INCORPORATION OF THE 1986 AASHTO GUIDE INTO THE CONCRETE PAVEMENT DESIGN GUIDELINES OF THE TEXAS SDHPT

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INTRODUCTION

Prior to the 1986 AASHTO Guide for the Design of Pavement Structures (1), the Texas State Department of Highways and Public Transportation (Texas SDHPT) needed to account for many variables in the design of concrete pavements which were not explicitly covered in the 1981 AASHTO Guide (2). The variables included:

The huge rainfall differences across the state, ranging from 8 inches per year in El Paso County to 56 inches per year in Orange County;

The effect of tied concrete curb and gutter, monolithic curbs, and concrete shoulders on the thickness of the adjacent mainlane pavement;

The need to design undowelled jointed concrete pavement placed directly on subgrade for city streets where construction would adversely impact local businesses; and

The need for high reliability for pavements in critical high-traffic areas (where future repair operations could significantly delay traffic) and lower reliability for pavements in less critical areas.

In addition, the Texas SDHPT could not evaluate the effect of positive drainage on the design of concrete pavement structures, even though such drainage was not being used.

Now, with the 1986 AASHTO Guide, the Department is attempting to account for these variables in design. The Texas SDHPT adopted the design procedure from the 1986 Guide. Numbers for these variables are being used even though no performance data exists for the values assigned. The Department has also produced a computer program for the IBM Personal Computer based on the 1986 AASHTO Rigid Pavement Equation.

This paper first covers the design parameters being adopted by the Texas SDHPT for use in the 1986 Guide. Examples of pavement designs for two classifications are then discussed as follows:

Urban and rural freeway expansions, including mainlanes and frontage roads, and unbonded portland cement concrete (p.c.c.) overlays; and

Highway intersections and arterial street improvements, which involve thick, plain, jointed concrete pavements with no load transfer devices placed directly on the subgrade.

The authors have reviewed pavement designs generated by the Departmental designers during the 1980's and compared the answers with that which would have been obtained with the new guidelines using the 1986 AASHTO Guide.

DESIGN PARAMETERS ADOPTED FROM THE 1986 AASHTO GUIDE

The following design inputs were recommended to the Texas SDHPT District designers on July 20, 1987 as tentative recommendations. It is planned to finalize these recommendations in a Pavement Design Guide to be published in response to the new Federal Highway Administrations (FHWA) Pavement Policy.

Mean Concrete Modulus of Rupture

For concrete pavement, the Texas SDHPT currently specifies an average modulus of rupture of 650 psi using the center point loading test conducted seven days after the specimen is cast. The

1986 AASHTO Guide Rigid Pavement Equation requires a value based on the third-point loading test conducted 28 days after the specimen is cast. Assuming a standardized concrete strength gain curve and a using a conversion factor from center-point to third-point loading, a modulus of rupture value of 720 psi at 28-day third-point loading is recommended for design.

Concrete Elastic Modulus

The concrete elastic modulus varies depending on the coarse aggregate type to be used in the concrete pavement. It was found from past test data that 4,000,000 psi could be used for concrete containing limestone and 5,000,000 psi for concrete containing silicieous river gravel. Although the actual values could be somewhat different from these numbers, the elastic modulus does not have an important effect on the thickness of the pavement in the 1986 AASHTO Rigid Pavement Equation.

Effective Modulus of Subgrade/Subbase Reaction

Unlike the 1981 Guide, the 1986 AASHTO Guide allows pavement designers to take into account all layers to be placed under the concrete pavement. It also allows designers to consider the effect of loss of support of the underlying material due to erosion or deterioration. The previous Texas SDHPT design procedure does take the loss of support into account. However, the 1986 Guide recommends loss of support values for several materials, including a value of around 0.5 for stabilized subbase layers; the previous Texas SDHPT procedure recommended using loss of support values around 1 for such layers. Thus, Texas SDHPT pavement designers who previously used k-values from 100 to 200 pci for stabilized layers for use in the 1981 AASHTO Guide design procedure now generate values around 300 to 400 pci, based on the loss-of-support recommendations from the 1986 Guide. The effect is that more credit is given by the 1986 Guide for the support provided by stabilized subbases than the 1981 Guide considered.

Serviceability Loss

The 1986 AASHTO Guide procedure now puts more emphasis on the difference between the initial and terminal serviceability values rather than on the specific values themselves. Thus, a serviceability loss of 2.0 was adopted (usually from 4.5 to 2.5).

Load Transfer Coefficient

The selection of the proper load transfer coefficient depends on two factors:

The use of tied concrete shoulders, tied or monolithic curb and gutter, or greater than two lanes of traffic in one direction; and

The use of load transfer devices at transverse joints and cracks.

Table 1(a) lists the recommended load transfer coefficients.

Drainage Coefficient

The 1986 AASHTO Guide has incorporated a drainage coefficient that is dependent on the quality of the drainage under the pavement and on the anticipated exposure to moisture. The Texas SDHPT has not used positive drainage under concrete pavements. However, the Department has had vast experience with stabilized subbase layers. As a result of this experience, the Department believes that the non-erosive stabilized subbases currently used around the state provide performance equivalent to a fair level of drainage as used in the 1986 Guide. Thus, the coefficient of drainage is selected based on the anticipated yearly rainfall in the project area, provided that a non-erosive stabilized subbase is to be used. The recommended drainage coefficients are listed in Table 1(b).

If a non-erosive stabilized subbase is not provided, the drainage must be fair or better. However, if positive drainage (drainage blanket and edge drains) is to be provided, the drainage coefficient is selected based on the the proposed design with assistance from the Texas SDHPT Pavement Design Section of the Highway Design Division.

Overall Standard Deviation

This value, representing the variability of the inputs into the AASHTO Rigid Pavement Equation, was selected by the Department to be 0.39. It is felt that this number bests represents the overall uncertainty of the 1986 AASHTO Guide design procedure.

Reliability

The reliability factor incorporated into the 1986 AASHTO Guide Rigid Pavement Equation is now a separate input. Previously, a safety factor applied to the concrete strength was used with the 1981 Guide. The Department feels that higher reliabilities should be used for pavements where the consequences of failure would be very detrimental. In Texas, the selected reliability level is determined by the projected average daily traffic (ADT) per lane of the facility and by whether or not the facility would be a controlled access freeway. The projected ADT is obtained from the Texas SDHPT Transportation Planning Division's traffic data analysis for the particular project. The recommended reliability levels are shown in Table 1(c).

It is assumed that higher reliability levels would produce facilities that require less repair maintenance over their design lives. Thus, higher reliabilities are provided for facilities where future repair operations could adversely delay traffic. Conversely, lower reliabilities are suggested for facilities where delays to traffic would not be as significant.

Design Traffic

In addition to the projected ADT of the facility, the traffic data analysis obtained from the Transportation Planning Division (D-10) also includes the total number of 18 kip equivalent single axle loads (KSALs) for a thirty year design life (Previously, the Department designed for twenty years). This value is then corrected for the total number of lanes in both directions. A correction factor, known as the lanal distribution factor, is selected as shown in Table 1(d).

PAVEMENT DESIGN EXAMPLES

The following pavements were designed using one of the following methods:

1. the 1986 AASHTO Guide without the recommended values discussed in the previous section,

2. the 1986 AASHTO Guide with the recommended values, or

3. the 1981 AASHTO Guide.

As mentioned in the introduction, the examples are split into two categories. The first category is made up of pavement designs for urban and rural freeway expansions. The second category consists of pavement designs for intersections and city arterial improvements. For the examples designed using either method 1 or 3 above, the designs are compared to what the 1986 AASHTO Guide generates with the recommended values, method 2.

Category I: Pavement Designs for Urban and Rural Freeway Expansions

Table 2 lists the designs under this category. These designs include Beltway 8, U.S. 90, IH 10, and IH 45 in Houston; IH-10 east of Beaumont in Chambers County; and IH-35E and US 75 in Dallas. The Table also includes designs for various Farm to Market Roads (FM) and Metropolitan Highways (MH).

The designs in this category involve CRCP for mainlanes and frontage roads. Seven of these designs involve unbonded PCC overlays of existing pavements, which means that the quality of the support is considered to be greatly improved for these pavements as compared to pavements over other subbases. Thus, the potential loss of support for these overlays is reduced.

Category II: Pavement Designs for Highway Intersections and Arterial Street Improvements

Table 3 contains selected examples for this category, which consists entirely of thick concrete pavements with no load-transfer devices placed directly on the subgrade. As noted earlier, these designs are for roadways in urban areas where construction would adversely impact local businesses. Five of the six designs in the Table are from Texas SDHPT District 19, the largest user of this pavement type. In addition, Table 4 contains other projects in District 19 using pavements under this category; they are presented as information only and are not compared with the 1986 AASHTO Guide designs (3). As it can been seen from the tables, the District has been constructing such pavements since 1976. So far, the District has had favorable experience with these roadways in terms of both constructability and performance.

Comparison of Examples with the 1986 AASHTO Guide

Tables 5 and 6 shows the originally proposed designs made by various Texas SDHPT pavement designers using the 1981 AASHTO Guide and the 1986 AASHTO Guide, respectively. In addition, for comparative purposes, Tables 7 and 8 show what the design inputs and the resulting concrete pavement thickness would be for each example if the designers used the 1986 AASHTO Guide with the recommended values discussed in the previous section of this paper. The original design thicknesses are indicated in the tables by T81 for the 1981 Guide designs and T86 for the 1986 Guide designs. The comparative thicknesses generated for this paper using the 1986 Guide and the recommendations are indicated by TC. The 1986 Guide values are rounded up to the nearest inch, as were most of the original designs (For example, 9.28 inches is rounded up to 10 inches).

For the designs using the 1981 Guide, the design concrete strength required in the Texas SDHPT specifications was divided by a factor of safety (defined in the 1981 AASHTO Guide as C) to generate the allowable working stress. For the vast majority of these designs, a safety factor of 1.5 was used. Additionally, for the 1986 Guide designs (methods (1) and (2)), the difference between the initial and terminal present serviceability indices (PSI's) was two, with the majority of the designs using an initial PSI of 4.5 and a terminal PSI of 2.5.

Figure 1 is a plot of the actual thicknesses originally proposed using the 1981 Guide and the thicknesses generated for this paper using the 1986 Guide. Figure 2 is a histogram showing the frequency of the differences between these thicknesses. The difference for each example was calculated using the equation:

$$D = T81 - TC$$

where:

D = Difference, inches
T81= Original thickness generated using the 1981 Guide, inches
TC = Comparative thickness generated using the 1986 Guide with the recommended values, inches

Thus, when the difference is positive, the designs using the 1981 Guide are larger than the comparative 1986 Guide designs; when the difference is negative, the comparative 1986 Guide designs are larger.

Figures 3 and 4 are similar graphs to Figures 1 and 2, but these graphs show the difference between the original thickness generated using the 1986 Guide (T86) and the comparative thickness generated for this paper using the 1986 Guide and the recommended values (TC). As mentioned earlier, some of these designs were calculated without the benefit of the recommended values; therefore, the figures show the effect of the recommendations on the original designs generated by the Texas SDHPT pavement designers.

To see how much the individual inputs for the 1986 AASHTO Rigid Pavement Equation affected the final concrete pavement thickness, a sensitivity analysis was conducted. The selected variables are listed in Table 9, and the results of this analysis are shown in Figures 5 through 9. As it can be seen, the reliability and load transfer coefficient affect the thickness the most, followed by the coefficient of drainage, the change from twenty to thirty year traffic projections, and the loss of support.

After reviewing the examples, it was found that, in the cases where more thickness was calculated by the Texas SDHPT designers than the comparative designs generated by the 1986 Guide with the recommended values:

Larger reliabilities were used in the original designs than what are now recommended,

Larger loss of support values were used in the original designs than what are now recommended, and

The effect of tied concrete shoulders, tied curb and gutter, or greater than two lanes in one direction was not considered originally.

Conversely, for the cases where less thickness was calculated by the Texas SDHPT designers than the comparative designs generated by the 1986 Guide with the recommended values:

Smaller reliabilities were used in the original designs than what are now recommended,

The load transfer coefficients originally used were lower than what are now recommended,

Twenty-year, rather than thirty-year, traffic projections were used in the original designs, and

Lanal distribution factors lower than what are now recommended were used by the Texas SDHPT designers.

It should also be added that the 1986 AASHTO Guide procedure, along with the recommended values, does not generate radically different answers than what the Department had calculated before, and, on the average, it gives the same answers, as shown in Figure 10. However, it is believed Texas SDHPT designers can design more accurately by assigning more meaningful inputs to represent real-world conditions. Adoption of the guidelines will result in consistent answers. Hopefully, the answers generated by the 1986 Guide will produce the correct concrete pavement thicknesses at the right locations.

CONCLUSIONS

The following conclusions are made from this paper:

The 1986 AASHTO Guide appears to give reasonable answers to concrete pavement design problems.

The 1986 AASHTO Guide addresses some important design considerations that were not considered in the 1981 Guide, such as:

(a) the amount of rainfall,

(b) the effect of load transfer provided by reinforcing steel at transverse joints and cracks, tied concrete shoulders, tied curb and gutter, and where greater than two lanes of traffic in one direction exist,

(c) the idea of providing greater reliability for pavements in critical high traffic areas and lower reliability in less critical areas, and

(d) the effect of positive drainage under concrete pavements.

Recommended inputs have been developed for use in the 1986 AASHTO Guide design procedure. These inputs have, on the average, generated the same thicknesses as the designs previously produced by Texas SDHPT designers using either the 1981 Guide or the 1986 Guide without the benefit of the recommended inputs.

The use of the recommended inputs for the 1986 AASHTO Guide design procedure will result in more consistent and repeatable designs.

REFERENCES

1. "AASHTO Guide for Design of Pavement Structures, 1986," American Association of State Highway and Transportation Officials, Washington, D.C., 1986.

2. "AASHTO Interim Guide for Design of Pavement Structures, 1972, Chapter III Revised, 1981," American Association of State Highway and Transportation Officials, Washington, D.C., 1981.

3. Wimberly, Sawyer R., "Thick Concrete Pavement Evaluation Report," Experimental Project Report 633-1, Texas State Department of Highways and Public Transportation, March 1985; Wimberly, Sawyer R., "Addenda to 'Thick Concrete Pavement Evaluation Report' Report Number 633-1", Texas State Department of Highways and Public Transportation, March 1987; and Wimberly, Sawyer R., unpublished data.

TABLE 1. RECOMMENDED VALUES FOR DESIGN USING THE 1986 AASHTO GUIDE

Table 1(a). Load Transfer Coefficients

Tied PCC Shoulders, Curb and Gutter, or Greater than Two Lanes in One Direction		Yes	No
Load Transfer Devices at Transverse Joints or Cracks or Dowels at Joints	Yes	2.9	3.2
	No	3.7	4.2

Table 1(b). Drainage Coefficients

Annual Rainfall	Drainage Coefficient
58-50	0.91-0.95
48-40	0.96-1.00
38-30	1.01-1.05
28-20	1.06-1.10
18-8	1.11-1.16

Table 1(c). Recommended Reliability Values

Projected ADT/Lane		
Controlled Access Freeway	Other Highways	Recommended Reliability
N/A	< 15,000	85%
< 15,000	15,000-20,000	95%
15,000-20,000	21,000-25,000	99%
> 20,000	> 25,000	99.9%

Table 1(d). Lanal Distribution Factors

Number of Lanes in Both Directions	Lanal Distribution Factor
4 lanes and less	1.0
6 lanes	0.7
8 lanes or more	0.6

TABLE 2. PAVEMENT DESIGNS FOR URBAN AND RURAL FREEWAY EXPANSIONS

PROJ REF NO.[a]	HWY[b]	DST[c]	PAVEMENT[d]	NO. LNS[e]	DATE MO YR[f]		ADT[g]	LDF[h]	TRAFFIC[j]	DES LIFE[k]	T[m]
1	FM2499	2	CRCP ML	4	12 87	11 (91)	29 (20)	1.00	2.6	30	8
2	US82	3	CRCP ML	4	11 86	30 (85)	72 (05)	1.00	6.0	20	10
3	US90	12	CRCP FR	4 *	10 85	10 (87)	45 (17)	1.00	0.2	30	8
4	US90	12	CRCP FR	6	10 86	3 (85)	11 (15)	0.70	1.2	30	8
5	FM518	12	CRCP ML	4	11 85	10 (87)	27 (05)	1.00	2.6	20	9
6	FM518	12	CRCP ML	4	6 85	13 (?)	43 (?)	0.60	2.8	30	9
7	BW8	12	CRCP FR	6	1 86	8 (89)	15 (09)	0.70	3.6	30	9
8	BW8	12	CRCP FR	6	1 86	8 (89)	15 (09)	0.70	3.6	30	9
9	BW8	12	CRCP FR	6	1 86	6 (89)	11 (19)	0.70	3.6	30	9
10	SH35	12	JRCP ML	6	4 87	21 (90)	40 (20)	0.70	4.0	30	9
11	FM1462	12	CRCP ML	4	3 84	4 (83)	10 (03)	1.00	4.1	20	9
12	BW8	12	CRCP FR	6	1 86	10 (86)	17 (16)	0.70	4.4	30	10
13	BW8	12	CRCP FR	6	1 86	10 (86)	17 (16)	0.70	4.4	30	10
14	US90	12	CRCP FR	6	4 87	6 (97)	14 (24)	0.70	4.6	30	10
15	BW8	12	CRCP FR	6	1 86	10 (88)	17 (18)	0.70	4.8	30	10
16	FM2094	12	CRCP ML	4	1 87	8 (89)	27 (19)	1.00	5.3	30	10
17	FM1093	12	CRCP ML	6	11 86	15 (88)	35 (18)	0.70	5.7	30	10
18	FM525	12	CRCP ML	6	9 86	26 (92)	57 (19)	0.70	6.6	30	10
19	IH10(E)	12	JRCP FR	6 *	4 87	4 (87)	14 (17)	0.70	7.1	30	11
20	IH45	12	CRCP FR	6	6 85	10 (85)	40 (15)	0.70	7.4	30	10
21	IH45	12	CRCP FR	6	12 87	13 (88)	43 (18)	0.70	8.6	30	10
22	FM528	12	CRCP ML	6	6 87	15 (90)	44 (20)	0.70	9.1	30	10
23	FM528	12	CRCP ML	6	6 87	17 (90)	51 (20)	0.70	9.3	30	10
24	FM2351	12	CRCP ML	4	12 87	19 (91)	56 (21)	1.00	11.3	30	9
25	US90	12	CRCP ML	4	3 86	20 (85)	59 (05)	1.00	11.8	20	13
26	FM528	12	CRCP ML	4	6 87	15 (90)	44 (20)	1.00	13.0	30	10
27	BW8	12	CRCP FR	6	7 85	48 (85)	69 (05)	0.60	13.8	20	10
28	SH146	12	CRCP ML	4	1 85	16 (85)	41 (05)	1.00	13.8	20	11
29	US90	12	CRCP ML	8	4 87	33 (97)	115 (27)	0.60	14.5	30	12
30	US90	12	CRCP ML	4 *	10 85	10 (87)	45 (17)	1.00	15.8	30	11
31	SH6	12	CRCP MLOLW	6	11 86	37 (85)	87 (15)	0.70	16.2	30	11
32	SH6	12	CRCP ML	6	12 85	47 (90)	90 (15)	0.70	16.3	30	11
33	FM1960	12	CRCP ML	6	11 86	35 (86)	94 (16)	0.70	18.2	30	11
34	BW8	12	CRCP ML	6	8 87	47 (89)	148 (19)	0.70	28.8	30	13
35	BW8	12	CRCP ML	6	3 85	25 (84)	81 (05)	0.70	32.2	30	12
36	IH10(W)	12	CRCP MLOL	6	4 87	40 (89)	78 (19)	0.70	37.8	30	13
37	IH10	12	CRCP ML	6	5 86	6 (85)	37 (15)	0.70	42.6	30	13
38	BW8	12	CRCP ML	6	6 87	6 (85)	37 (15)	0.70	42.6	30	13
39	BW8	12	CRCP ML	6	11 86	58 (87)	101 (17)	0.70	45.0	30	13
40	BW8	12	CRCP ML	6	1 86	58 (87)	101 (17)	0.70	45.0	30	13
41	IH10(W)	12	CRCP MLOL	6	4 87	77 (87)	118 (17)	0.70	53.6	30	13
42	IH10(W)	12	CRCP MLOLW	6	4 87	77 (87)	118 (17)	0.70	53.6	30	14
43	IH10(E)	12	CRCP MLOL	6 *	4 87	116 (87)	220 (17)	0.60	76.8	30	15
44	IH45	12	CRCP ML	8	6 85	77 (85)	200 (15)	0.60	80.3	30	15
45	IH45	12	CRCP ML	10	12 87	90 (88)	212 (18)	0.60	92.2	30	15
46	US290	14	CRCP ML	6	2 88	36 (90)	68 (10)	0.70	5.4	30	10
47	IH35E	18	CPCD RAMPS	1 *	10 86	5 (86)	10 (06)	1.00	0.6	20	8
48	MH40	18	CPCD ML	6	5 86	9 (86)	31 (06)	0.84	0.7	20	8
49	FM2514	18	CPCD ML	6	5 87	9 (90)	16 (10)	1.00	0.7	20	8
50	SH5	18	CPCD ML	6	5 87	11 (90)	17 (10)	1.00	1.0	20	8
51	FM544	18	CPCD ML	6	5 87	11 (90)	19 (10)	1.00	1.2	20	8
52	FM2478	18	CPCD ML	6	5 87	11 (90)	19 (10)	1.00	1.3	20	8
53	SH5	18	CPCD ML	6	5 87	18 (90)	35 (10)	1.00	1.6	20	8
54	MH418	18	CPCD ML	6 *	4 87	32 (87)	50 (07)	0.80	3.7	20	8
55	US75	18	CRCP FR	6 *	3 88	22 (88)	46 (18)	0.90	3.8	30	8
56	US75	18	CRCP FR	6 *	3 88	22 (88)	46 (18)	0.90	3.8	30	8
57	SH289	18	CPCD ML	4	7 88	15 (92)	40 (22)	1.00	3.9	30	9
58	FM1382	18	JRCP ML	6	7 87	18 (84)	39 (04)	1.00	5.4	20	9
59	MH68	18	JRCP ML	6	7 87	18 (84)	39 (04)	1.00	5.4	20	9
60	US75	18	JRCP NBFR	6	3 87	12 (90)	23 (20)	0.60	8.2	30	9
61	SH78	18	CPCD ML	6	6 88	16 (87)	41 (17)	0.70	8.6	30	10
62	US75	18	JRCP SBFR	6	3 87	13 (90)	24 (20)	0.60	8.7	30	9
63	MH420	18	CPCD ML	4 *	8 87	22 (87)	67 (07)	1.00	9.5	20	10
64	SH190	18	CRCP FR	6 *	11 86	33 (90)	76 (10)	1.00	14.0	20	10
65	US67	18	CPCD ML	4	5 87	25 (86)	61 (16)	1.00	19.5	30	11
66	SPR354	18	CPCD ML	6	2 88	31 (87)	62 (17)	0.70	25.0	30	11
67	SH190	18	CRCP ML	8 *	10 87	48 (90)	165 (20)	0.60	30.8	30	13
68	US75	18	CPCD MLOL	6	10 85	44 (88)	83 (08)	1.00	32.3	20	12
69	US75	18	CRCP ML	8	3 88	121 (88)	206 (18)	0.75	39.8	30	13
70	US75	18	CRCP ML	8	3 88	121 (88)	206 (18)	0.75	39.8	30	13
71	US75	18	CRCP ML	8	3 88	121 (88)	206 (18)	0.75	39.8	30	13
72	US75	18	CRCP ML	8	3 88	121 (88)	206 (18)	0.75	39.8	30	13
73	IH35E	18	CPCD ML	6	5 87	52 (88)	105 (18)	0.70	54.8	30	12
74	US75	18	CRCP ML	8	3 87	110 (90)	197 (20)	0.60	69.5	30	13
75	SPR380	20	JRCP ML	6	9 86	18 (85)	45 (15)	0.70	11.0	30	12
76	IH10	20	CPSJ MLOL	6	7 88	26 (87)	46 (07)	0.70	73.2	30	14
77	IH10	24	CRCP RAMPS	1	10 86	24 (86)	32 (06)	1.00	0.9	20	8

FOOTNOTES FOR TABLE 2:

* - Assumed value for the number of lanes.

a - The project reference number.

b - For the highway designations:

FM:	Farm-to-Market Road	SH:	State Highway
IH:	Interstate Highway	US:	U.S. Highway
MH:	Metropolitan Highway	BW:	Beltway
SPR:	Spur		

c - This column indicates the Texas SDHPT District where the pavement will be constructed. The respective District Headquarters are as follows:

District 2 - Fort Worth	District 19 - Atlanta
District 3 - Wichita Falls	District 20 - Beaumont
District 12 - Houston	District 24 - El Paso
District 14 - Austin	District 25 - Childress
District 18 - Dallas	

d - The definitions for the individual pavement abbreviations are as follows:

CRCP - Continuously Reinforced Concrete Pavement
JRCP - Joint Reinforced Concrete Pavement
CPCD - Concrete Pavement Contraction Joint Design
CPSJ - Skewed Joint Concrete Pavement
ML - Main Lanes
FR - Frontage Roads
INT - Intersection
OL - Overlay
W - Widening
NB - Northbound
SB - Southbound

e - This column represents the total number of lanes of the facility.

f - This is the date the design was submitted by the Texas SDHPT pavement designer to the Highway Design Division.

g - The column represents the Average Daily Traffic values (in thousands of vehicles per day) and the years in which they were calculated. Thus:
18 (84) 39 (04)
means 18000 vehicles/day in 1984 and 39000 vehicles/day in 2004.

h - Lanal Distribution Factor.

j - The Design Traffic, expressed as 18 KSAL's in millions, used in the design calculation. This figure is the product of the Lanal Distribution Factor and the projected traffic provided by the Transportation Planning Division's traffic analysis.

k - The design life of the facility in years.

m - The thickness (in inches) originally proposed by the Texas SDHPT pavement designer (both the 1981 and 1986 Guide designs).

TABLE 3. PAVEMENT DESIGNS FOR HIGHWAY INTERSECTIONS AND ARTERIAL STREET IMPROVEMENTS

PROJ REF NO.	HWY	DST	PAVEMENT	NO. LNS	DATE MO YR	ADT		LDF	TRAFFIC	DES LIFE	T
78	US67	19	CPCD ML	4	5 86	9 (87)	12 (07)	1.20	4.4	30	13
79	FM559	19	CPCD ML	4	6 84	14 (87)	22 (07)	1.00	6.9	20	13
80	FM559	19	CPCD ML	4	11 86	7 (85)	15 (05)	1.20	13.6	30	13
81	US259	19	CPCD ML	4	12 87	10 (91)	19 (11)	1.00	16.1	30	13
82	US59	19	CPCD ML	4	7 87	8 (85)	16 (05)	1.00	28.7	30	13
83	US59	19	CPCD ML	6	11 87	12 (85)	23 (05)	0.70	38.0	30	14
84	US287	25	CPCD ML	4	9 84	15 (83)	26 (03)	1.00	23.7	20	13

See Table 2 for table definitions.

TABLE 4. PAVEMENTS FOR HIGHWAY INTERSECTIONS AND ARTERIAL STREET IMPROVEMENTS IN DISTRICT 19

HWY	PAVEMENT	CONSTR MO	CONSTR YR[a]	ADT[b]	TRAFFIC		TA[c]
US67&US82	CPCD ML	12	76	20 (83)	7.9		13
US67	CPCD ML	8	77	20 (83)	7.9		13
US67	CPCD ML	4	79	13 (83)	6.2		13
IH20	CPCD RAMPS	2	81	17 (83)	32.5	*	13
IH20	CPCD RAMPS	6	83	12 (83)	11.1	*	13
LP 281	CPCD ML,RAMPS	10	84	5 (83)	10.7		13
US59	CPCD ML	8	81	10 (83)	17.0		13
US59	CPCD INT NBML	11	83	7 (83)	11.5		13
US59&US79	CPCD RAMPS	11	83	5 (83)	10.6		13
US59&US79	CPCD ML,RAMPS	11	83	5 (83)	11.7		13
US59	CPCD RAMPS	11	83	6 (83)	11.1		13
LP419	CPCD ML	6	83	13 (83)	28.5		13
IH30	CPCD RAMPS	7	80	13 (83)	20.5	#	13
IH30	CPCD RAMPS	3	81	11 (83)	15.1	#	13
IH30	CPCD RAMPS	3	81	12 (83)	21.0	#	13
US259	CPCD INT	11	82	11 (83)	18.6		13
FM989	CPCD ML	8	84	2 (83)	1.6		13
SH93	CPCD ML	8	84	10 (83)	6.6		13
SH43	CPCD ML	3	84	9 (83)	12.6		13
US259	CPCD ML	4	83	8 (83)	14.9		13
US271&US67	CPCD INT	12	84	11 (83)	20.0	<	13
US 271	CPCD ML	3	84	4 (83)	8.2		13
US67	CPCD ML	3	85	20 (85)	3.6		13
US59&US79	CPCD ML,RAMPS	6	85	4 (85)	4.2	^	13
US59&US80	CPCD ML, INT	U.C.		21 (85)	35.2		13
US271&SH49	CPCD ML	U.C.		19 (85)	19.1		13
US59	CPCD ML	PLANNED		12 (85)	38.9		14
US67	CPCD ML	PLANNED		9 (87)	4.4		13
FM1397	CPCD ML	U.C.		7 (85)	3.3		13
FM559	CPCD ML	U.C.		- -	-		-
FM559	CPCD ML	PLANNED		7 (85)	13.6		13
SH300	CPCD ML	PLANNED		6 (85)	6.0		13
US67	CPCD ML	PLANNED		15 (91)	5.1		13
US59	CPCD INT	U.C.		8 (85)	16.4		13
SH11	CPCD ML	PLANNED		6 (87)	7.6		13
US259	CPCD ML	PLANNED		- -	16.1		-

Dashes indicate that the data are not available.

FOOTNOTES FOR TABLE 4:

* - IH 20 corridor traffic.

- IH 30 corridor traffic.

< - Total traffic for the intersection.

^ - US 79 traffic only.

a - The date when construction was completed on the project. If "PLANNED" is stated, the project is planned for future construction. If "U.C." is stated, the project is under construction.

b - This column represents the Average Daily Traffic values (in thousands of vehicles per day) and the years in which they were calculated.
Thus:
18 (84)
means 18000 vehicles/day in 1984.

c - The actual thickness of the pavement in inches.

See Table 2 for other table definitions.

TABLE 5. PAVEMENT DESIGNS USING THE 1981 AASHTO GUIDE DESIGN PROCEDURE

PROJ REF NO.	HWY	PAVEMENT	LDF	TRAFFIC	DES LIFE	E[a]	K[b]	T81[c]
2	US82	CRCP ML	1.00	6.0	20	4	100	10
3	US90	CRCP FR	1.00	0.2	30	4	60	8
4	US90	CRCP FR	0.70	1.2	30	4	57	8
5	FM518	CRCP ML	1.00	2.6	20	4	78	9
6	FM518	CRCP ML	0.60	2.8	30	4	65	9
7	BW8	CRCP FR	0.70	3.6	30	4	120	9
8	BW8	CRCP FR	0.70	3.6	30	4	120	9
9	BW8	CRCP FR	0.70	3.6	30	4	120	9
11	FM1462	CRCP ML	1.00	4.1	20	4	100	9
12	BW8	CRCP FR	0.70	4.4	30	4	62	10
13	BW8	CRCP FR	0.70	4.4	30	4	62	10
15	BW8	CRCP FR	0.70	4.8	30	4	105	10
16	FM2094	CRCP ML	1.00	5.3	30	4	70	10
17	FM1093	CRCP ML	0.70	5.7	30	4	62	10
18	FM525	CRCP ML	0.70	6.6	30	4	135	10
20	IH45	CRCP FR	0.70	7.4	30	4	100	10
25	US90	CRCP ML	1.00	11.8	20	4	100	13
27	BW8	CRCP FR	0.60	13.8	20	4	70	10
28	SH146	CRCP ML	1.00	13.8	20	4	100	11
30	US90	CRCP ML	1.00	15.8	30	4	60	11
31	SH6	CRCP MLOLW	0.70	16.2	30	4	66	11
32	SH6	CRCP ML	0.70	16.3	30	4	120	11
33	FM1960	CRCP ML	0.70	18.2	30	4	115	11
35	BW8	CRCP ML	0.70	32.2	30	4	100	12
36	IH10(W)	CRCP MLOL	0.70	37.8	30	4	130	13
37	IH10	CRCP ML	0.70	42.6	30	4	63	13
38	BW8	CRCP ML	0.70	42.6	30	4	63	13
39	BW8	CRCP ML	0.70	45.0	30	4	120	13
40	BW8	CRCP ML	0.70	45.0	30	4	120	13
41	IH10(W)	CRCP MLOL	0.70	53.6	30	4	130	13
44	IH45	CRCP ML	0.60	80.3	30	4	100	15
47	IH35E	CPCD RAMPS	1.00	0.6	20	4	100	8
48	MH40	CPCD ML	0.84	0.7	20	4	20	8
49	FM2514	CPCD ML	1.00	0.7	20	4	50	8
50	SH5	CPCD ML	1.00	1.0	20	4	50	8
51	FM544	CPCD ML	1.00	1.2	20	4	50	8
52	FM2478	CPCD ML	1.00	1.3	20	4	50	8
53	SH5	CPCD ML	1.00	1.6	20	4	50	8
64	SH190	CRCP FR	1.00	14.0	20	5	110	10
68	US75	CPCD MLOL	1.00	32.3	20	4	100	12
78	US67	CPCD ML	1.20	4.4	30	5	25	13
79	FM559	CPCD ML	1.00	6.9	20	5	40	13
80	FM559	CPCD ML	1.20	13.6	30	5	100	13
84	US287	CPCD ML	1.00	23.7	20	4	200	13

FOOTNOTES FOR TABLE 5:

a - The modulus of elasticity of the concrete. The values should be multiplied by 10^6 to get the input. Therefore, if the value is 4, then the modulus of elasticity is 4,000,000 psi, and if it is 5, the modulus is 5,000,000 psi.

b - The modulus of subgrade/subbase reaction in pci modified for loss of support.

c - The thickness (in inches) originally proposed by the Texas SDHPT pavement designer using the 1981 AASHTO Guide.

See Table 2 for other table definitions.

TABLE 6. PAVEMENT DESIGNS USING THE 1986 AASHTO GUIDE DESIGN PROCEDURE

PROJ REF NO.	HWY	PAVEMENT	LDF	TRAFFIC	DES LIFE	E	K	J[a]	C(D)[b]	REL[c]	T86[d]
1	FM2499	CRCP ML	1.00	2.6	30	4	300	2.9	1.03	85	8
10	SH35	JRCP ML	0.70	4.0	30	4	300	3.2	0.95	95	9
14	US90	CRCP FR	0.70	4.6	30	4	600	2.9	0.96	99.9	10
19	IH10(E)	JRCP FR	0.70	7.1	30	4	600	2.9	0.97	99.9	11
21	IH45	CRCP FR	0.70	8.6	30	4	600	2.9	0.97	99.9	10
22	FM528	CRCP ML	0.70	9.1	30	4	300	3.2	0.95	90	10
23	FM528	CRCP ML	0.70	9.3	30	4	300	3.2	0.95	90	10
24	FM2351	CRCP ML	1.00	11.3	30	4	300	2.9	0.95	85	9
26	FM528	CRCP ML	1.00	13.0	30	4	300	2.9	0.95	90	10
29	US90	CRCP ML	0.60	14.5	30	4	600	2.9	0.96	99.9	12
34	BW8	CRCP ML	0.70	28.8	30	4	300	2.9	0.98	99	13
42	IH10(W)	CRCP MLOLW	0.70	53.6	30	4	300	2.9	0.99	99	14
43	IH10(E)	CRCP MLOL	0.60	76.8	30	4	600	2.9	0.97	99.9	15
45	IH45	CRCP ML	0.60	92.2	30	4	600	2.9	0.97	99.9	15
46	US290	CRCP ML	0.70	5.4	30	5	100	2.9	1.05	99	10
54	MH418	CPCD ML	0.80	3.7	20	4	360	2.9	1.02	95	8
55	US75	CRCP FR	0.90	3.8	30	4	200	2.9	1.02	95	8
56	US75	CRCP FR	0.90	3.8	30	4	174	2.9	1.02	95	8
57	SH289	CPCD ML	1.00	3.9	30	4	170	2.9	1.01	95	9
58	FM1382	JRCP ML	1.00	5.4	20	4	300	3.2	1.01	95	9
59	MH68	JRCP ML	1.00	5.4	20	4	300	3.2	1.01	95	9
60	US75	JRCP NBFR	0.60	8.2	30	4	270	2.6	1.05	99	9
61	SH78	CPCD ML	0.70	8.6	30	4	240	2.9	1.02	95	10
62	US75	JRCP SBFR	0.60	8.7	30	4	270	2.6	1.05	99	9
63	MH420	CPCD ML	1.00	9.5	20	5	300	2.9	1.01	95	10
65	US67	CPCD ML	1.00	19.5	30	5	300	2.9	1.01	95	11
66	SPR354	CPCD ML	0.70	25.0	30	4	300	2.9	1.01	95	11
67	SH190	CRCP ML	0.60	30.8	30	5	300	2.9	1.05	99	13
69	US75	CRCP ML	0.75	39.8	30	4	380	2.9	1.20	99.9	13
70	US75	CRCP ML	0.75	39.8	30	4	265	2.9	1.20	99.9	13
71	US75	CRCP ML	0.75	39.8	30	4	209	2.9	1.20	99.9	13
72	US75	CRCP ML	0.75	39.8	30	4	243	2.9	1.20	99.9	13
73	IH35E	CPCD ML	0.70	54.8	30	4	300	2.9	1.03	95	12
74	US75	CRCP ML	0.60	69.5	30	4	270	2.6	1.05	99	13
75	SPR380	JRCP ML	0.70	11.0	30	4	100	3.2	0.90	95	12
76	IH10	CPSJ MLOL	0.70	73.2	30	4	350	3.6	0.95	95	14
77	IH10	CRCP RAMPS	1.00	0.9	20	5	600	2.9	1.00	99.9	8
81	US259	CPCD ML	1.00	16.1	30	5	100	3.9	1.01	95	13
82	US59	CPCD ML	1.00	28.7	30	5	100	4.2	0.96	85	13
83	US59	CPCD ML	0.70	38.0	30	5	25	3.9	0.97	85	14

FOOTNOTES TO TABLE 6:

a - The load transfer coefficient.

b - The coefficient of drainage.

c - The reliability of the facility, in percent.

d - The thickness (in inches) originally proposed by the Texas SDHPT pavement designer using the 1986 AASHTO Guide.

See Tables 2 and 5 for other table definitions.

TABLE 7. COMPARISON OF THICKNESSES GENERATED USING THE 1986 AASHTO GUIDE WITH THE RECOMMENDED REVISIONS TO THE ACTUAL DESIGNS WHICH USED THE 1981 AASHTO GUIDE

PROJ REF NO.	HWY	PAVEMENT	LDF	TRAF	DES LIFE	E	K	J	C(D)	REL	T81	TC[a]
2	US82	CRCP ML	1.0	10.9	30	4	300	2.9	1.05	99.0	10	11
3	US90	CRCP FR	1.0	1.8	30	4	300	2.9	0.96	85.0	8	8
4	US90	CRCP FR	0.7	1.2	30	4	300	2.9	0.96	85.0	8	8
5	FM518	CRCP ML	1.0	4.8	30	4	300	2.9	0.95	85.0	9	8
6	FM518	CRCP ML	1.0	4.7	30	4	300	2.9	0.95	85.0	9	8
7	BW8	CRCP FR	0.7	3.6	30	4	300	2.9	0.98	85.0	9	8
8	BW8	CRCP FR	0.7	3.6	30	4	300	2.9	0.97	85.0	9	8
9	BW8	CRCP FR	0.7	3.6	30	4	300	2.9	0.97	85.0	9	8
11	FM1462	CRCP ML	1.0	7.6	30	4	300	2.9	0.94	85.0	9	9
12	BW8	CRCP FR	0.7	4.4	30	4	300	2.9	0.98	85.0	10	8
13	BW8	CRCP FR	0.7	4.4	30	4	300	2.9	0.97	85.0	10	8
15	BW8	CRCP FR	0.7	4.8	30	4	300	2.9	0.97	85.0	10	8
16	FM2094	CRCP ML	1.0	5.3	30	4	300	2.9	0.98	85.0	10	8
17	FM1093	CRCP ML	0.7	5.7	30	4	300	2.9	0.99	85.0	10	8
18	FM525	CRCP ML	0.7	6.6	30	4	300	2.9	0.97	85.0	10	9
20	IH45	CRCP FR	0.7	7.4	30	4	300	2.9	0.97	85.0	10	9
25	US90	CRCP ML	1.0	22.2	30	4	300	2.9	0.96	99.0	13	12
27	BW8	CRCP FR	0.7	26.4	30	4	300	2.9	0.98	85.0	10	11
28	SH146	CRCP ML	1.0	25.5	30	4	300	2.9	0.95	95.0	11	12
30	US90	CRCP ML	1.0	15.8	30	4	300	2.9	0.96	95.0	11	11
31	SH6	CRCP MLOLW	0.7	16.2	30	4	300	2.9	0.95	95.0	11	11
32	SH6	CRCP ML	0.7	16.3	30	4	300	2.9	0.98	99.0	11	12
33	FM1960	CRCP ML	0.7	18.2	30	4	300	2.9	0.97	95.0	11	11
35	BW8	CRCP ML	0.7	32.2	30	4	300	2.9	0.97	99.0	12	13
36	IH10(W)	CRCP MLOL	0.7	37.8	30	4	300	2.9	0.99	95.0	13	12
37	IH10	CRCP ML	0.7	42.6	30	4	300	2.9	0.97	95.0	13	12
38	BW8	CRCP ML	0.7	42.6	30	4	300	2.9	0.98	95.0	13	12
39	BW8	CRCP ML	0.7	45.0	30	4	300	2.9	0.95	99.0	13	14
40	BW8	CRCP ML	0.7	45.0	30	4	300	2.9	0.97	99.0	13	14
41	IH10(W)	CRCP MLOL	0.7	53.6	30	4	300	2.9	0.99	99.0	13	14
44	IH45	CRCP ML	0.6	80.3	30	4	300	2.9	0.97	99.9	15	16
47	IH35E	CPCD RAMPS	1.0	1.0	30	4	100	2.9	1.03	85.0	8	8
48	MH40	CPCD ML	0.7	1.1	30	4	20	2.9	1.02	85.0	8	8
49	FM2514	CPCD ML	0.7	0.9	30	4	170	2.9	1.02	85.0	8	8
50	SH5	CPCD ML	0.7	1.2	30	4	170	2.9	1.01	85.0	8	8
51	FM544	CPCD ML	0.7	1.5	30	4	170	2.9	1.02	85.0	8	8
52	FM2478	CPCD ML	0.7	1.5	30	4	170	2.9	1.02	85.0	8	8
53	SH5	CPCD ML	0.7	1.9	30	4	170	2.9	1.01	85.0	8	8
64	SH190	CRCP FR	0.7	17.5	30	5	300	2.9	1.05	95.0	10	11
68	US75	CPCD MLOL	0.7	39.1	30	4	300	2.9	1.03	99.0	12	13
78	US67	CPCD ML	1.0	4.4	30	5	25	4.2	0.9	85.0	13	11
79	FM559	CPCD ML	1.0	11.5	30	5	40	4.2	0.96	85.0	13	12
80	FM559	CPCD ML	1.0	11.3	30	5	100	4.2	0.96	85.0	13	12
84	US287	CPCD ML	1.0	40.2	30	4	100	4.2	1.1	85.0	13	13

FOOTNOTES TO TABLE 7:

a - The comparative thickness generated using the 1986 AASHTO Guide and the recommended inputs discussed in the paper.

See Tables 2, 5, and 6 for other table definitions.

TABLE 8. COMPARISON OF THICKNESSES GENERATED USING THE 1986 AASHTO GUIDE WITH THE RECOMMENDED REVISIONS TO THE ACTUAL DESIGNS WHICH USED THE 1986 AASHTO GUIDE

PROJ REF NO.	HWY	PAVEMENT	LDF	TRAFFIC	DES LIFE	E	K	J	C(D)	REL	T86	TC
1	FM2499	CRCP ML	1.00	2.6	30	4	300	2.9	1.03	85.0	8	8
10	SH35	JRCP ML	0.70	4.0	30	4	300	3.2	0.95	95.0	9	9
14	US90	CRCP FR	0.70	4.6	30	4	300	2.9	0.96	85.0	10	8
19	IH10(E)	JRCP FR	0.70	7.1	30	4	300	2.9	0.97	85.0	11	9
21	IH45	CRCP FR	0.70	8.6	30	4	300	2.9	0.97	85.0	10	9
22	FM528	CRCP ML	0.70	9.1	30	4	300	3.2	0.95	85.0	10	10
23	FM528	CRCP ML	0.70	8.6	30	4	300	3.2	0.95	85.0	10	9
24	FM2351	CRCP ML	1.00	10.8	30	4	300	2.9	0.95	85.0	9	9
26	FM528	CRCP ML	1.00	13.0	30	4	300	2.9	0.95	85.0	10	10
29	US90	CRCP ML	0.60	14.5	30	4	300	2.9	0.96	95.0	12	11
34	BW8	CRCP ML	0.70	28.8	30	4	300	2.9	0.98	99.9	13	14
42	IH10(W)	CRCP MLOLW	0.70	53.6	30	4	300	2.9	0.99	99.0	14	14
43	IH10(E)	CRCP MLOL	0.70	89.6	30	4	600	2.9	0.97	99.9	15	16
45	IH45	CRCP ML	0.60	92.2	30	4	300	2.9	0.97	99.9	15	17
46	US290	CRCP ML	0.70	5.4	30	5	300	2.9	1.05	95.0	10	9
54	MH418	CPCD ML	0.70	5.3	30	4	300	2.9	1.02	85.0	8	8
55	US75	CRCP FR	0.70	2.9	30	4	300	2.9	1.02	85.0	8	8
56	US75	CRCP FR	0.70	2.9	30	4	174	2.9	1.02	85.0	8	8
57	SH289	CPCD ML	1.00	3.9	30	4	170	2.9	1.01	95.0	9	9
58	FM1382	JRCP ML	0.70	6.7	30	4	300	3.2	1.01	95.0	9	10
59	MH68	JRCP ML	0.70	6.7	30	4	300	3.2	1.01	95.0	9	10
60	US75	JRCP NBFR	0.70	9.6	30	4	300	2.9	1.05	95.0	9	9
61	SH78	CPCD ML	0.70	8.6	30	4	300	2.9	1.02	95.0	10	9
62	US75	JRCP SBFR	0.70	10.1	30	4	300	2.9	1.05	95.0	9	10
63	MH420	CPCD ML	1.00	17.8	30	5	300	2.9	1.01	99.0	10	12
65	US67	CPCD ML	1.00	19.5	30	5	300	2.9	1.01	99.0	11	12
66	SPR354	CPCD ML	0.70	25.0	30	4	300	2.9	1.01	95.0	11	11
67	SH190	CRCP ML	0.60	30.8	30	5	300	2.9	1.05	99.9	13	14
69	US75	CRCP ML	0.60	31.8	30	4	300	2.9	1.2	99.9	13	13
70	US75	CRCP ML	0.60	31.8	30	4	300	2.9	1.2	99.9	13	13
71	US75	CRCP ML	0.60	31.8	30	4	300	2.9	1.2	99.9	13	13
72	US75	CRCP ML	0.60	31.8	30	4	300	2.9	1.2	99.9	13	13
73	IH35E	CPCD ML	0.70	54.8	30	4	300	2.9	1.03	99.0	12	14
74	US75	CRCP ML	0.60	69.5	30	4	300	2.9	1.05	99.9	13	16
75	SPR380	JRCP ML	0.70	10.9	30	4	300	3.2	0.92	95.0	12	11
76	IH10	CPSJ MLOL	0.70	73.2	30	4	300	3.7	0.95	95.0	14	15
77	IH10	CRCP RAMPS	1.00	1.5	30	5	600	2.9	1.16	99.9	8	8
81	US259	CPCD ML	1.00	16.1	30	5	100	4.2	0.98	85.0	13	12
82	US59	CPCD ML	1.00	28.7	30	5	100	4.2	0.96	85.0	13	14
83	US59	CPCD ML	0.70	37.0	30	5	25	4.2	0.97	85.0	14	15

FOOTNOTE FOR TABLE 8:

See Tables 2, 5, 6, and 7 for table definitions.

TABLE 9. INPUTS FOR THE SENSITIVITY ANALYSIS OF THE 1986 AASHTO GUIDE

PARAMETER[a]	MR[b]	E	K	PI[c]	PT[d]	J	C(D)	SD[e]	REL	TRAFFIC	T[f]
STANDARD	720	4	300	4.5	2.5	2.9	1.00	0.39	95	1.0	6.01
STANDARD	720	4	300	4.5	2.5	2.9	1.00	0.39	95	10.0	9.28
STANDARD	720	4	300	4.5	2.5	2.9	1.00	0.39	95	100.0	13.38
20 YR TRAFFIC	720	4	300	4.5	2.5	2.9	1.00	0.39	95	0.7	5.49
20 YR TRAFFIC	720	4	300	4.5	2.5	2.9	1.00	0.39	95	6.7	8.67
20 YR TRAFFIC	720	4	300	4.5	2.5	2.9	1.00	0.39	95	66.7	12.57
85% RELIABILITY	720	4	300	4.5	2.5	2.9	1.00	0.39	85	1.0	5.32
85% RELIABILITY	720	4	300	4.5	2.5	2.9	1.00	0.39	85	10.0	8.46
85% RELIABILITY	720	4	300	4.5	2.5	2.9	1.00	0.39	85	100.0	12.30
99% RELIABILITY	720	4	300	4.5	2.5	2.9	1.00	0.39	99	1.0	6.84
99% RELIABILITY	720	4	300	4.5	2.5	2.9	1.00	0.39	99	10.0	10.26
99% RELIABILITY	720	4	300	4.5	2.5	2.9	1.00	0.39	99	100.0	14.68
99.9% RELIABILITY	720	4	300	4.5	2.5	2.9	1.00	0.39	99.9	1.0	7.80
99.9% RELIABILITY	720	4	300	4.5	2.5	2.9	1.00	0.39	99.9	10.0	11.45
99.9% RELIABILITY	720	4	300	4.5	2.5	2.9	1.00	0.39	99.9	100.0	16.27
0.91 CD	720	4	300	4.5	2.5	2.9	0.91	0.39	95	1.0	6.44
0.91 CD	720	4	300	4.5	2.5	2.9	0.91	0.39	95	10.0	9.79
0.91 CD	720	4	300	4.5	2.5	2.9	0.91	0.39	95	100.0	14.05
1.16 CD	720	4	300	4.5	2.5	2.9	1.16	0.39	95	1.0	5.36
1.16 CD	720	4	300	4.5	2.5	2.9	1.16	0.39	95	10.0	8.52
1.16 CD	720	4	300	4.5	2.5	2.9	1.16	0.39	95	100.0	12.37
1 LOSS OF SUPPORT	720	4	164	4.5	2.5	2.9	1.00	0.39	95	1.0	6.46
1 LOSS OF SUPPORT	720	4	164	4.5	2.5	2.9	1.00	0.39	95	10.0	9.61
1 LOSS OF SUPPORT	720	4	164	4.5	2.5	2.9	1.00	0.39	95	100.0	13.68
0 LOSS OF SUPPORT	720	4	552	4.5	2.5	2.9	1.00	0.39	95	1.0	5.26
0 LOSS OF SUPPORT	720	4	552	4.5	2.5	2.9	1.00	0.39	95	10.0	8.83
0 LOSS OF SUPPORT	720	4	552	4.5	2.5	2.9	1.00	0.39	95	100.0	12.99
3.2 LOAD TRANSFER	720	4	300	4.5	2.5	3.2	1.00	0.39	95	1.0	6.46
3.2 LOAD TRANSFER	720	4	300	4.5	2.5	3.2	1.00	0.39	95	10.0	9.81
3.2 LOAD TRANSFER	720	4	300	4.5	2.5	3.2	1.00	0.39	95	100.0	14.08
3.7 LOAD TRANSFER	720	4	300	4.5	2.5	3.7	1.00	0.39	95	1.0	7.14
3.7 LOAD TRANSFER	720	4	300	4.5	2.5	3.7	1.00	0.39	95	10.0	10.63
3.7 LOAD TRANSFER	720	4	300	4.5	2.5	3.7	1.00	0.39	95	100.0	15.18
4.2 LOAD TRANSFER	720	4	300	4.5	2.5	4.2	1.00	0.39	95	1.0	7.75
4.2 LOAD TRANSFER	720	4	300	4.5	2.5	4.2	1.00	0.39	95	10.0	11.39
4.2 LOAD TRANSFER	720	4	300	4.5	2.5	4.2	1.00	0.39	95	100.0	16.19

FOOTNOTES FOR TABLE 9:

a - "Standard" indicates the standard design. The other successive parameter names indicate the value of the input that was changed.

b - Modulus of Rupture, psi.

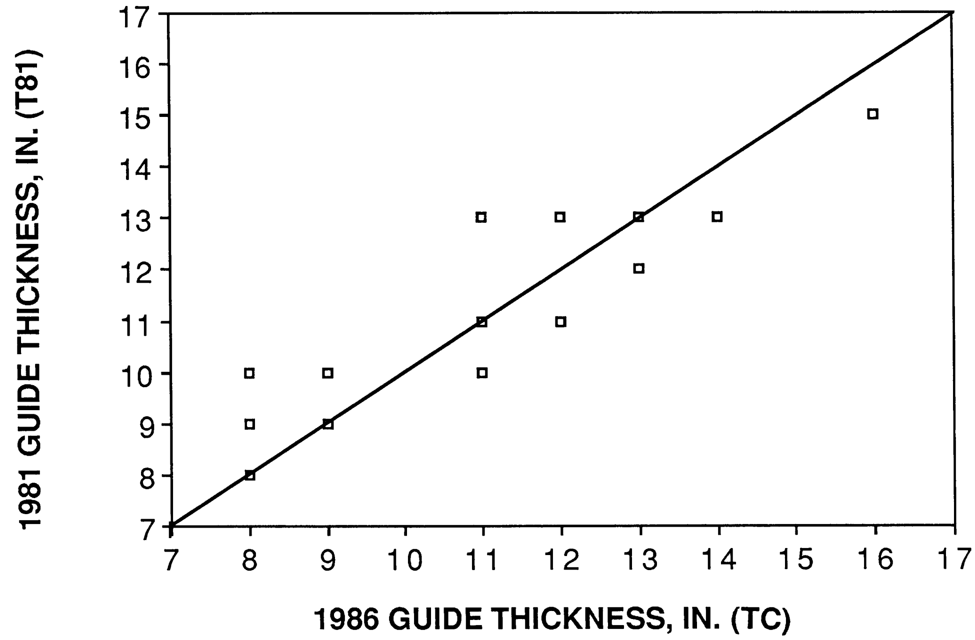
c - Initial Present Serviceability Index.

d - Terminal Present Serviceability Index.

e - Standard Deviation.

f - Resulting thickness, inches.

See Tables 2, 5, 6, and 7 for other table definitions.



Note: A data point may represent multiple data points.

FIGURE 1. COMPARATIVE THICKNESSES GENERATED USING THE 1986 AASHTO GUIDE WITH THE RECOMMENDATIONS VERSUS DESIGNS CALCULATED BY TEXAS SDHPT PAVEMENT DESIGNERS USING THE 1981 GUIDE

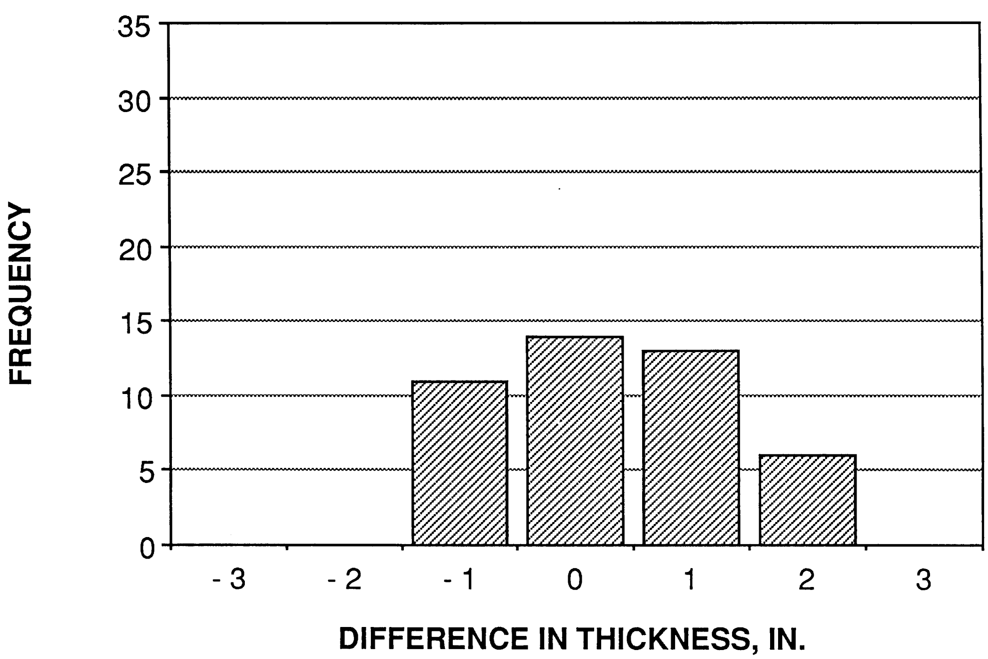
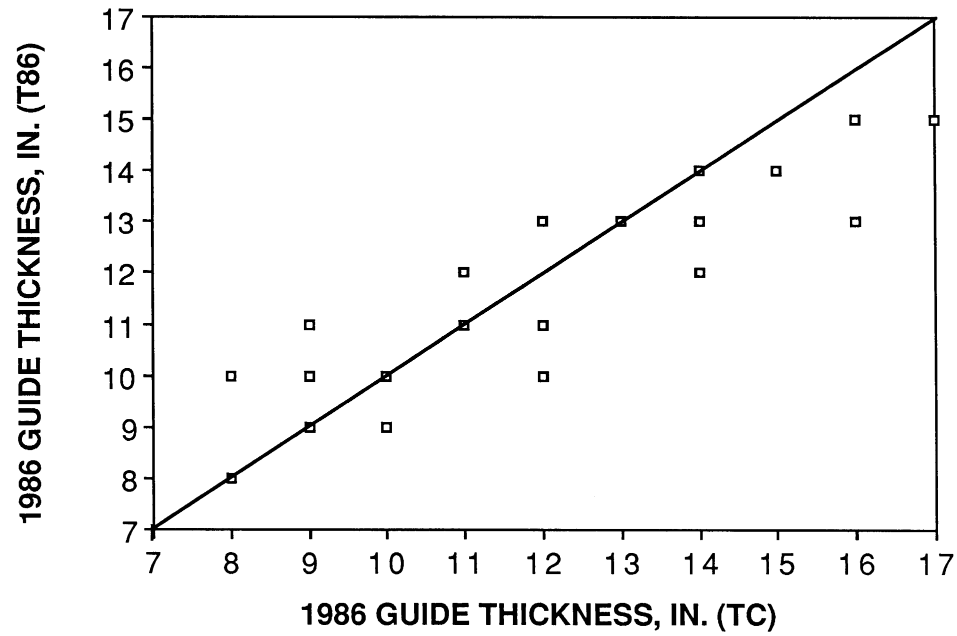


FIGURE 2. DIFFERENCE BETWEEN TEXAS SDHPT PAVEMENT DESIGNS PRODUCED USING THE 1981 AASHTO GUIDE AND THE COMPARATIVE THICKNESSES PRODUCED USING THE 1986 AASHTO GUIDE WITH THE RECOMMENDED INPUTS.



Note: A data point may represent multiple data points.

FIGURE 3. COMPARATIVE THICKNESSES GENERATED USING THE 1986 AASHTO GUIDE WITH THE RECOMMENDATIONS VERSUS DESIGNS CALCULATED BY TEXAS SDHPT PAVEMENT DESIGNERS USING THE 1986 GUIDE.

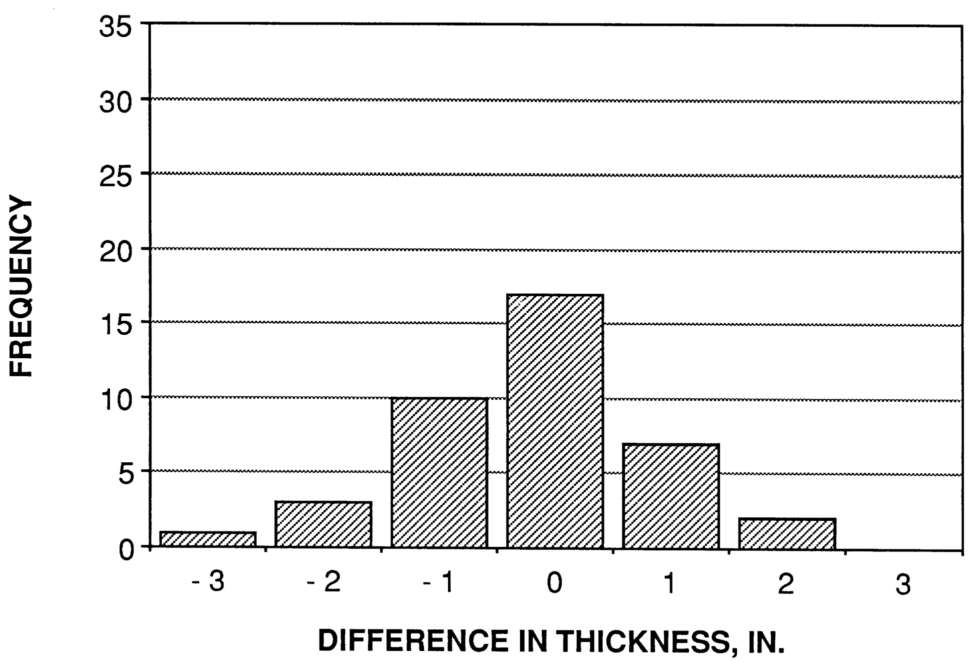


FIGURE 4. DIFFERENCE BETWEEN TEXAS SDHPT PAVEMENT DESIGNS PRODUCED USING THE 1986 AASHTO GUIDE AND THE COMPARATIVE THICKNESSES PRODUCED USING THE 1986 AASHTO GUIDE WITH THE RECOMMENDED INPUTS.

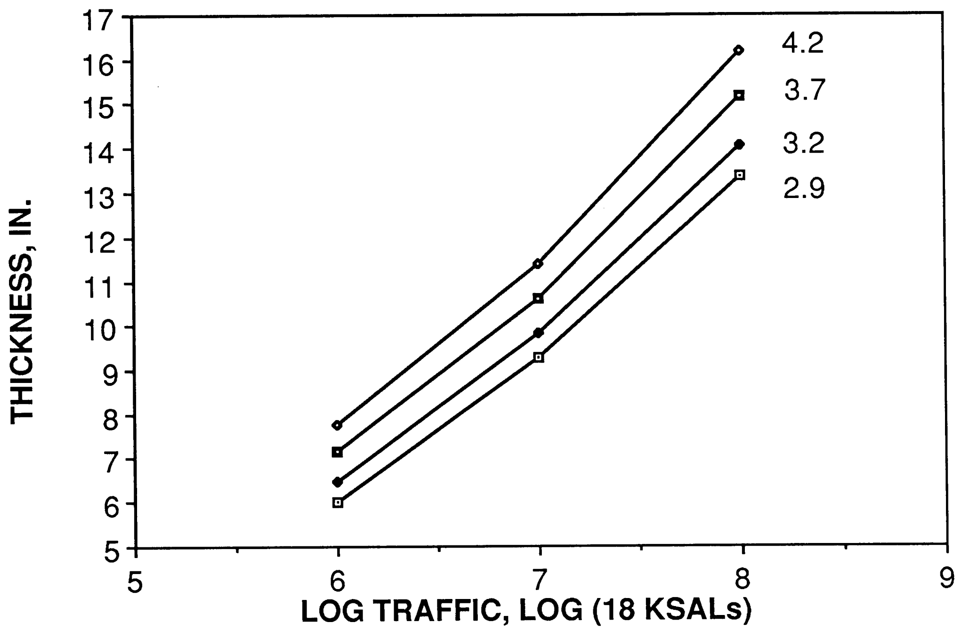


FIGURE 5. EFFECT OF THE LOAD TRANSFER COEFFICIENT ON THE CONCRETE PAVEMENT THICKNESS.

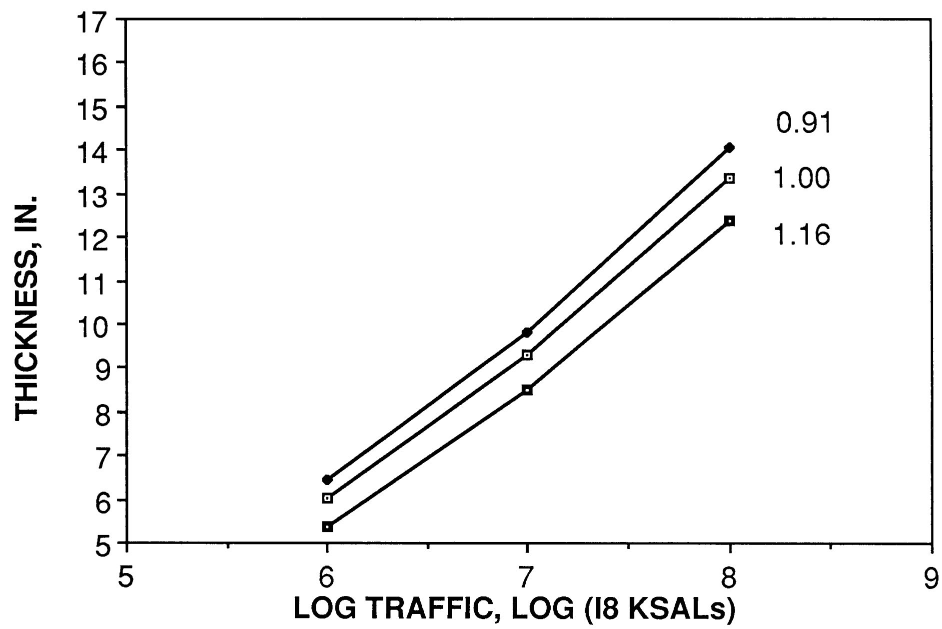


FIGURE 6. EFFECT OF THE DRAINAGE COEFFICIENT ON THE CONCRETE PAVEMENT THICKNESS.

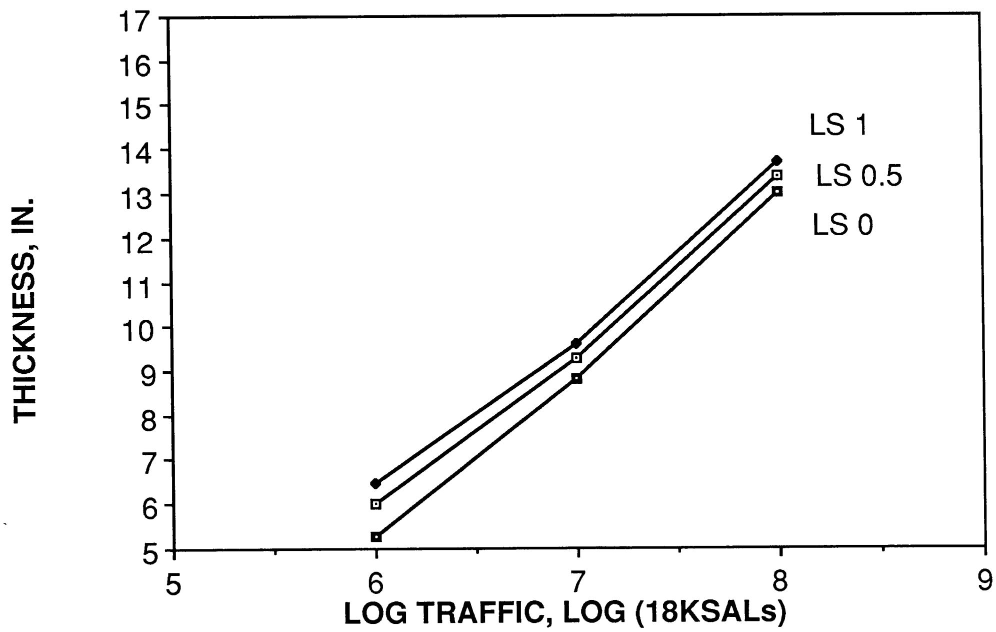


FIGURE 7. EFFECT OF THE LOSS OF SUPPORT ON THE CONCRETE PAVEMENT THICKNESS.

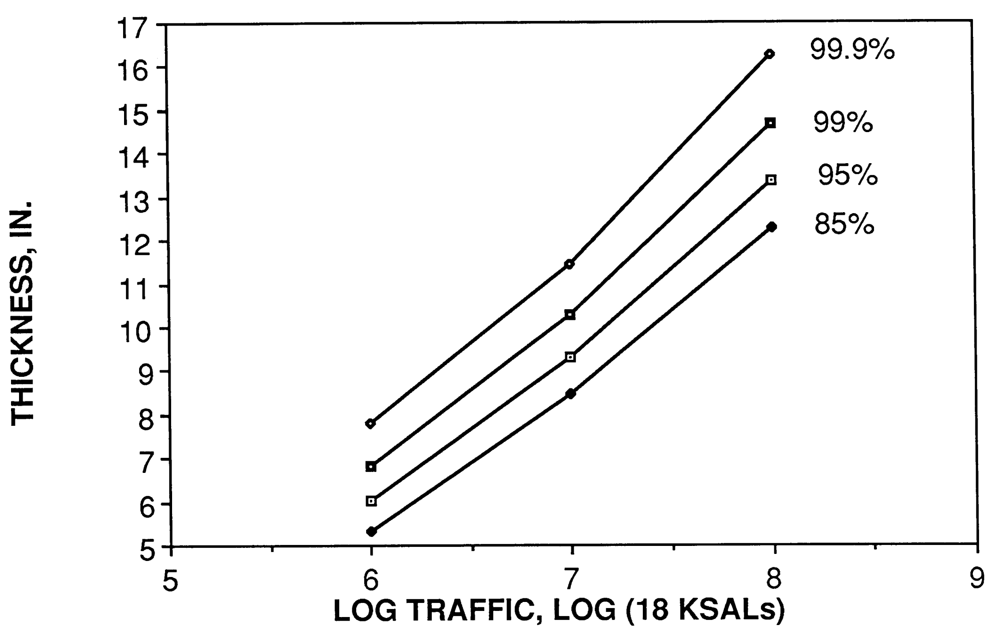


FIGURE 8. EFFECT OF RELIABILITY ON THE CONCRETE PAVEMENT THICKNESS.

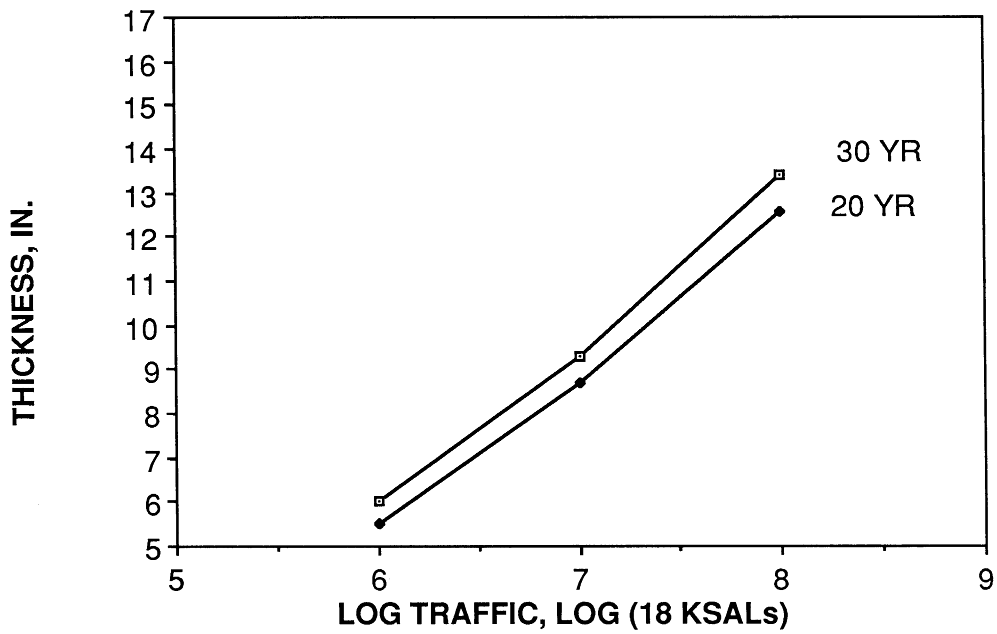


FIGURE 9. EFFECT OF DESIGN TRAFFIC ON THE CONCRETE PAVEMENT THICKNESS.

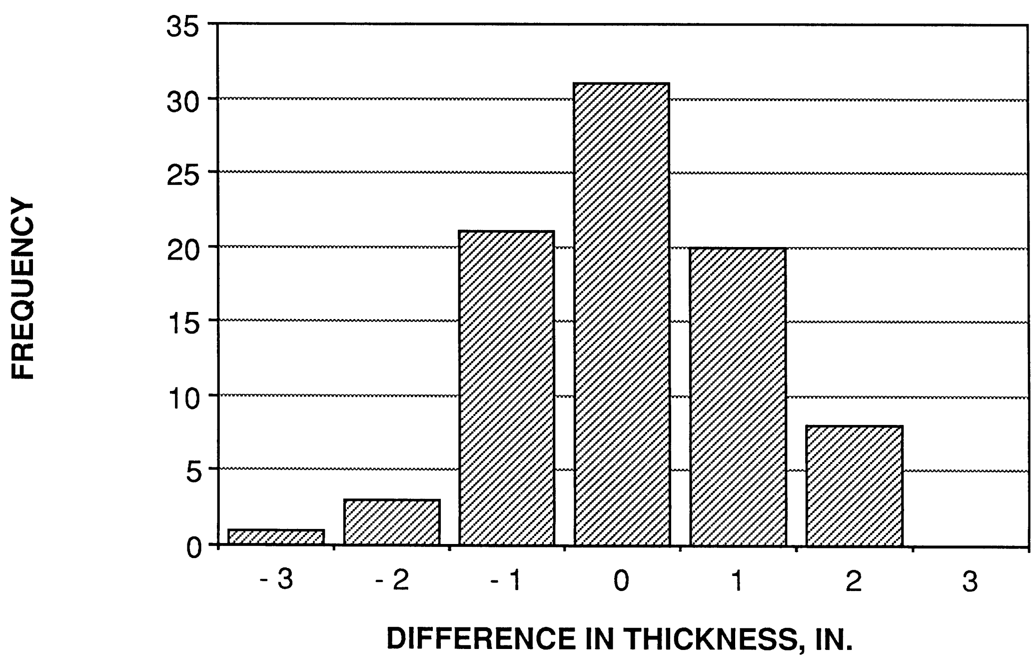


FIGURE 10. DIFFERENCE BETWEEN TEXAS SDHPT PAVEMENT DESIGNS AND THE COMPARATIVE THICKNESSES PRODUCED USING THE 1986 AASHTO GUIDE WITH THE RECOMMENDED INPUTS (ALL DESIGNS).