-3TC20)	Three of the original five test sections were overlayed with 0.08 foot asphalt concrete blanket in 1968. The remaining two test sections are still part of study.
9)	05-Mon-101 (62-5T13C4)	Seal coat placed in spring of 1968 and project was dropped from study.
12)	05-SBt-156 (61-5TC3)	0.08 foot asphalt concrete blanket placed over one test section in 1966 and dropped from study.
18)	06-Fre-1329-CR (64-6Y24C20-P)	One test section lost to canal construction in summer of 1966.
19)	06-Fre-33 (60-6TC13-FP)	Seal coat placed in summer of 1967 and project dropped from study.

Approximately ten newly completed projects were investigated for possible inclusion in this phase of the study but were eliminated from consideration due to low deflection levels. The Lane-Wells Dynaflect unit was used to great advantage in the selection or elimination of these test projects.

Table 1 presents the status of all projects remaining in this study and also the status of those which were eliminated at the time of elimination. Included is the range of surface distress for each project and also the traffic level which is defined in the subsequent discussion.

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For all projects remaining in this study, deflection measurements and condition surveys are continuing on an annual basis. However, rut depth measurements in the wheel tracks are now only being obtained where rutting is obvious, since no changes in rut depths have occurred over the last few years on these projects. AC core samples are being taken every two years and a large backlog of data is accumulating on recovered asphalt properties.

As indicated in the last interim report, traffic information is only available to 1963. It was reported that a statewide traffic count would be made in 1966, unfortunately, however, no truck counts were included. During the interim, we programmed in the computer annual truck traffic count information beginning with the year 1950 and proceeding through 1963 on the majority of the projects under study. The program provided extrapolation of equivalent 5000 pound wheel loads (EWL) to year 1972 in terms of accumulative EWL for each year, from the date of completion to year 1972. Utilizing this data, the Traffic Indices (TI) to year 1968 were calculated and are presented in Table 1.

The level of distress on each roadway as shown by Table 1, was calculated in terms of surface area. Here the linear measurement of transverse and longitudinal cracks was weighted the same as the area of block cracking, according to the following equation:

$$\text{Distress (\%)} = B(\%) + T(\%) + L(\%)$$

Where:

$$B = \frac{(\text{Area of block cracking (ft)}^2)}{(\text{Area of test section (ft)}^2)} \quad (100)$$

$$T = \frac{(\text{Linear ft. of transverse cracks})}{(\text{Area of test section (ft)}^2)} \quad (1 \text{ ft.})(100)$$

$$L = \frac{(\text{Linear ft. of longitudinal cracks})}{(\text{Area of test section (ft)}^2)} \quad (1 \text{ ft.})(100)$$

The values derived from this equation seem adequate in most cases for defining distress of pavements with flexible bases but appear as an over estimate of distress for roadways constructed with cement treated bases. For the latter, cracking is more closely related to shrinkage than to fatigue. Therefore, the equation for distress may be revised somewhat in final analyses.

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A comparison between the 1968 data and that which was presented in the last interim report is shown on Figures 1 through 24. Here the change in asphalt properties, deflection levels and surface condition are presented for one test section per project. From this data, no clear cut trends or conclusions can be established. However, some preliminary computer analyses of data from one test section from each of five different Traffic Index-Deflection projects was performed. The results suggest that accumulative 5000 pound equivalent wheel loading was the most significant variable in contributing to surface distress. The second most important was the penetration value of the recovered asphalt binder and thirdly important was the pavement deflection. Since this was only a trial run, it may have little bearing on final results and conclusions, when all data is considered.

DEFLECTION ATTENUATION

During the interim period, follow-up deflection measurements were made over 16 different projects constructed subsequent to deflection study. Since the last reporting 177 different city, county and state roadways totaling over 500 centerline miles have been subject to deflection study for purposes of determining reconstruction and maintenance requirements. Appropriate reconstruction was recommended based on present deflection criteria.

Recently a computer analyses was performed on all deflection attenuation data thus far collected. The results indicated the deflection attenuation design criteria is still valid.

RADIUS OF CURVATURE

Another area of study that is continuing, consists of the determination and analysis of the area of influence or radius of curvature of a pavement under load, and the relationship of this variable to pavement performance. For this the Dehlen "curvature meter" device is being used to collect data on all projects which are subject to deflection measurement.

Correlation curves relating radius of curvature to pavement deflection for both cement treated and untreated aggregate base construction have been established by computer analyses. The results reveal a coefficient of correlation of 0.73 for the untreated

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base sections and 0.84 for the cement treated base sections. The standard error of the estimate in terms of Benkelman beam deflection was found to be ± 0.008 inch for the untreated base sections and ± 0.007 inch for cement treated base sections. This suggests, it is possible to estimate the deflection level of a particular roadway by means of radius of curvature measurements.

PAVEMENT PERFORMANCE PHASE

This phase of the study has involved visual inspection of mainline AC pavements which have been constructed since 1961 and have been in service at least three years, the purpose of which is to evaluate present design standards and accumulate detailed information related to the effectiveness of construction methods and materials used in highway construction throughout the State of California. To gain information on different projects, District Maintenance Engineers and Area Maintenance Superintendents are first contacted and requested to report unusual or early distress which may be occurring on individual roadways. On projects where early distress is evident, an engineer from the Materials and Research Department will make a field review which will include photographs and condition surveys. From this, he will plan a test program. If fatigue cracking is observed, deflection measurements will then be obtained over representative test sections in cracked and uncracked areas. Detailed crack surveys and rut depth measurements will be made and AC core samples and samples of the other elements of the structural section will be obtained for testing.

Generally about 20 projects are reviewed each year but only three or less are actually tested. A log of projects is being kept and will be reviewed on an annual basis as new projects are added. If failures develop, testing will be initiated. Thus far, only a few projects have been tested as early failures are more or less non-existent.

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REFERENCES

1. Zube, E., Forsyth, R. A. and Hannon, J. B., "An Interim Report on Statewide Follow-up Deflection Study of Overlays and Roadway Reconstruction", Research Report, Materials and Research Department, California Division of Highways, Sacramento, California, August 1966.

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TABLE 1

STATUS OF TRAFFIC INDEX-DEFLECTION TEST PROJECTS
JULY 1968

Project	Structural Section	Design (TI)	Year 1968 (TI)	Minimum Asphalt Properties by Abson Recovery 1968 Penetration(mm)	Ductility(cm)	Mean Deflection level range 1968 (inches)	Range of Distress in Percent (%)
1)03-Col-45 (61-3T13C20)	0.25'AC 0.50'AB 0.83'AS	6.1	6.8	10	6	0.013 to 0.030	0 to 5.1
2)03-Gle-162 (60-14TC22-F)	0.25'AC 0.50'AB 0.75'AS	7.9	6.9	12	8.5	0.011	0.5
3)03-Gle-162 (64-14T13C6)	0.30'AC 0.50'AB 1.08'AS	7.0	6.5(67)	32	100+	0.011 to 0.012	nil
4A)03-Sac-99 (60-3TC20)	0.30'AC 0.67'CTB Exist.Pvmt.	8.0	8.8	17	100+	0.001 to 0.003	0.2 to 9.4
4B)03-Sac-99 (61-3TC9)	0.55'AC 0.50'AB Exist.Pvmt.	8.0	8.7	20	100+	0.011 & 0.016	0.3
4C)03-Sac-99 (61-3TC9)	0.30'AC 1.00'AB Exist.Pvmt.	8.0	8.7	18	100+	0.011 to 0.015	nil
5)03-Yol-99 (61-3T13C31)	0.29'AC 0.67'AB 1.17'AS	8.5	8.2	13	5	0.011 to 0.016	0.5 to 2.5
6)04-Nap-121,29 (62-4T13C5-F)	0.25'AC 0.67'CTB 1.50'AS	8.2	8.0	32	100+	0.001 to 0.019	0.2 to 3.0
7)05-Mon-101 (62-5T13C3-F)	0.36'AC 0.25'ACB 0.50'AB 1.25'AS	9.3	9.5	22	70	0.007 to 0.013	nil

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TABLE 1 (CON'T)

STATUS OF TRAFFIC INDEX-DEFLECTION TEST PROJECTS
JULY 1968

Project	Structural Section	Design (TI)	Year 1968 (TI)	Minimum Asphalt Properties by Absorption Recovery 1968 Penetration (mm)	Ductility (cm)	Mean Deflection level range 1968 (inches)	Range of Distress in Percent (%)
8) 05-Mon-101 (60-14TC1-F)	0.59'AC 0.50'AB 0.92'AS	9.0	10.0	26	100+	0.004 to 0.011	0 to 5.8
9) 05-Mon-101 (62-5T13C4)	0.25'AC 0.67'CTB 0.75'AS	8.3	9.3(67)	23	64	0.002 to 0.009	2.5 to 9.2
10) 05-SB-246 (61-5V13C9)	0.31'AC 0.50'AB	7.9	6.5	23	14	0.011 to 0.029	2.3 to 4.1
11) 05-SBt-156 (62-5T13C2)	0.31'AC 0.67'AB 1.00'AS	7.9	8.4	30	100+	0.010 to 0.012	0 to 1.8
12) 05-SBt-156 (61-5TC3)	0.31'AC 0.50'CTB 0.17'AB 0.75'AS	7.3	8.4	27	100+	0.001 to 0.002	2.8 to 5.2
13) 05-SLO-1 (61-5V13C12)	0.27'AC 0.67'AB 1.00'AS	7.7	6.8	21	31	0.007 to 0.022	nil
14) 06-Ker-204 (64-6V13C2-F)	0.29'AC 0.67'AB 0.83' to 1.04'AS	8.2	7.7	18	100+	0.017 to 0.029	0 to 2.6
15) 06-Kin-198 (62-6T13C4)	0.25'AC 0.50'CTB 0.67'AS 0.33'IB	7.9	7.7	23	26	0.004 to 0.021	2.6 to 14.6

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TABLE 1 (CON'T)

STATUS OF TRAFFIC INDEX-DEFLECTION TEST PROJECTS
JULY 1968

Project	Structural Section	Design (TI)	Year 1968 (TI)	Minimum Asphalt Properties by Abson Recovery 1968 Penetration(mm)	Ductility(cm)	Mean Deflection level range 1968 (inches)	Range of Distress in Percent (%)
16)06-Kin,Tul-43 (63-6T13C2-P)	0.25'AC 0.50'CTB Exist.Pvmt.	7.5	6.8	14	100+	0.001 to 0.005	0.5 to 12.5
17)06-Fre-811-CR (64-6Y24C19-P)	0.25'AC 0.50'AB 1.17'AS	---	---	13	1	0.022 to 0.026	0 to 0.2
18)06-Fre-1329-CR (64-6Y24C20-P)	0.25'AC 0.50'AB 0.92' to 1.00'AS	---	---	12	1	0.012 to 0.024	0.1 to 0.4
19)06-Fre-33 (60-6TC13-FP)	0.29'AC 0.50'AB 1.21'AS	7.5	7.0	12	7	0.020 to 0.030	0 to 1.6
20)10-Cal-49 (64-10T13C14)	0.25'AC 0.50'AB 1.00'AS	7.0	5.9	23	100+	0.021 to 0.031	nil
21)10-Sol-680 (60-10TC18-FI)	0.39'AC 0.67'CTB 1.00'ISM 1.00'Per.Matl.	8.7	7.2	14	14	0.002 to 0.008	0 to 3.2
22A)City of Woodland	0.17'AC 0.50'AB 0.G.	---	---	--	--	0.029 to 0.034	0 to 1.7
22B)City of Woodland	0.33'AC 0.G.	---	---	--	--	0.026	nil

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PROJECT 1
03–Col–45
CONT. 61-3T13C20
SOUTHBOUND LANE

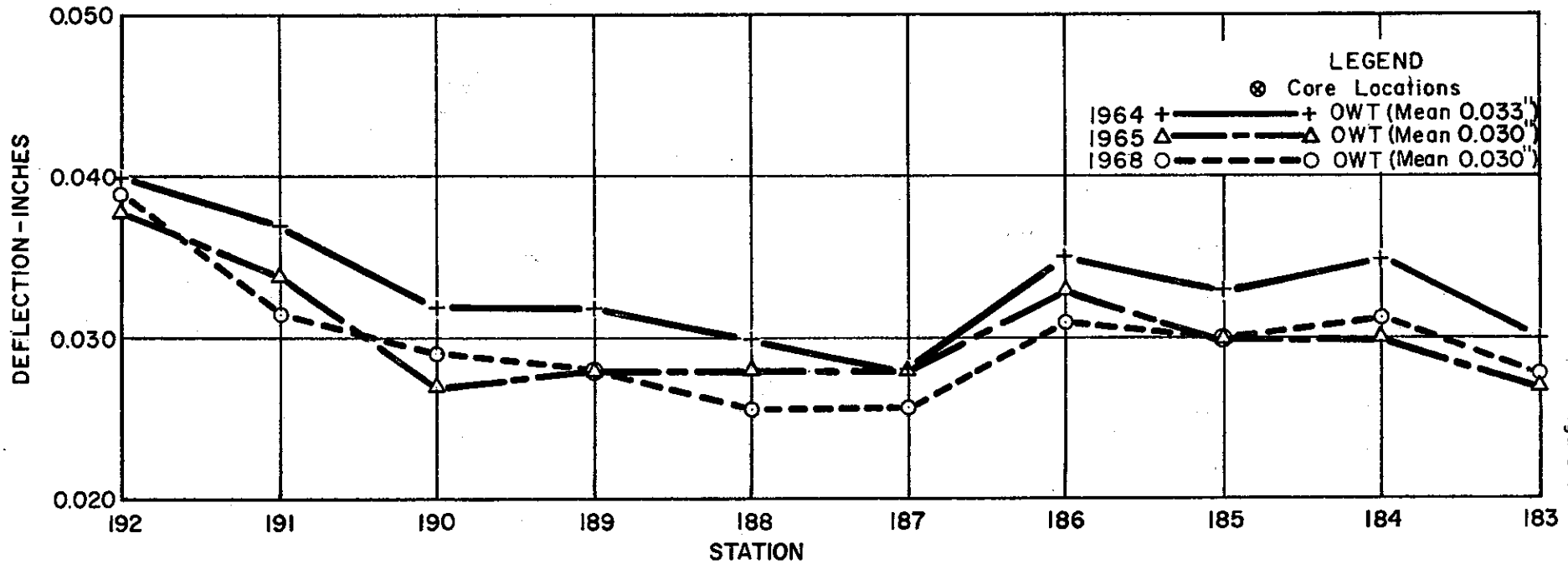


Figure 1

Rut Depth 1964*	0	4	0	0	0	4	4	0	8	0
Rut Depth 1965*	9	9	6	11	3	8	11	5	7	4

⊗ T4-8-6
⊗ T4-4-7
⊗ T4-4-8

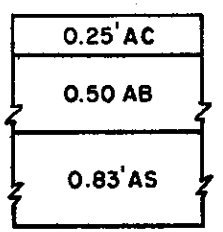
** Core Designation (Center number indicates year sampled)

TEST DATA

	T4-4-7	T4-4-8	T4-8-6**
% Asphalt	3.7	—	3.2
Pen. at 77°F	18	33	18
S.P. (F°)	160	146	176
Duct. at 77°F (Cm)	8.9	96.9	1

* Measured to nearest 0.001" in outer wheel track.

STRUCTURAL SECTION



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PROJECT 2
03 - Gle - 162
CONT. 60-14TC22-F
EASTBOUND LANE

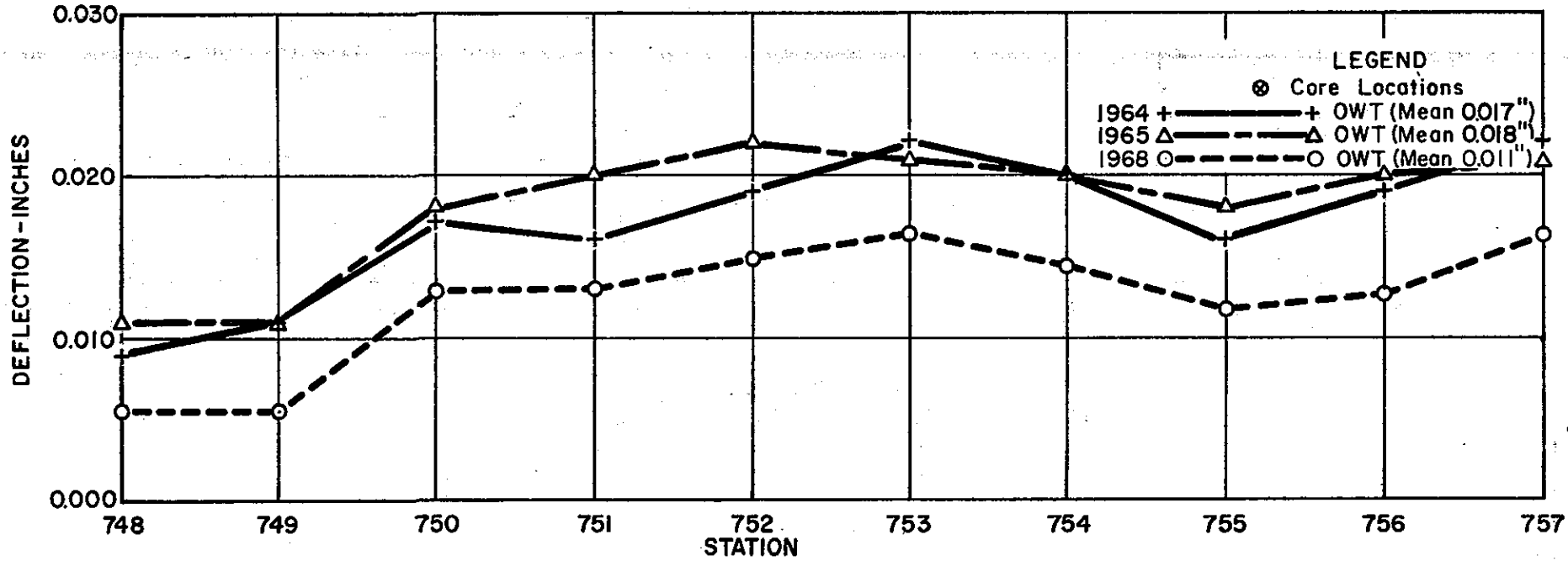


Figure 2

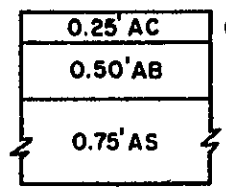
Rut Depth 1964*	0	-	0	0	0	0	0	0	0	4
Rut Depth 1965*	5	5	3	0	3	7	5	4	5	5

** Core Designation (Center number indicates year sampled).

TEST DATA

	T2-4-1	T2-4-2	T2-7-2**
% Asphalt	3.9	4.3	4.4
Pen. at 77°F	22	14	12
S.P. (F°)	149	155	157
Duct. at 77°F (Cm)	41.5	9.8	8.5

STRUCTURAL SECTION



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* Measured to nearest 0.001' in outer wheel track.

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PROJECT 3
03 - Gle - 162
CONT. 64-14T13C6
EASTBOUND LANE

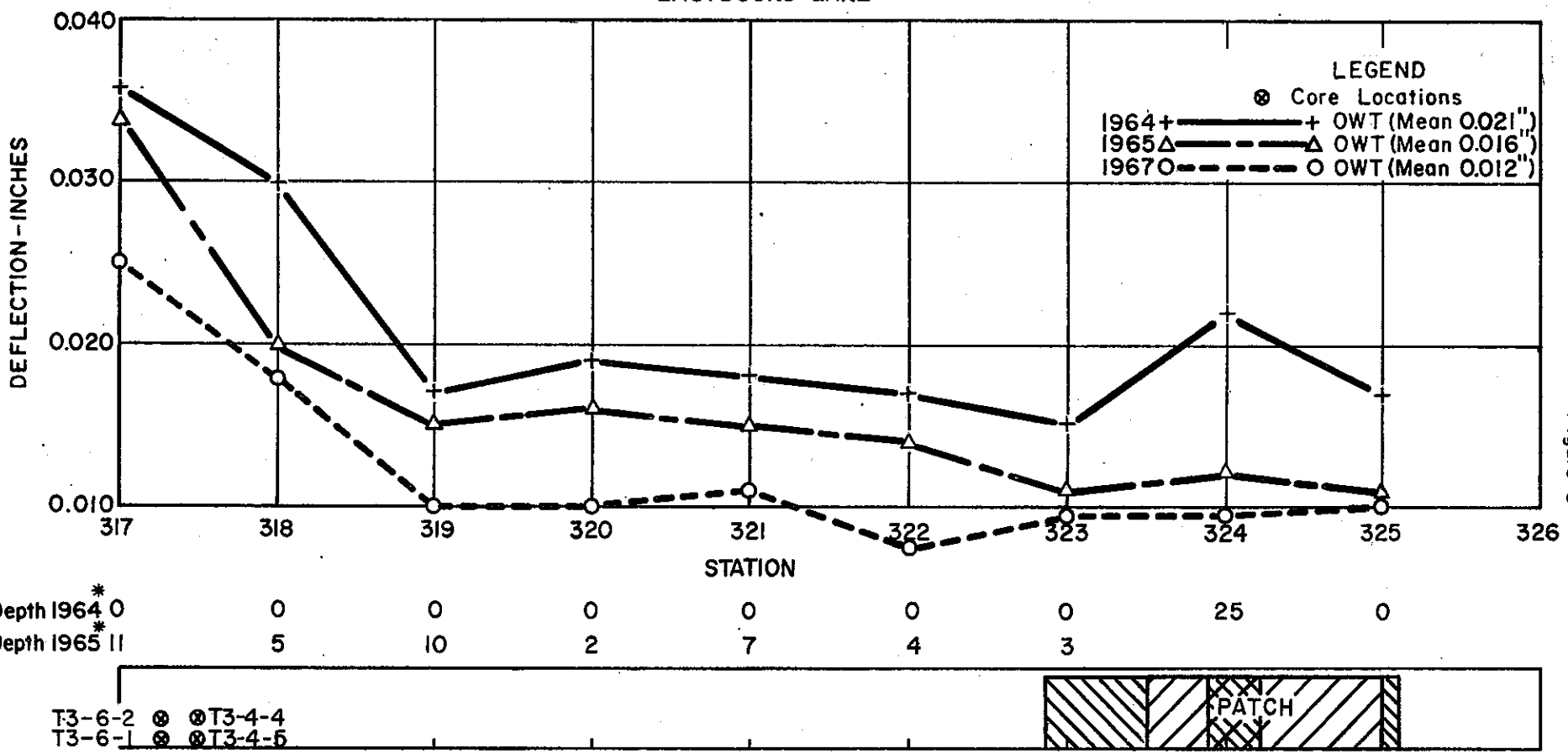

Figure 3

Rut Depth 1964*	0	0	0	0	0	0	0	25	0
Rut Depth 1965*	11	5	10	2	7	4	3		

** Core Designation (Center number indicates year sampled).

Blanket overlay in spring of 1967 dropped from study.

TEST DATA

	T3-4-4	T3-4-5	T3-6-2	T3-6-1**
% Asphalt	—	3.8	4.0	4.6 Surface 3.4 Base
Pen. at 77°F	94	60	76	118
S.P. (F°)	121	129.5	120	106
Duct. at 77°F (Cm)	100+	100+	100+	100+

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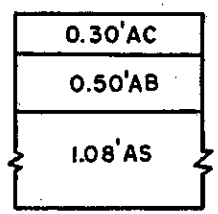

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* Measured to nearest 0.001' in outer wheel track.

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PROJECT 4A
03 – Sac – 99
CONT. 60-3TC-20
SOUTHBOUND LANE

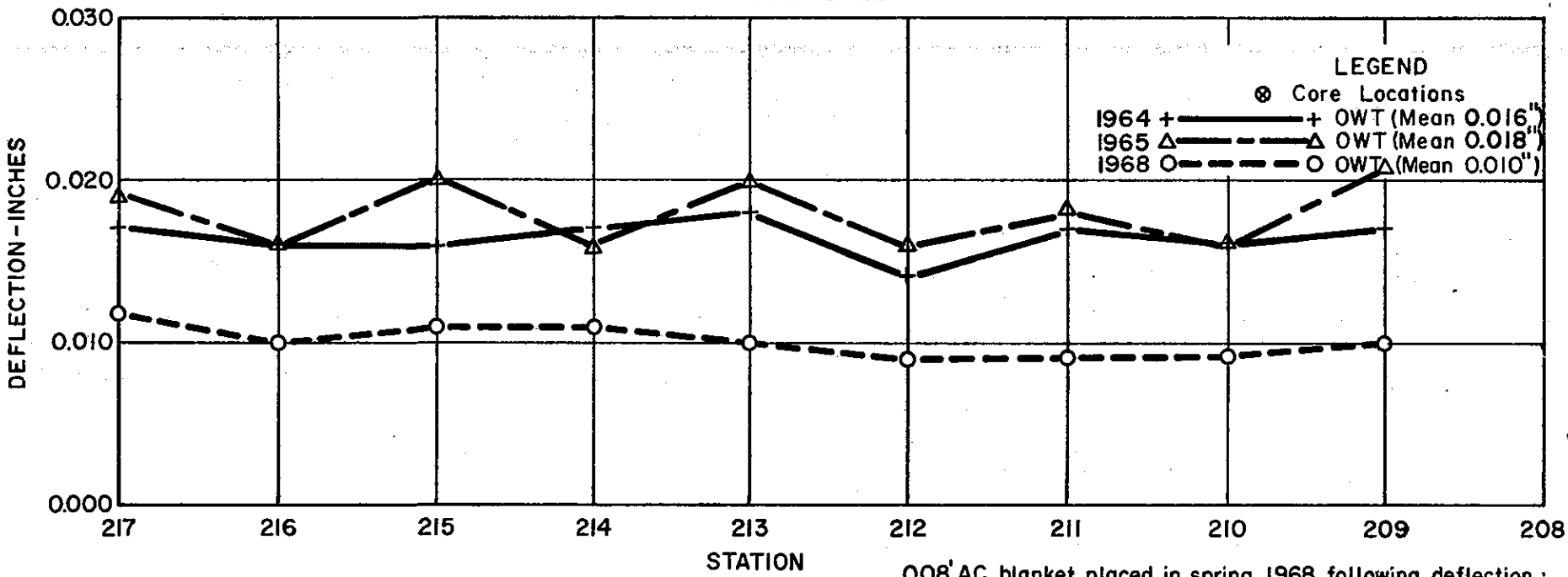
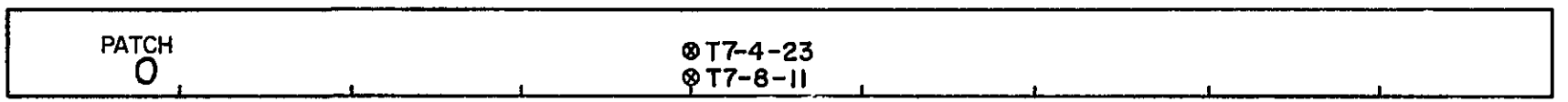


Figure 4

0.08' AC blanket placed in spring 1968 following deflection measurements. Test section dropped from study.

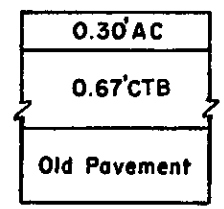


**Core Designation (Center number indicates year sampled).

TEST DATA

	T7-4-23	T7-8-11**
% Asphalt	5.2	5.7
Pen. at 77°F	24	19
S.P. (F°)	139.5	144
Duct. at 77°F (Cm)	100+	100+

STRUCTURAL SECTION



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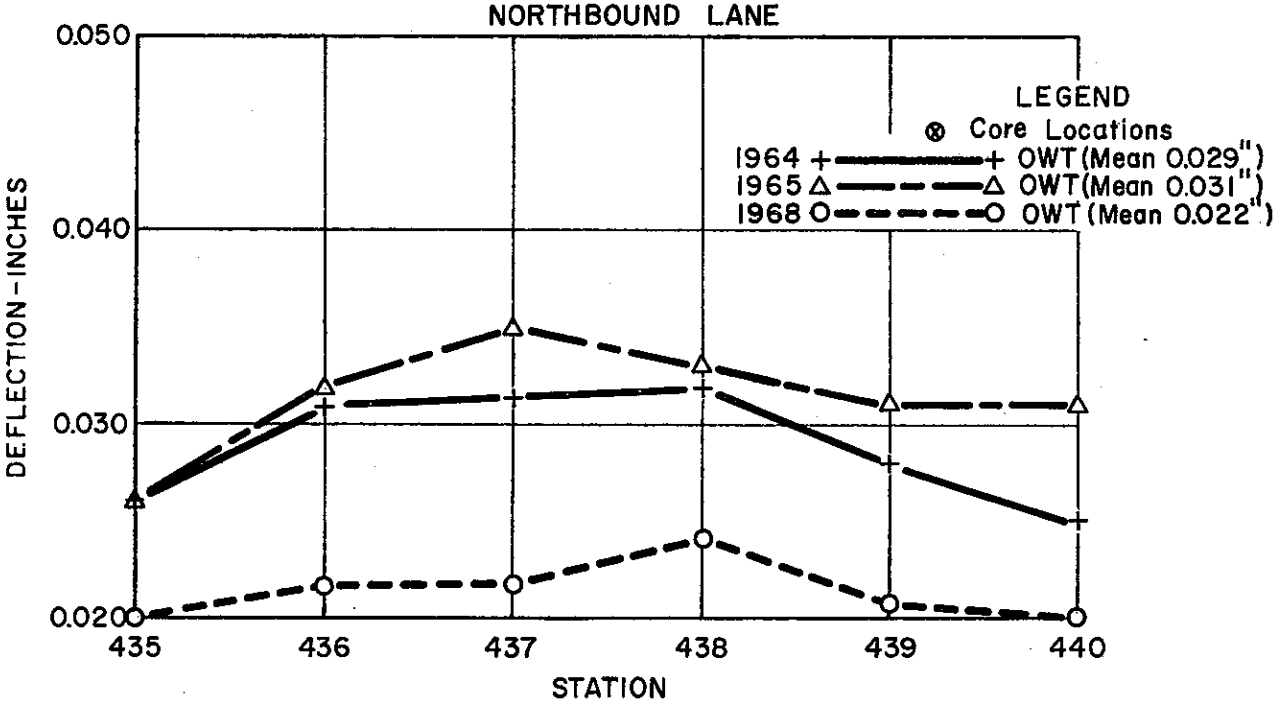
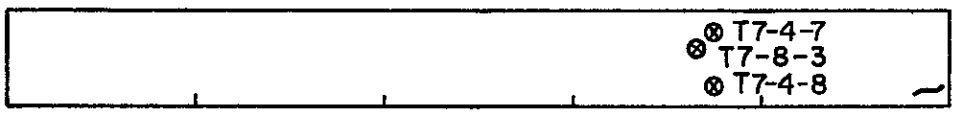
PROJECT 4B
03-Sac-99
CONT. 61-3TC9
NORTHBOUND LANE



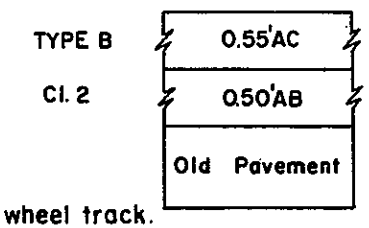
Rut Depth 1965* 5 9 9 11 13 11



TEST DATA

	T7-4-7	T7-4-8 Surf.	T7-4-8 Base	T7-8-3
% Asphalt	5.7	5.5	5.0	5.0
Pen. at 77°F	33	47		30
S.P. (F°)	138	127		137
Duct. at 77°F (Cm)	100+	100+		100+

STRUCTURAL SECTION



Completed 9/23/60

* Measured to nearest 0.001' in outer wheel track.

Figure 5

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PROJECT 4C
03-Sac-99
CONT. 61-3TC9
SOUTHBOUND LANE

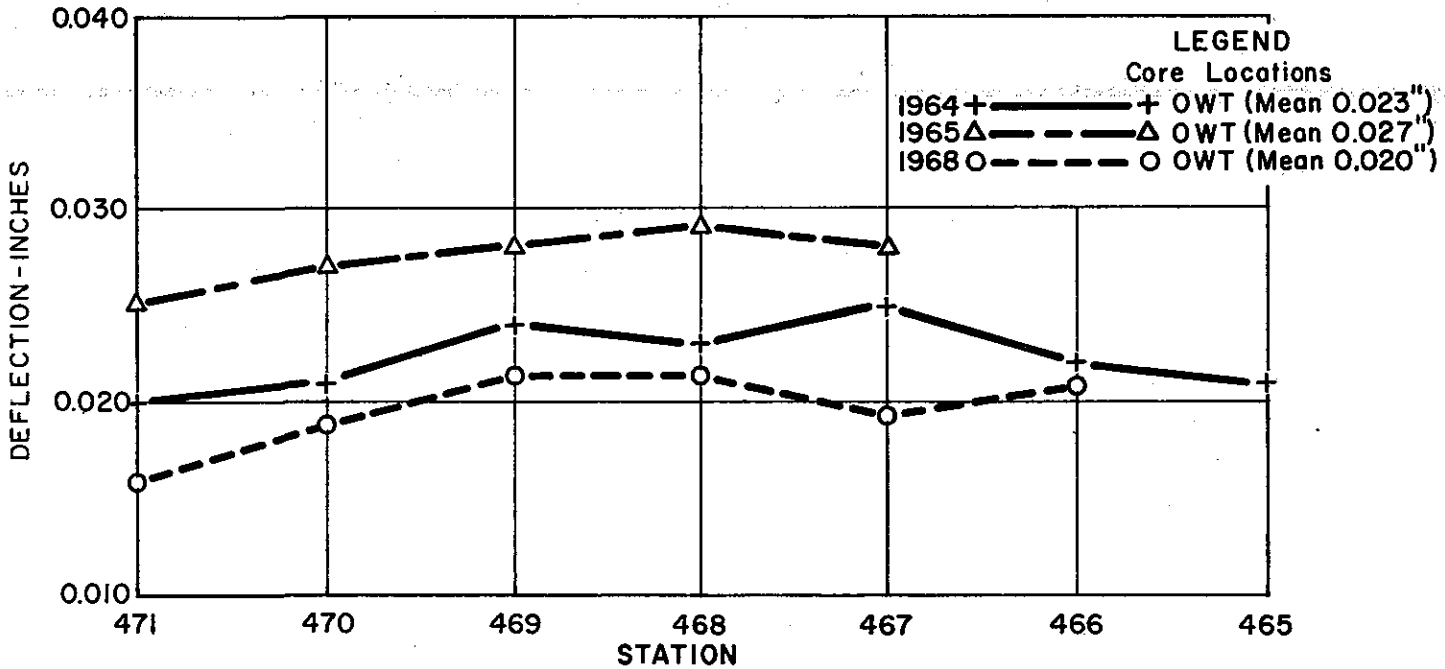


Figure 6

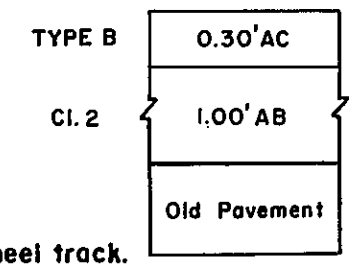
Rut Depth 1965* 2 8 13 11 13 7

⊗ T7-4-9
⊗ T7-8-1
⊗ T7-4-10

TEST DATA

	T7-4-9	T7-4-10	T7-8-1
% Asphalt	4.2	5.4	4.7
Pen. at 77°F	23	31	20
S.P. (F°)	148	142	149
Duct. at 77°F (Cm)	58	100+	100+

STRUCTURAL SECTION



Completed 9/23/60

* Measured to nearest 0.001' in outer wheel track.

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PROJECT 5
03 – Yol – 99
CONT. 61-3T13C31
SOUTHBOUND LANE

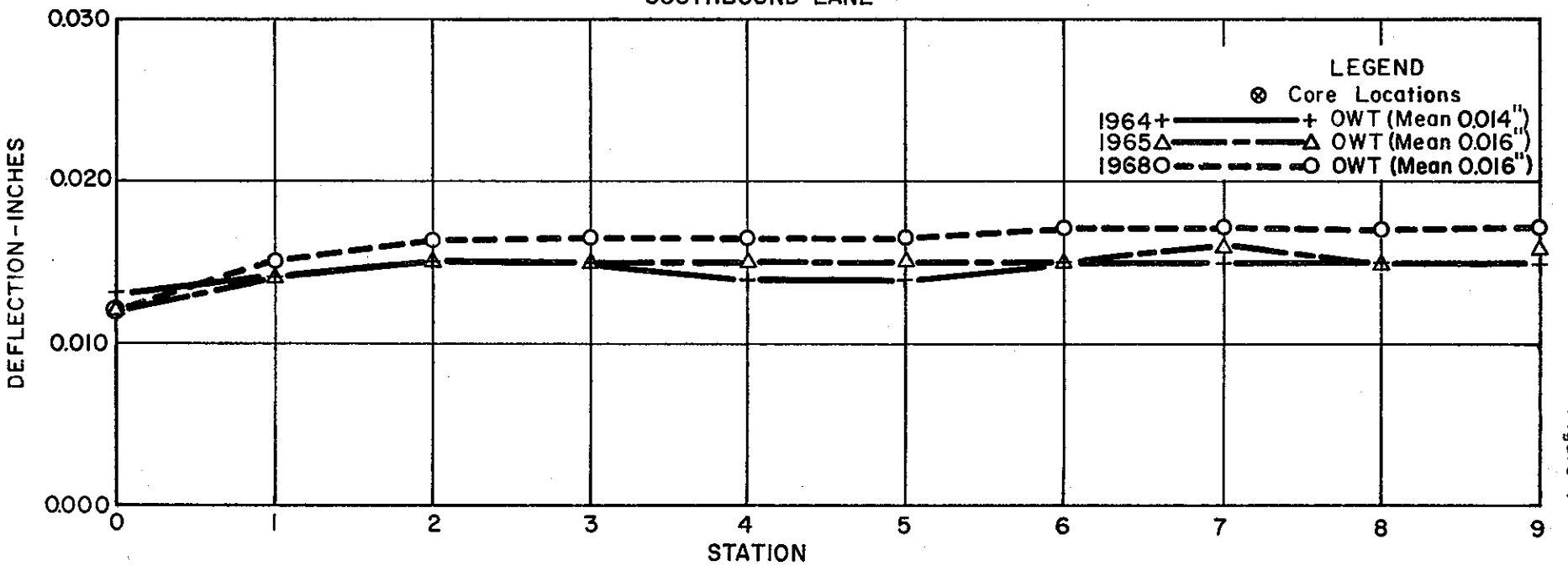
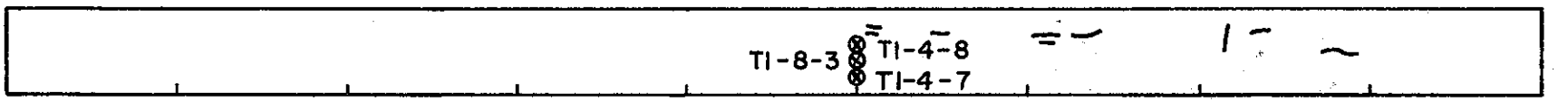


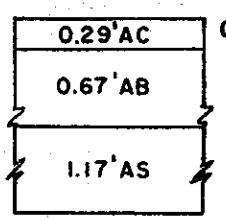
Figure 7



TEST DATA

	T1-4-7	T1-4-8	T1-8-3
% Asphalt	5.1	5.3	5.2
Pen. at 77°F	31	33	18
S.P. (F°)	142.5	141	150
Duct. at 77°F (Cm)	100+	100+	20

STRUCTURAL SECTION



Completed 4/27/61

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PROJECT 6

04-Nap-121,29

CONT. 62-4T13C5-E

SOUTHBOUND TRAVEL LANE

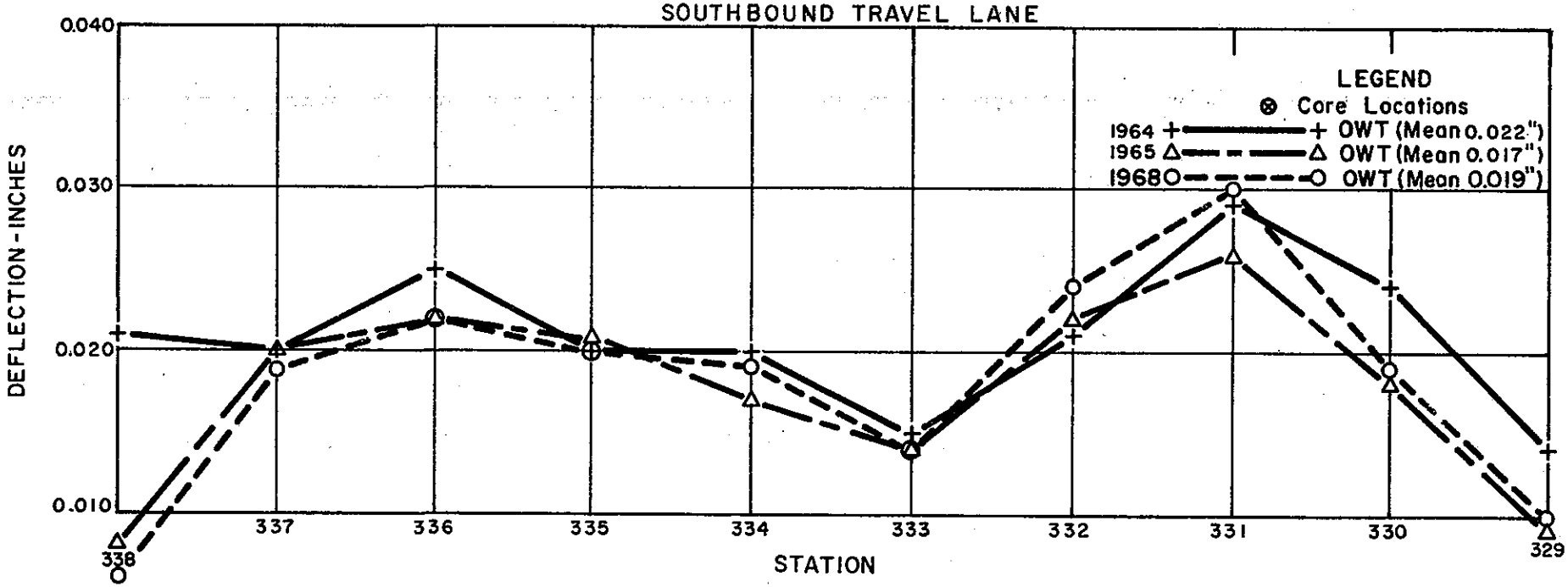
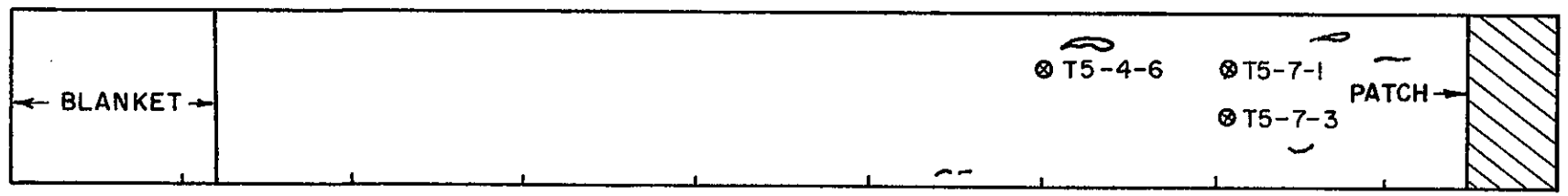


Figure 8

Rut Depth 1964*	12	4	0	4	0	4	4	12	8	8
Rut Depth 1965*	16	11	6	6	7	6	10	7	10	8

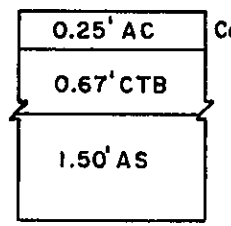


TEST DATA

	T5-4-6	T5-7-1	T5-7-3
% Asphalt	4.8	4.7	4.5
Pen. at 77°F	60	32	31
S.P. (F°)	137	137	137
Duct. at 77°F (Cm)	100+	100+	100+

* Measured to nearest 0.001' in outer wheel track.

STRUCTURAL SECTION



Completed 2/2/62

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PROJECT 7

05-Mon-101

CONT. 62-5T13C3-F

SOUTHBOUND TRAVEL LANE

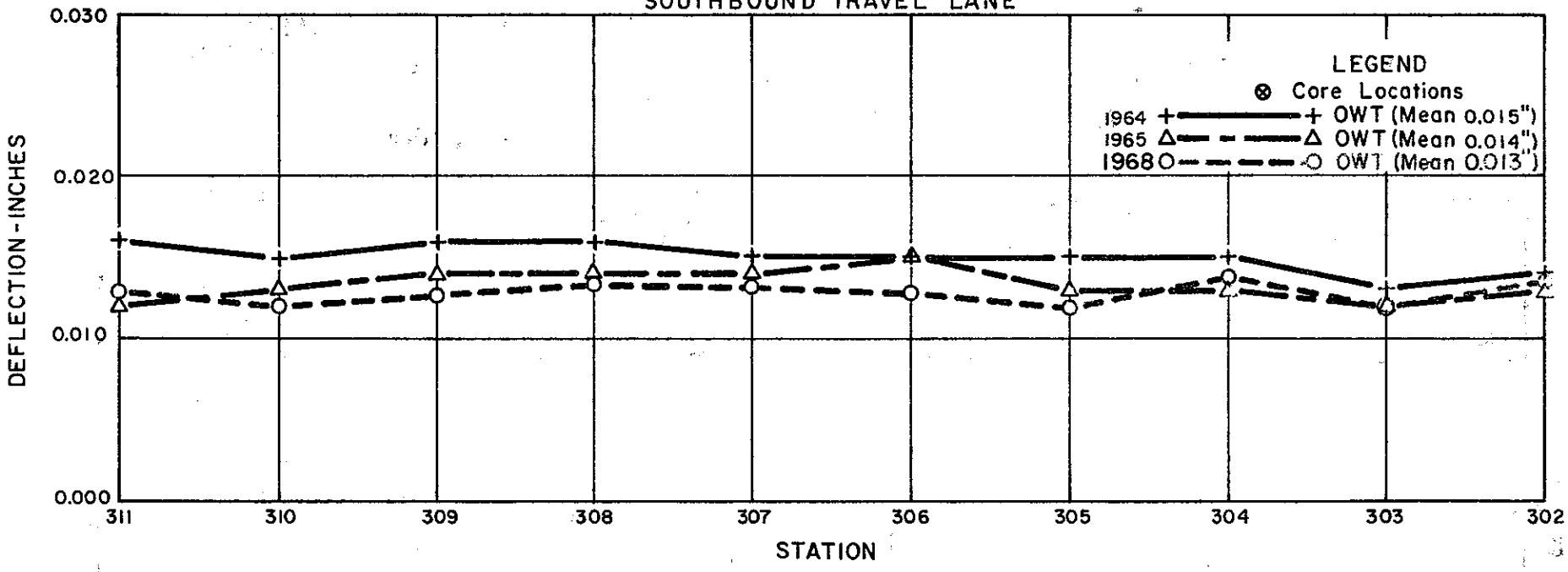
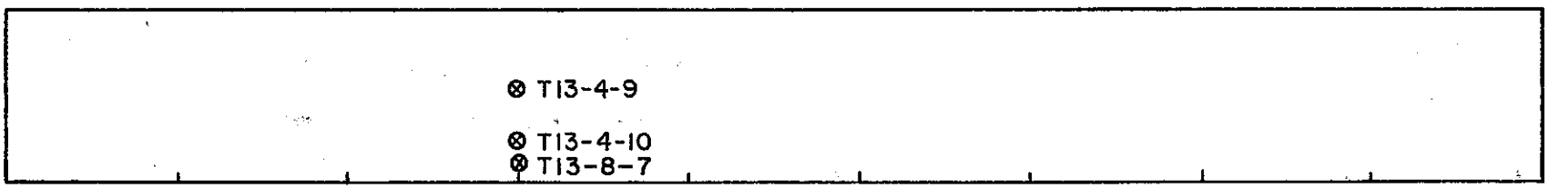


Figure 9

	311	310	309	308	307	306	305	304	303	302
Rut Depth 1964*	0	0	0	0	0	0	0	4	0	0
Rut Depth 1965*	5	8	6	13	9	7	8	4	8	9

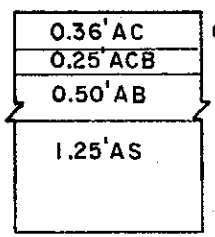


TEST DATA

	T13-4-10		T13-4-9		T13-8-7	
	Surf.	Base	Surf.	Base	Surf.	Base
% Asphalt	5.8	4.0	5.7	4.3	5.2	4.0
Pen. at 77°F	48	34	55	36	28	46
S.P. (F°)	129.5	140	131	127.5	136	130
Duct. at 77°F (Cm)	100+		100+	100+	100+	100+
Mod. of Rupture (PSI)	124.3		118.9			

* Measured to nearest 0.001' in outer wheel track.

STRUCTURAL SECTION



Completed 7/16/53

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PROJECT 8

05 - Mon - 101

CONT. 60 - 14TC1-F

SOUTH BOUND TRAVEL LANE

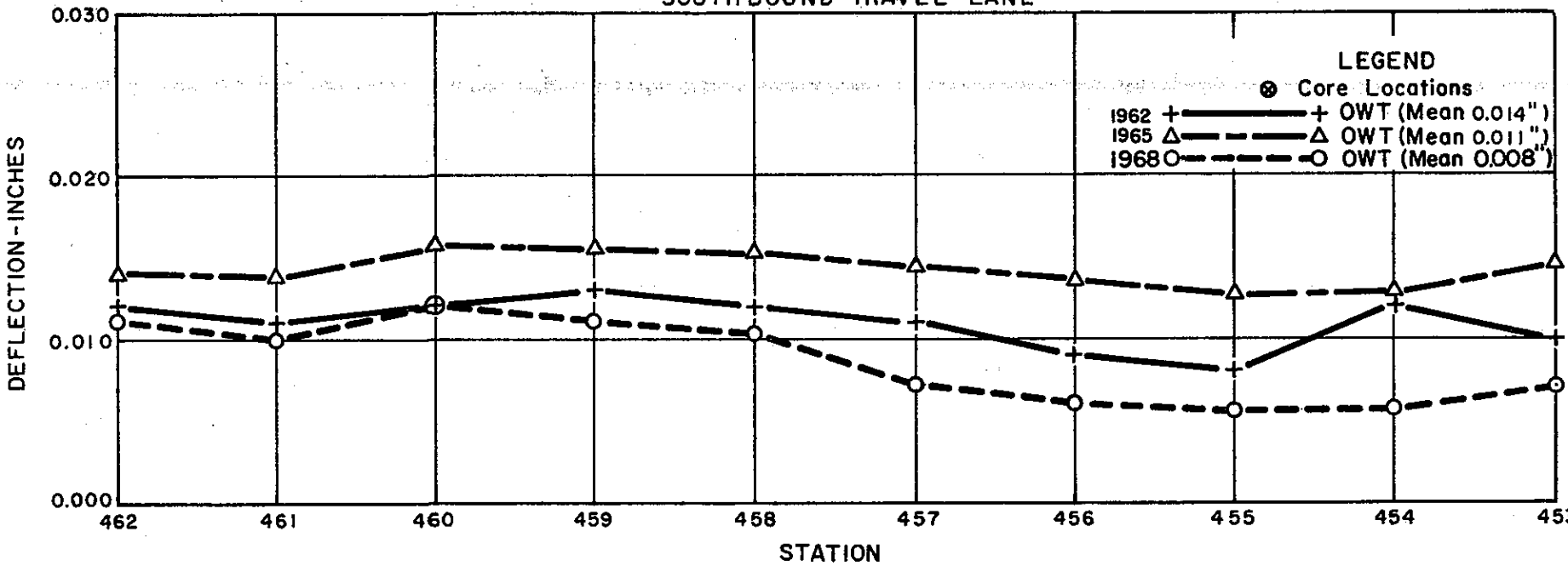
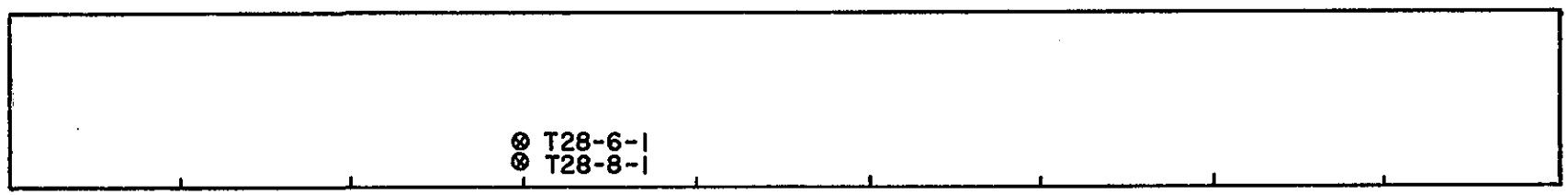


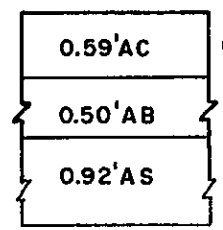
Figure 10



TEST DATA

	T28-6-1		T28-8-1	
	Surf.	Base	Surf.	Base
% Asphalt	—	—	4.9	5.2
Pen. at 77°F	35	57	38	29
S.P. (F°)	126	118	130	126
Duct. at 77°F (Cm)	100+	100+	100+	100+

STRUCTURAL SECTION



Completed 12/13/60

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PROJECT 9

05-Mon-101

CONT. 62-5T13 C4

SOUTHBOUND TRAVEL LANE

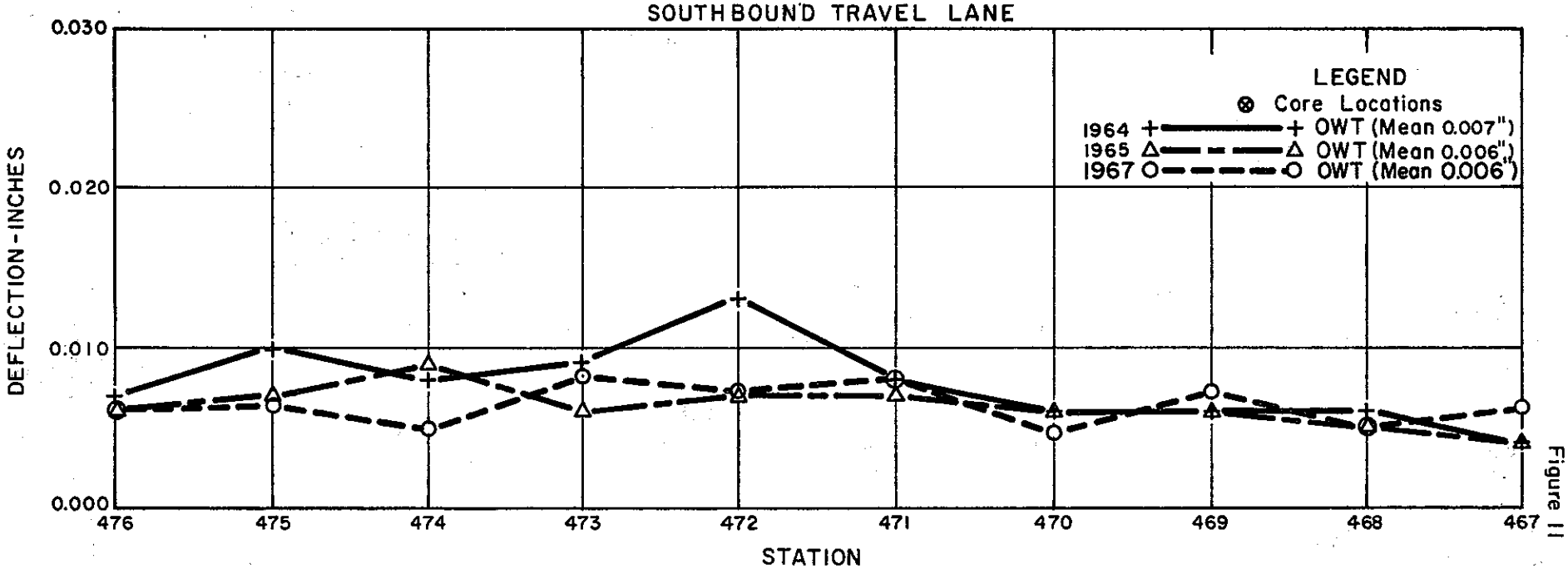
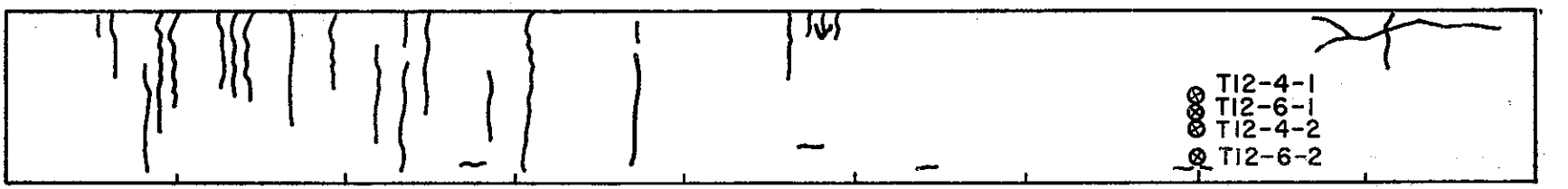


Figure 11

Rut Depth 1964*	0	0	0	0	0	0	0	0	4	4
Rut Depth 1965*	3	3	3	2	8	3	3	3	7	1

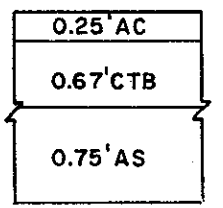


Seal coat placed in April, 1968. Project dropped from study.

TEST DATA

	T12-4-1	T12-4-2	T12-6-1	T12-6-2
% Asphalt	5.0	5.0	—	—
Pen. at 77°F	38	40	35	27
S.P. (F°)	142	139	143	149
Duct. at 77°F (Cm)	100+	100+	100+	100+

STRUCTURAL SECTION



Completed 7/26/62

* Measured to nearest 0.001' in outer wheel track.

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PROJECT 10
05 – SB – 246
CONT. 61-5V13C9
WESTBOUND LANE

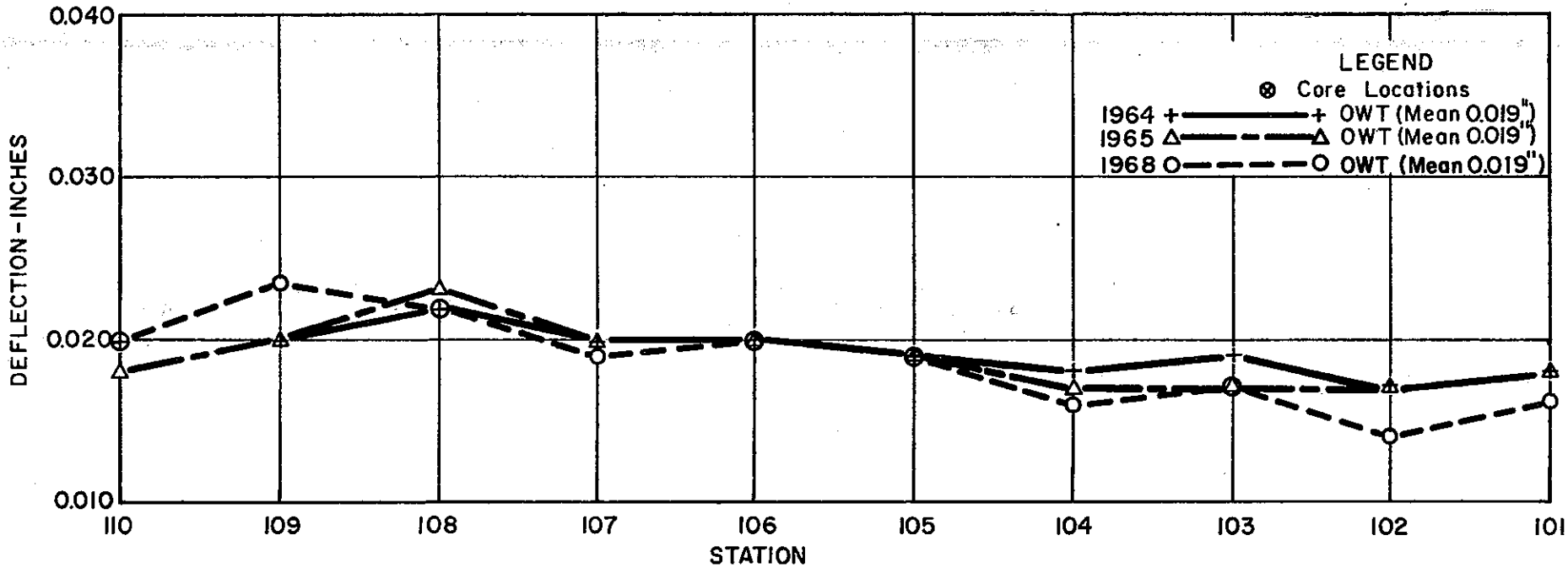
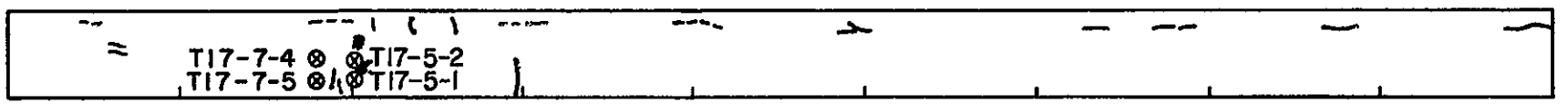


Figure 12

Rut Depth 1964*	0	0	0	0	8	0	0	0	0	0
Rut Depth 1965*	12	7	8	7	7	3	5	4	7	5

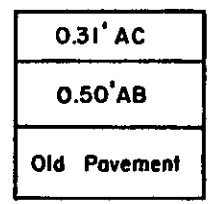


TEST DATA

	T17-5-1	T17-5-2	T17-7-4	T17-7-5
% Asphalt	—	—	5.6	7.2
Pen. at 77°F	21	14	16	23
S.P. (F°)	154	185	159	152
Duct. at 77°F (Cm)	18	3	15	14

* Measured to nearest 0.001' in outer wheel track.

STRUCTURAL SECTION



Completed 4/17/61

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PROJECT 11
05– SBt – 156
CONT. 62-5T13C2
EASTBOUND LANE

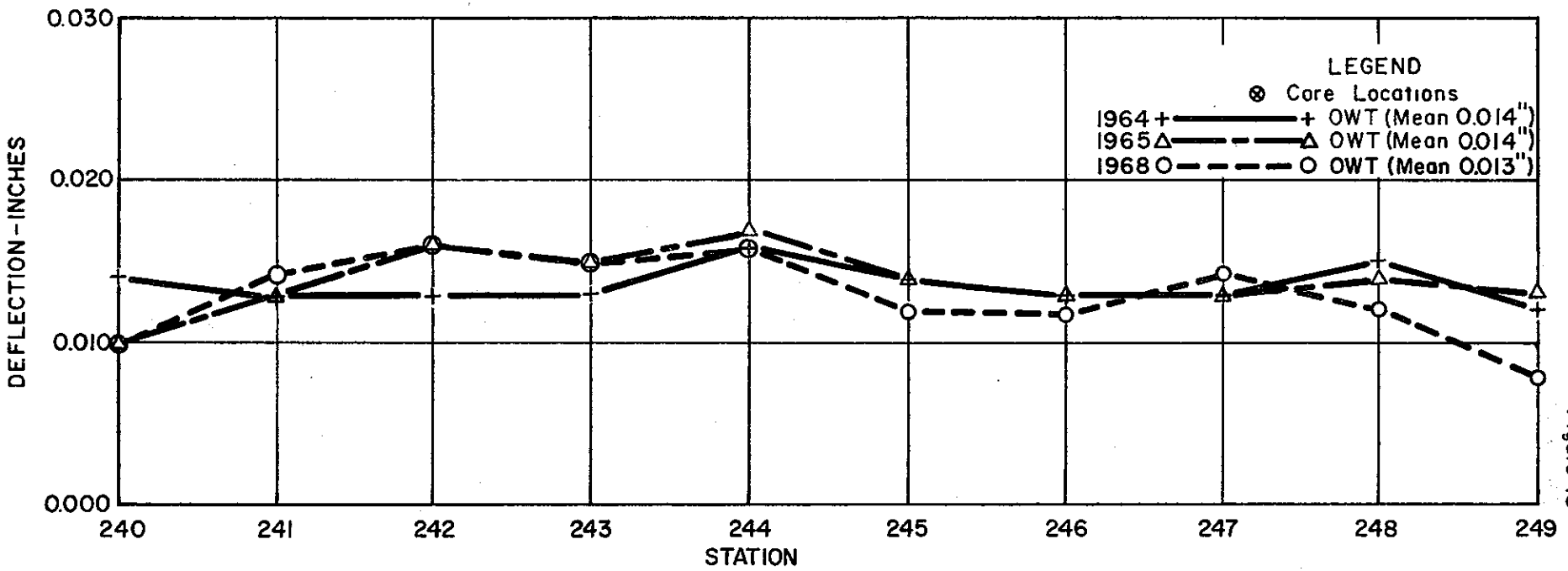
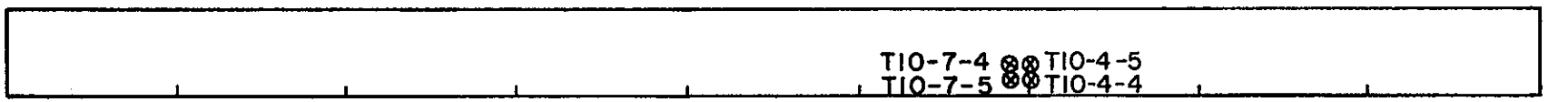


Figure 13

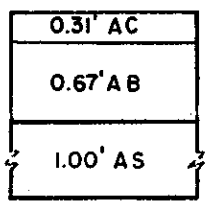
Rut Depth 1964*	0	4	4	0	4	0	8	0	0	0
Rut Depth 1965*	8	9	6	8	5	9	5	11	8	6



TEST DATA

	T10-4-4	T10-4-5	T10-7-4	T10-7-5
% Asphalt	5.0	5.7	6.0	4.9
Pen. at 77°F	28	32	38	29
S.P. (F°)	138	135	127.5	135
Duct. at 77°F (Cm)	100+	100+	100+	100+

STRUCTURAL SECTION



Completed 1/4/62

* Measured to nearest 0.001' in outer wheel track.

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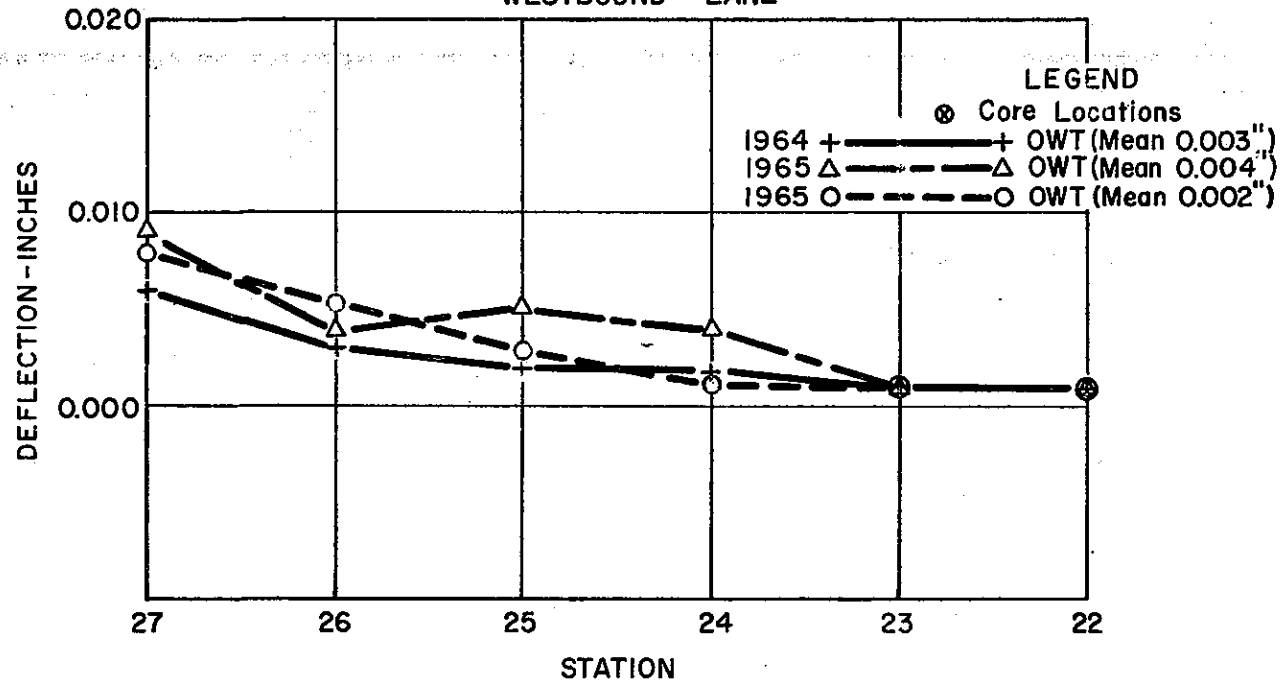
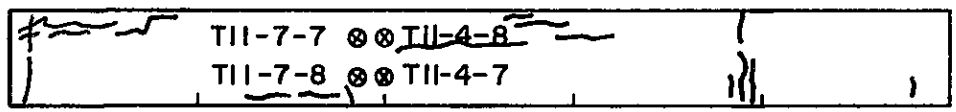
PROJECT 12
05-SBt-156
CONT. 61-5TC3
WESTBOUND LANE



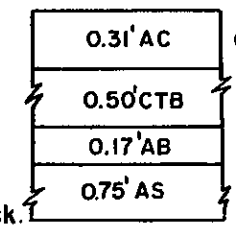
Rut Depth 1964*	8	4	4	4	4
Rut Depth 1965*	13	8	6	6	7



TEST DATA

	T11-4-7	T11-4-8	T11-7-7	T11-7-8
% Asphalt	5.0	4.9	5.1	4.6
Pen. at 77°F	23	31	56	27
S.P. (F°)	152.5	145	130	137
Duct. at 77°F (Cm)	29	100+	100+	100+

STRUCTURAL SECTION



Completed 6/5/6

* Measured to nearest 0.001' in outer wheel track.

Figure 14

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PROJECT 13
05-SLO-1
CONT. 61 - 5V13 C12
NORTHBOUND TRAVEL LANE

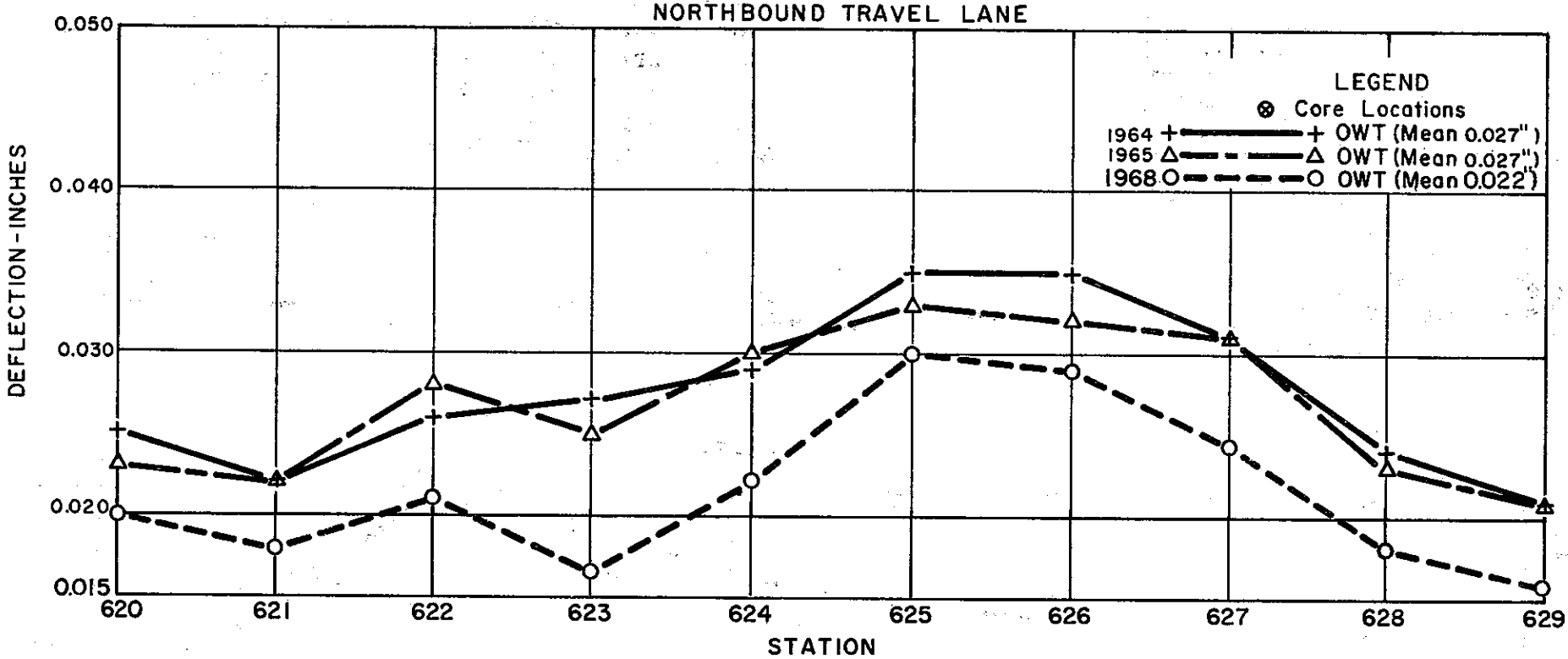


Figure 15

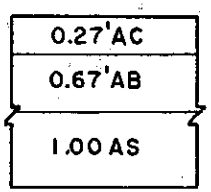
Rut Depth 1964*	0	0	0	0	0	4	0	4	8	0
Rut Depth 1965*	8	6	12	9	5	9	7	4	12	8

⊗ T14-7-1

TEST DATA

	T14-7-1
% Asphalt	5.6
Pen. at 77° F	23
S.P. (F°)	140
Duct. at 77° F (Cm)	100+

STRUCTURAL SECTION



Completed 8/15/63

* Measured to nearest 0.001' in outer wheel track.

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PROJECT 14

06-Ker-204

CONT. 64-6V13C2-F

WESTBOUND TRAVEL LANE

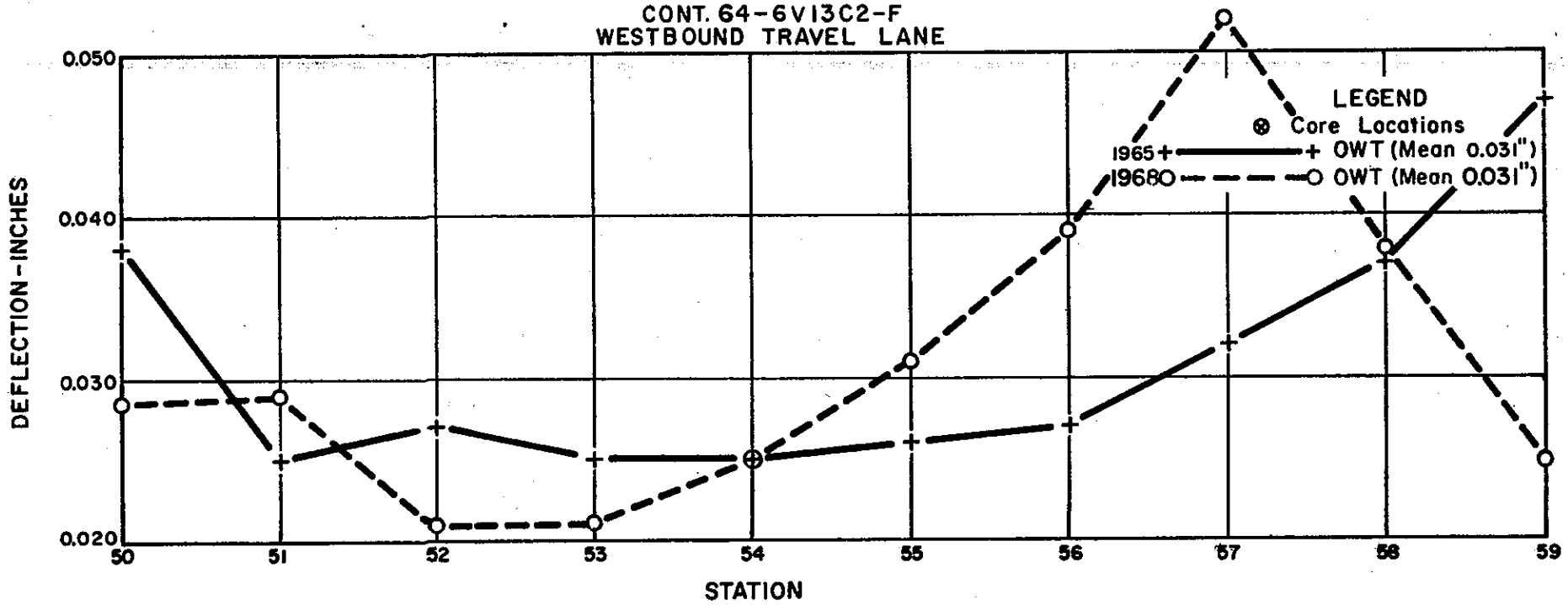
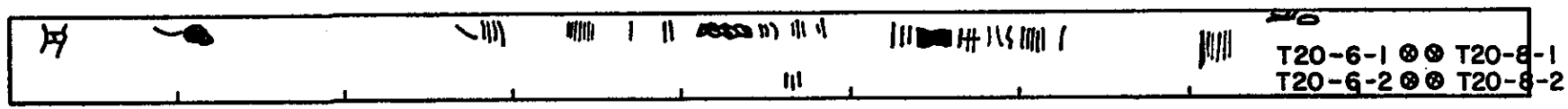
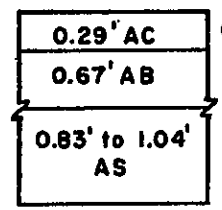


Figure 16



	T20-6-1	T20-6-2	T20-8-1	T20-8-2
% Asphalt	—	—	5.4	5.5
Pen. at 77°F	36	32	35	22
S.P. (F°)	129	132	130	136
Duct at 77° F (Cm)	100+	100+	100+	100+

STRUCTURAL SECTION



Completed 5/5/64

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PROJECT 15
06– Kin – 198
CONT. 62-6T13C4
EASTBOUND TRAVEL LANE

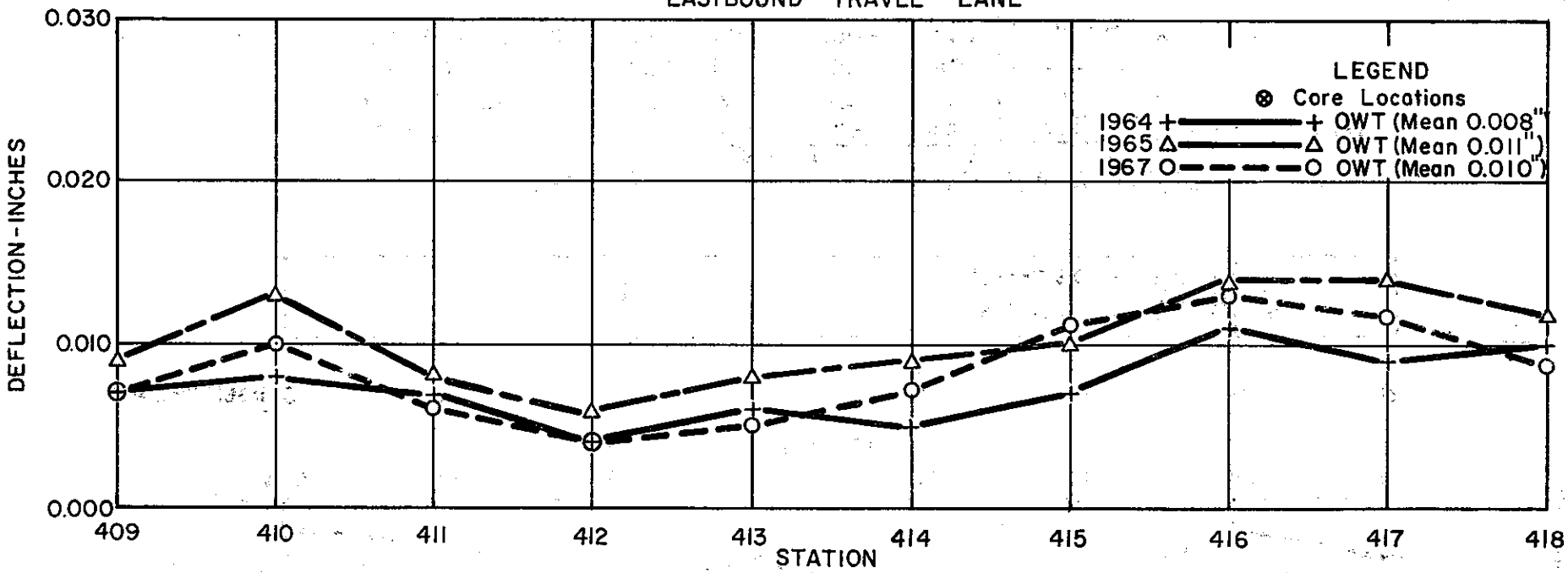


Figure 17

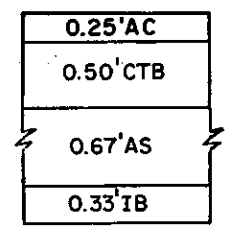
Rut Depth 1964*	0	0	0	0	0	0	0	0	0	0
Rut Depth 1965*	0	5	0	4	5	3	6	12	3	9

TEST DATA

	T9-5**	T9-4**	T9-7-4**	T9-7-5**
% Asphalt	5.2	4.9	5.3	4.6
Pen. at 77°F	26	20	20	20
S.P. (F°)	145.5	153	152	150
Duct. at 77°F (Cm)	69	22.5	10.6	11

* Measured to nearest 0.001'in outer wheel track.
** Cores taken at Sta. 419

STRUCTURAL SECTION



Completed 6/26/63

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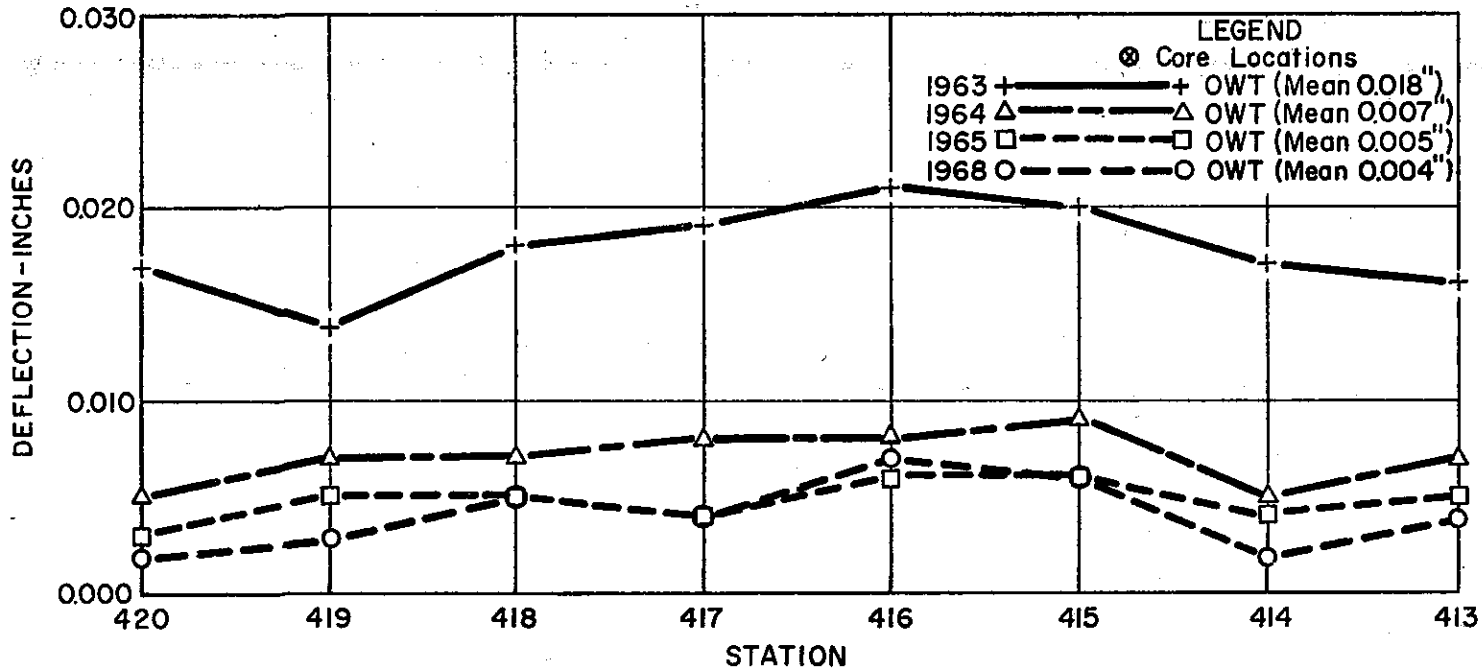
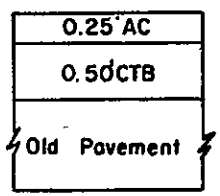
PROJECT 16
06-Kin, Tul-43
CONT. 63-6TI3C2-P
NORTHBOUND LANE



Rut Depth 1964 *	10	4	0	12	18	10	6	12

TEST DATA	TI5-5-4	TI5-5-5	TI5-7-4	TI5-7-5
% Asphalt	5.1	5.0	4.9	4.8
Pen. at 77°F	22	24	17	14
S.P. (F°)	139.5	138	137	140
Duct. at 77°F (Cm)	100+	100+	100+	100+

STRUCTURAL SECTION



Completed 2/4/63

* Measured to nearest 0.001' in outer wheel track.

Figure 18

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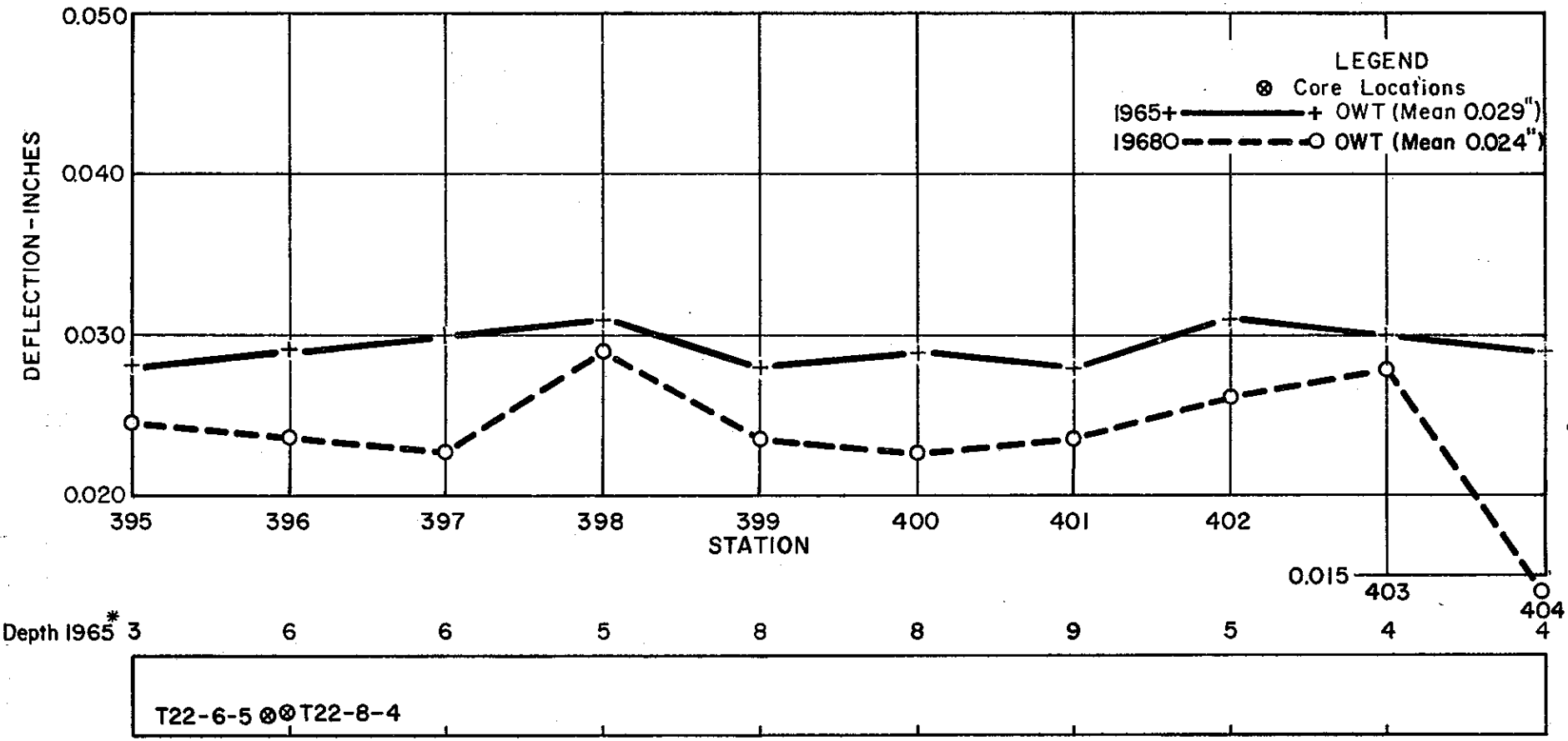
PROJECT 17
06-Fre-811-FAS
CONT. 64-6Y24C19-P
EASTBOUND LANE



Rut Depth 1965*	3	6	6	5	8	8	9	5	4	4

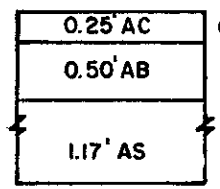
T22-6-5 ⊗⊗ T22-8-4

Figure 19

TEST DATA

	T22-6-5	T22-8-4
% Asphalt	—	5.0
Pen. at 77°F	15	17
S.P. (F°)	148	148
Duct. at 77°F (Cm)	100+	1

STRUCTURAL SECTION



Completed 9/29/64

* Measured to nearest 0.001' in outer wheel track.

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PROJECT 18
06-Fre-1329-CR
CONT. 64-6Y24C20-P
SOUTHBOUND LANE

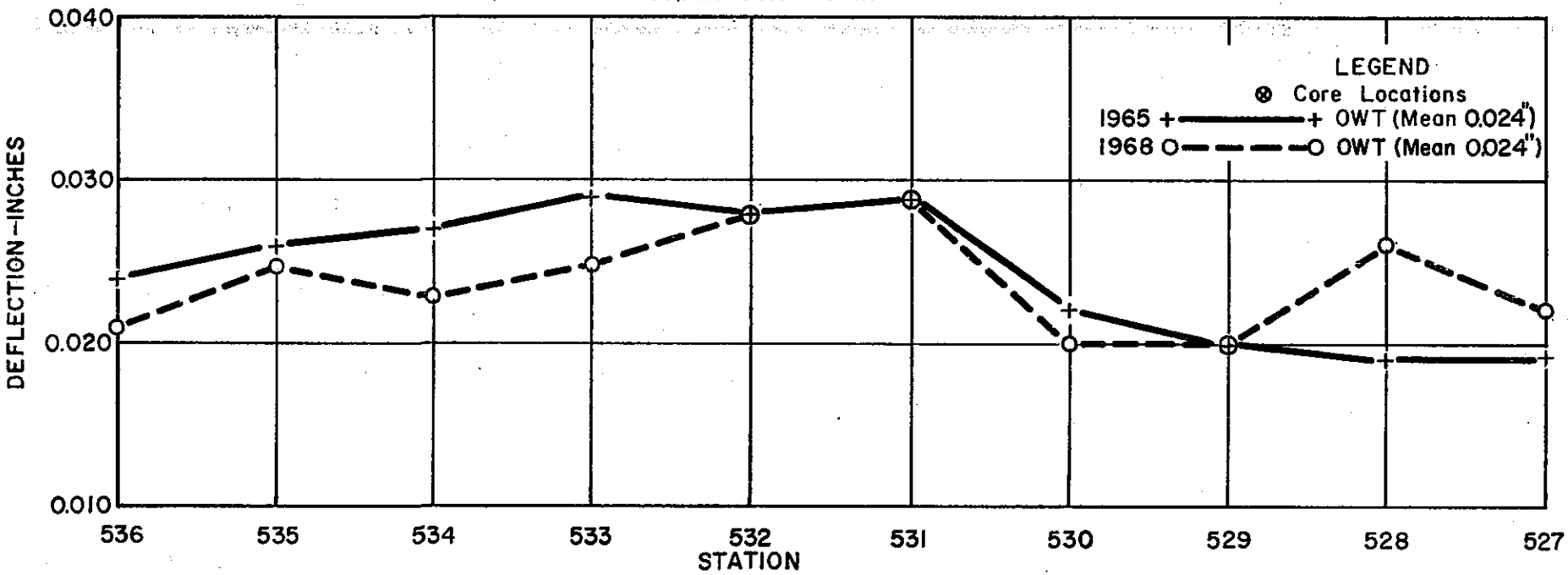


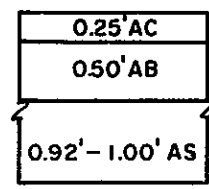
Figure 20

Rut Depth 1965* 0 6 7 3 0 6 7 0 7 4

TEST DATA

	T23-6-2	T23-8-1
% Asphalt	5.0	5.0
Pen. at 77° F	22	14
S.P. (F°)	134	146
Duct at 77° F (Cm)	100+	1

STRUCTURAL SECTION



Completed 10/7/64

* Measured to nearest 0.001' in outer wheel track.

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PROJECT 19
06 — Fre — 33
CONT. 60-6TC13-FP
SOUTHBOUND LANE

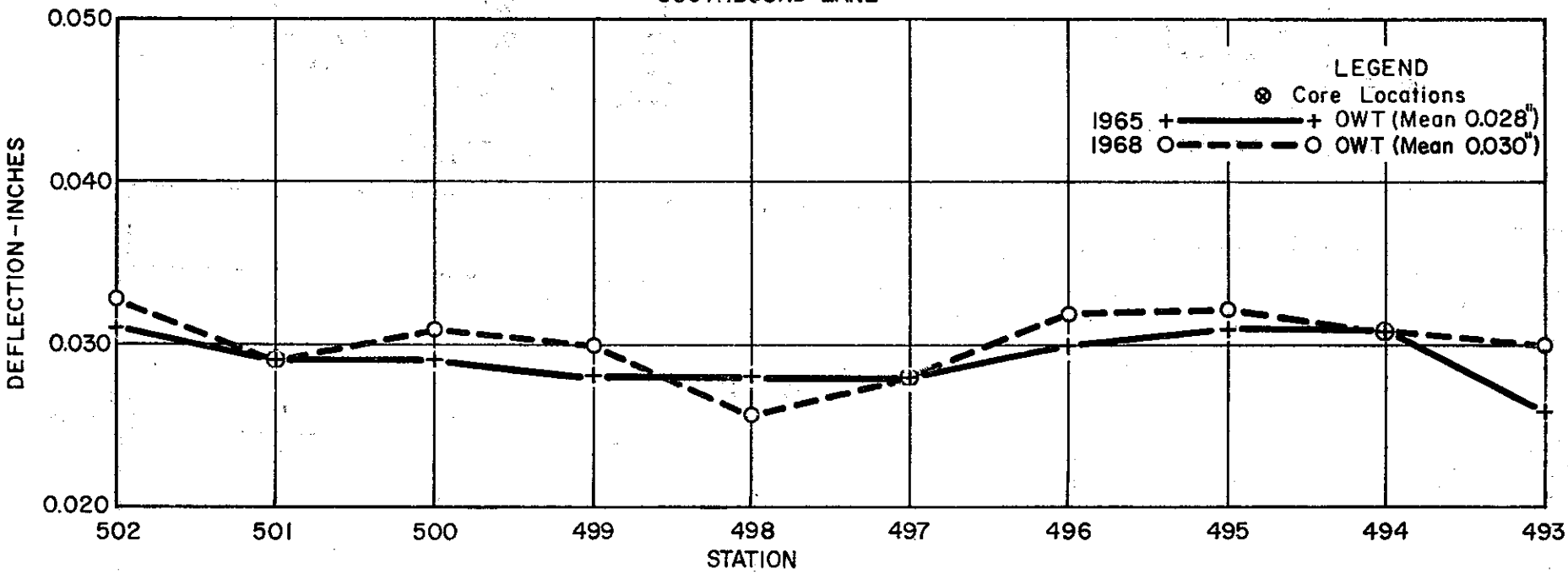
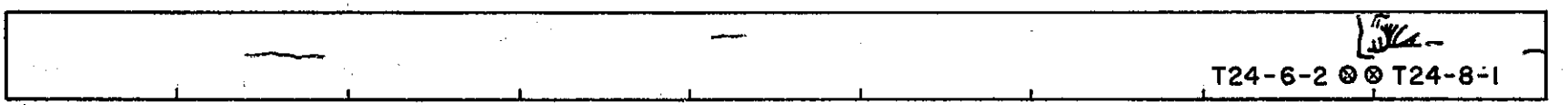


Figure 21

Rut Depth 1965* 11 8 15 18 9 16 18 16 8 16

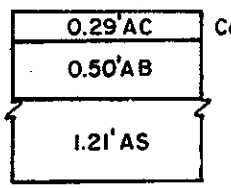


Seal coat placed 1967. Project dropped from study 1968

TEST DATA

	T24-6-2	T24-8-1
% Asphalt	—	4.7
Pen. at 77° F	16	12
S.P. (F°)	155	160
Duct. at 77° F (Cm)	8	7

STRUCTURAL SECTION



Completed 3/18/61

* Measured to nearest 0.001' in outer wheel track.

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PROJECT. 20
10-Cal-49
CONT. 64-10T13C14
SOUTHBOUND LANE

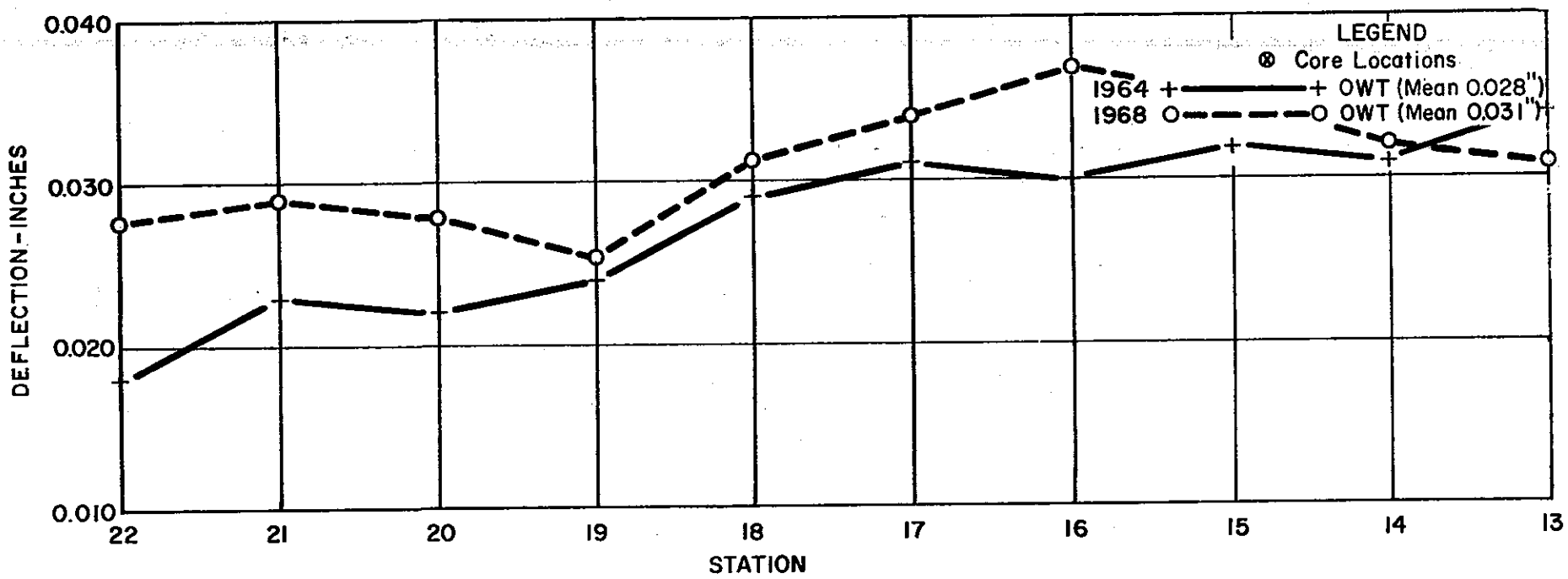
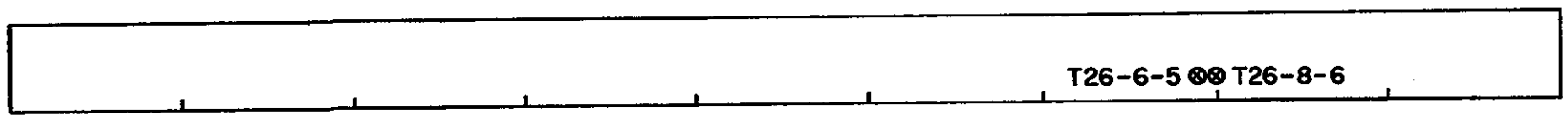


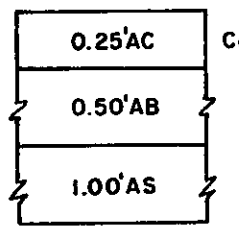
Figure 22



TEST DATA

	T26-6-5	T26-8-1
% Asphalt	—	4.6
Pen. at 77° F	30	23
S.P. (F°)	130	132
Duct at 77° F (Cm)	100+	100+

STRUCTURAL SECTION



Completed 8/12/64

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PROJECT 21

10-Sol-21

CONT. 60-10TC18-FI

WESTBOUND TRAVEL LANE

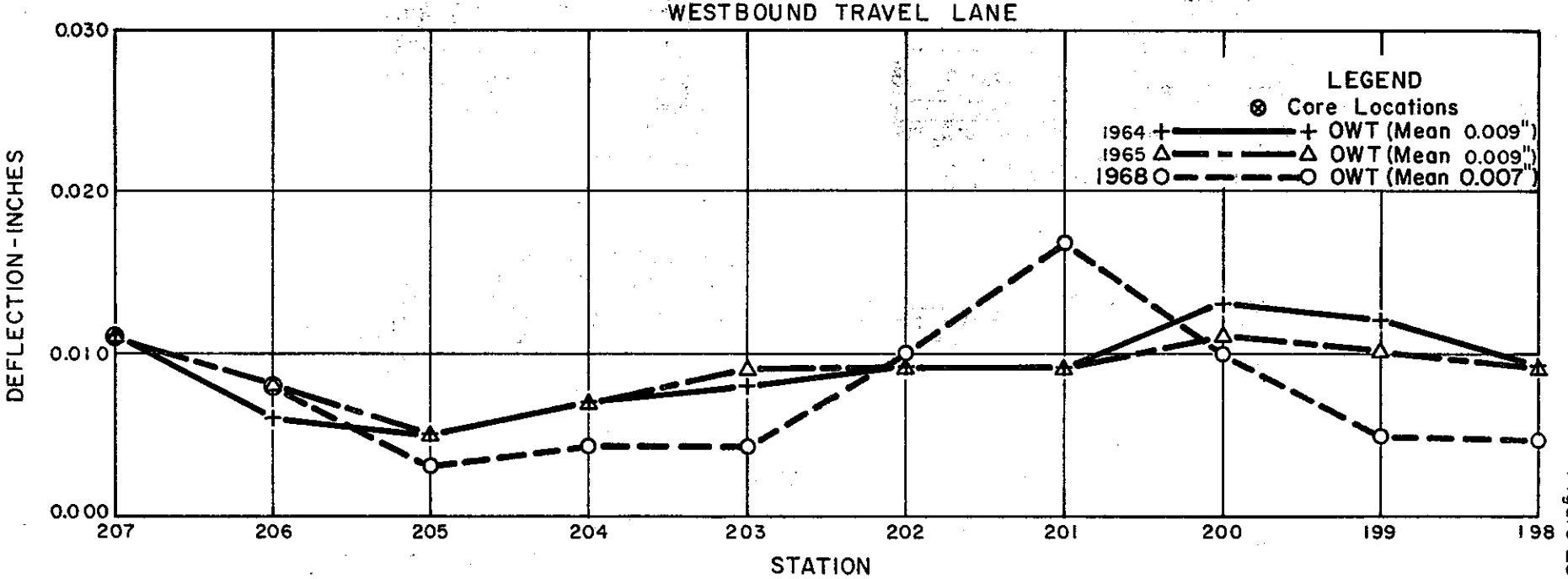
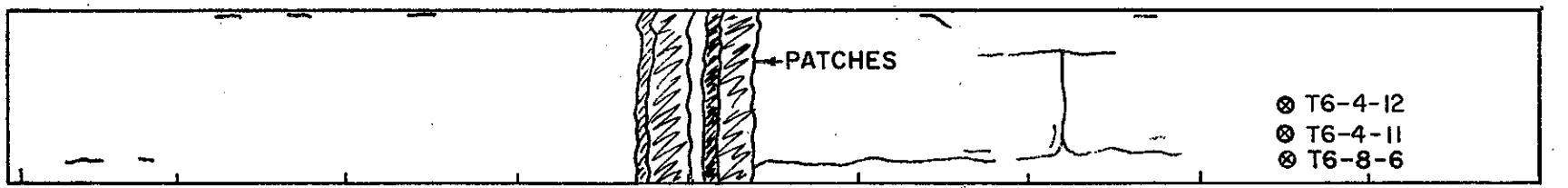


Figure 23

Rut Depth 1964*	0	0	8	12	16	0	0	0	8	0
Rut Depth 1965*	7	19	10	7	18	5	6	5	6	2

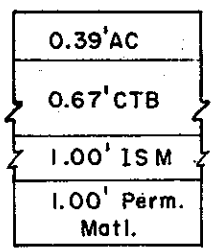


TEST DATA

	T6-4-11	T6-4-12	T6-8-6
% Asphalt	5.5	5.3	4.7
Pen. at 77°F	20	30	14
S.P. (F°)	149	142	151
Duct. at 77°F (Cm)	35	100+	14

* Measured to nearest 0.001' in outer wheel track.

STRUCTURAL SECTION



Completed 6/14/61

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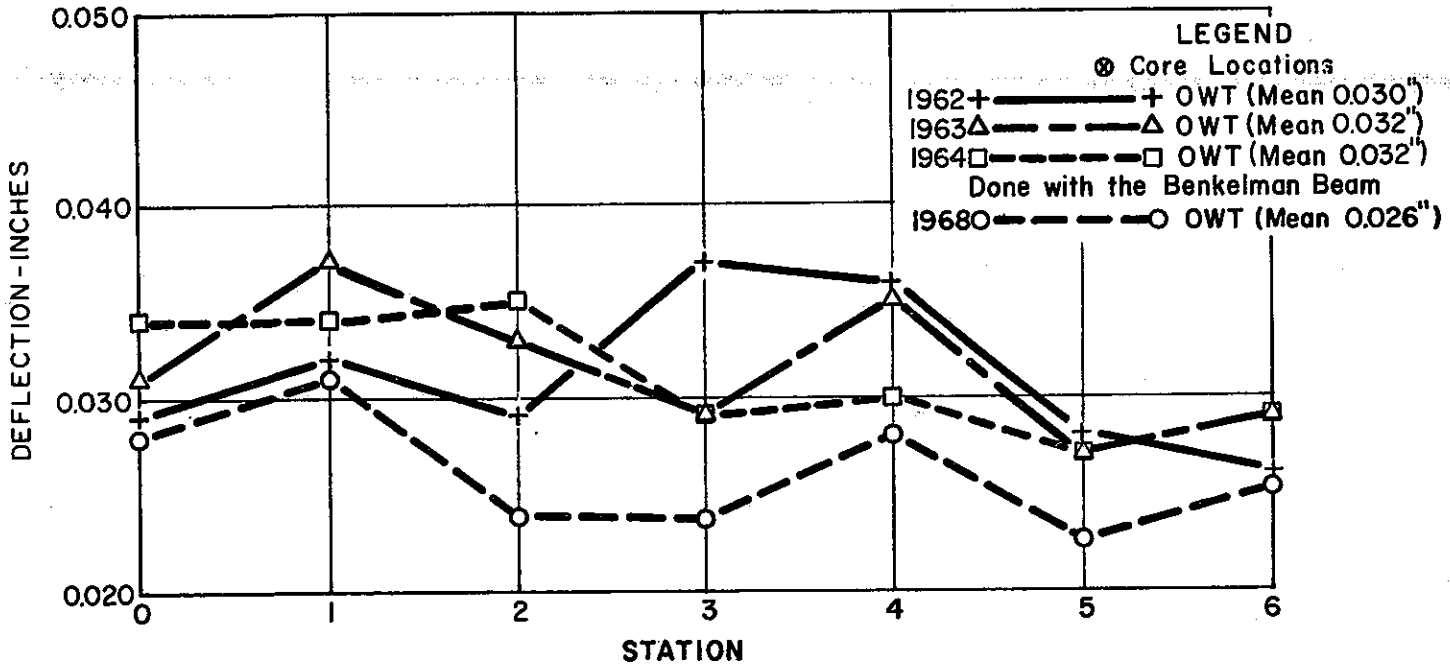
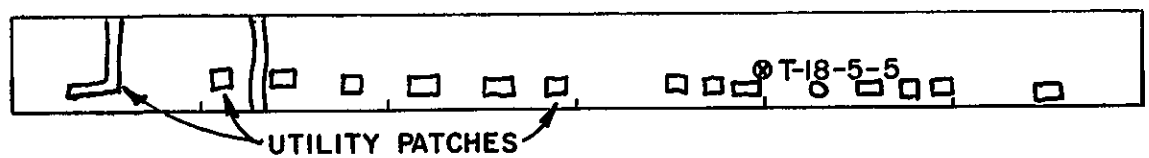
PROJECT 22A & 22B

City of Woodland – (03)

Cross Street Between

Elm And Cleveland

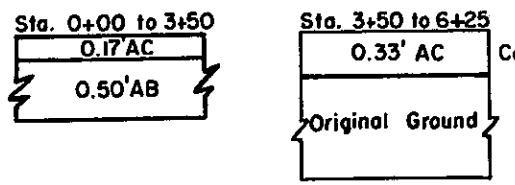




TEST DATA

	T-18-5-5
% Asphalt	4.3
Pen. at 77°F	27
S.P. (F°)	141
Duct. at 77° F (Cm)	100+

STRUCTURAL SECTION



Completed Summer of 1962

Figure 24

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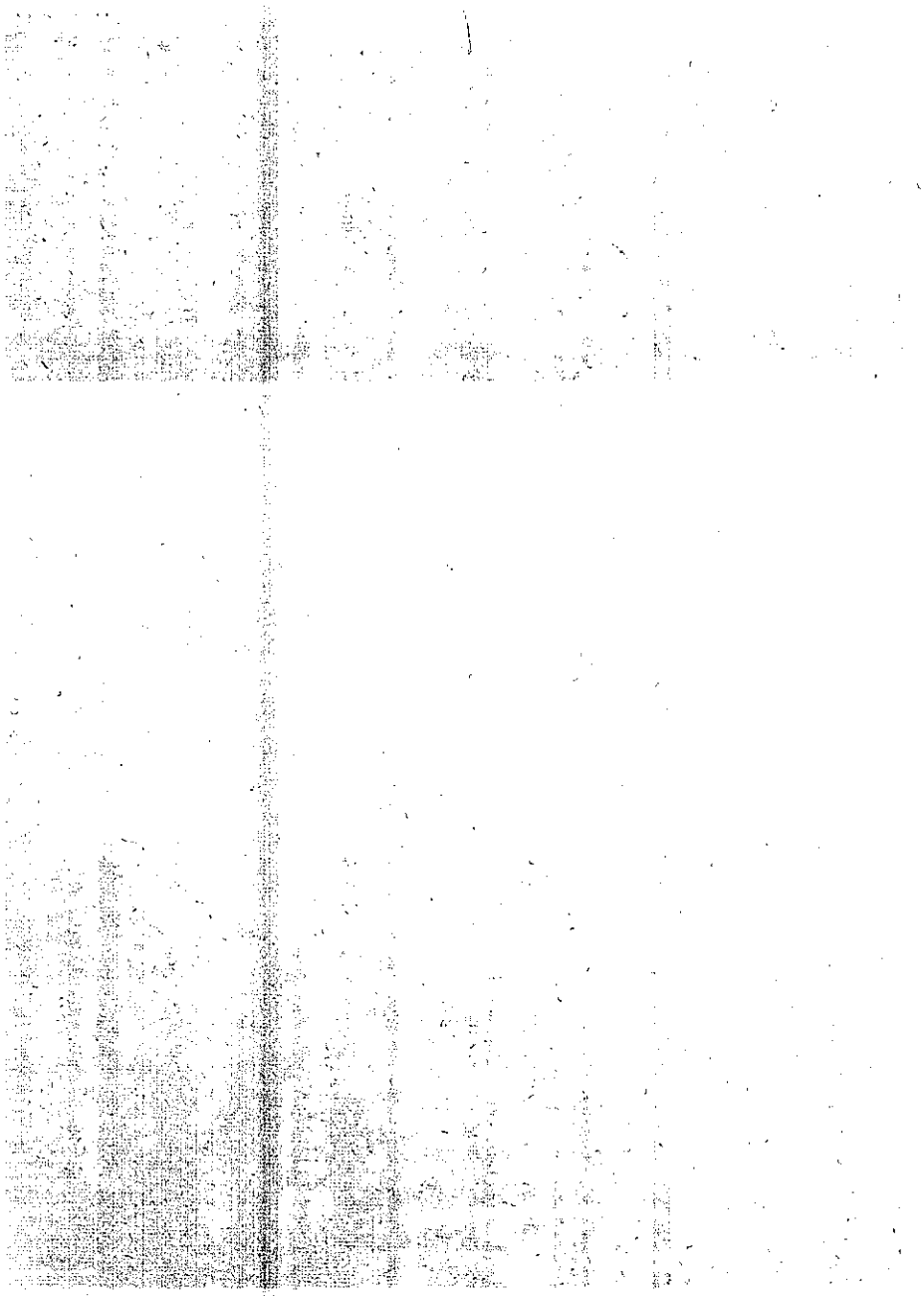

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