

Research Report
UKTRP-81-17

**DESIGN GUIDE
FOR
BITUMINOUS CONCRETE PAVEMENT STRUCTURES**

by

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College of Engineering
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in cooperation with the
DEPARTMENT OF TRANSPORTATION
Commonwealth of Kentucky

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INTRODUCTION

To determine pavement thicknesses from design charts and tables, it is necessary to know only the EAL's (equivalent axle loads), the CBR of the subgrade soil, and the modulus of elasticity of the bituminous concrete. Charts permit selection of pavement structures employing alternative proportions of bituminous concrete and crushed stone base. Total thickness varies according to the proportions chosen. It is implicitly intended that the selection of alternative structures be based on engineering considerations, such as

1. estimates of comparative construction costs,
2. compatibility with cross section template and shoulder designs,
3. uniformity or standardization of design practices,
4. highway system classification,
5. engineering precedence, and
6. utilization of indigenous resources.

Designs based on 33- and 67-percent proportions (thickness of pavement structure) of bituminous concrete and crushed rock base, respectively, conform with the current design chart (for high-type pavements) of the Kentucky Department of Transportation, representing conventional or precedential designs. The charts otherwise represent theoretical extensions of conventional designs and, from a theoretical standpoint, provide equally competent structures.

Heretofore, the Kentucky design system was based on EWL's (equivalent wheel loads). The proposed system is based on EAL's. This transformation was made for the sake of unifying design practices and standardizing design terms. EAL's are defined here as the cumulative number of equivalent 18-kip axle-

loads (1) in the design lane. An approximate conversion is made by dividing EWL's by 32 -- that is, divide by 2 to reduce two-directional EWL's to one direction and divide by 16 to convert from a 10-kip axleload (or 5-kip wheel load) to an 18-kip axleload.

Normally, traffic volumes are estimated in connection with needs studies and in the planning stages for all new routes and for major improvements of existing routes. Whereas the anticipated volume of traffic is an important consideration in the geometric design of a roadway, composition of the traffic in terms of axle weights and lane distributions is essential to the structural design of pavements. Traffic volumes used for EAL computations should therefore be reconciled with other planning forecasts of traffic. Historically, actual growths, particularly in EAL's, have exceeded forecasts in the majority of cases. Even though predictions of traffic volumes may be reasonable, estimates of EAL's are also dependent upon predictions of vehicle types and loadings over the design life. Again, previous experience shows an underestimation of EAL's due to inadequate predictions (or even the disregard of known overloads) of vehicle loadings. Thus, the design lives of the pavements may differ from the geometric design period.

Computation of EAL's involves an estimate of the total number of vehicles during the design life and multiplying factors for various vehicle types and loading configurations and magnitudes to convert traffic volumes to EAL's. Ideally, yearly increments of EAL's could be calculated and summed; this approach would permit consideration to be given to anticipated changes in legal weight limits, changes in styles of cargo haulers, and changes in routing.

DESIGN EAL

Two methods of estimating 18-kip EAL's are presented. The appropriate method -- to match the data base available -- should be used for a particular design situation.

1. DEACON AND DEEN METHOD

Deacon and Deen (2) described the development and testing of a predictive method (calculation of equivalent axleloads) for rural highways in Kentucky. The problem was treated as three separate but inter-related parts: (a) development of a proper methodology and identification of pertinent traffic parameters, (b) identification of relevant local conditions that serve

as indicators of the composition and weights of the traffic stream, and (c) development of significant relationships between traffic parameters and local conditions. Percentages of the various vehicle types and the average equivalent axleloads per vehicle were selected as the most significant traffic parameters. These were related by multiple regression and other techniques to local conditions, which included road type, direction of travel, availability and quality of alternate routes, type of service provided, traffic volume, maximum allowable gross weight, geographical area, and season. The resultant methodology was judged to be sufficiently accurate, simple, reasonable,

and usable to satisfy problem requirements. It is recommended for use, however, only when valid, actual long-term vehicle classification and weight data are unavailable for the route under investigation. The relationships should be updated every two to five years to account for changes in usage of vehicle types and changes in axleload limits.

2. DEEN/HAVENS/SOUTHGATE METHOD

Traffic Volume

Traffic volumes may be estimated in a number of ways; each is dependent upon the type of data available for analysis. The following approaches to the prediction of traffic volumes for the design period are suggested.

1. When specific historical traffic data are not available, the compound interest equation may be used:

$$A = P(1 + i)^n,$$

in which A = annual average daily traffic (AADT) in the nth year,

P = AADT at beginning of design period, and

i = yearly increase (growth) in traffic (normally varies from 0.03 to 0.08; use 0.05 if there are no factors to indicate other values).

2. The network of highways serving the same area as the route under consideration should be analyzed to assess the impact of the various parts of the network on the other segments of highways. The change in traffic patterns and volumes provide a basis for predicting the volumes for design of the route being considered.

3. Data for routes that provide services similar to those anticipated for the route being evaluated can provide the basis for analyses. The average traffic volumes for all or a group of similar routes may be analyzed. Data for a single similar route can provide the historical traffic volumes upon which to base predictions for the design period. Where possible, model facilities should be chosen for which there is recorded data representing conditions prior to and after construction of a new facility or upgrading an existing facility.

4. Maps summarizing the annual average daily traffic over the highway system may be used to obtain historical traffic volumes for projecting future traffic. Such maps have been prepared by many highway agencies for a number of years for most of the major routes in their jurisdictions.

5. Traffic counts for site-specific situations may also be used to obtain current traffic volumes

from which projections may be based. Such counts of traffic volumes may be obtained manually or with the aid of automatic counting and recording equipment.

6. Regardless of the method, or combination of methods, used to obtain historical and current traffic volumes, predictions and projections must be made for the design period of the specific project under consideration. Graphs, as a function of time, should be prepared so that trend lines can be established. Traffic volumes can then be projected over the design period.

Vehicle Classifications

Loads to be supported by a pavement system are related not only to the volume of vehicles but also are dependent upon the distribution of various types of vehicles (and their associated weights). As with traffic volumes, estimates of the proportions of various vehicle types in the traffic stream can be obtained in a number of ways.

1. When specific data are not available, Figure 1 may be used to estimate the percentages of various vehicle types. Note that, to make estimates of vehicle classification percentages, it is necessary to know or estimate the AADT. Figure 1 was developed from the analysis of statewide vehicle classification counts. If the facility under consideration provides a particular service, adjustments should be made to the classifications obtained from Figure 1. For example, a facility serving a recreational area might be expected to have a higher percentage of automobiles. Or the percentages of three-axle single unit trucks and five-axle combination trucks should be increased for a coal-haul road.

2. The network of highways serving the same area as the route under consideration may be analyzed to obtain estimates of vehicle classifications.

3. Vehicle classifications for all or a group of appropriate similar routes (routes providing similar

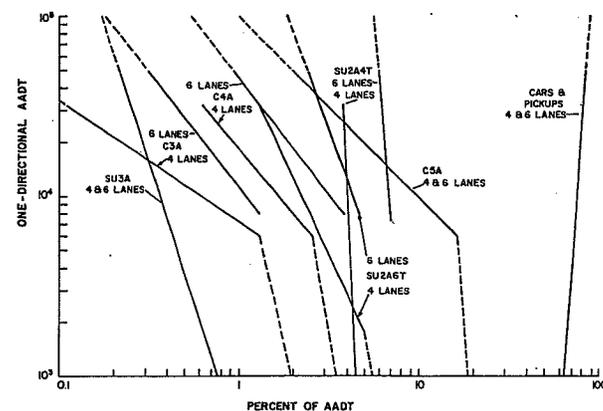


Figure 1. AADT versus Vehicle Classification Percentages.

type services) may be analyzed or data for a single similar route can provide the distribution of vehicle types.

4. W-4 tables published annually by the Federal Highway Administration contain historical data of vehicle and axle weights by classification. These data are listed for each loadometer site, summarized for rural and for urban sites, and averaged for total statewide values. If a weigh station is located near the facility under consideration and the expected classification of vehicle types is approximately the same, the analysis should be based on the data from that specific loadometer station. Otherwise, the statewide averages, or averages of vehicle classifications of sites providing similar services, may be more appropriate.

5. Classification counts for site-specific situations may be obtained manually or with automatic counter-classifier recording equipment.

6. Regardless of the method, or combination of methods, used to obtain historical and current vehicle classification distributions, predictions and projections must be made for the design period of the specific project under consideration.

Lane Distributions

The distributions of traffic among the various lanes of a multilane facility is required. Again, these distributions can be obtained in a number of ways.

1. When specific data for the project under consideration are not available, estimates of lane distributions may be obtained from Table 1 for trucks. When lane distributions for vehicle classifications are desired, use Figure 2.

2. Traffic counts for site-specific situations may also be used to obtain data upon which to base estimates of lane distributions. Such data may be obtained manually or with the aid of automatic counter-classifier recording equipment.

3. Predictions and projections must be made for the design period of the specific project. Lane distributions are not as likely as traffic volumes or vehicle classifications, for example, to vary greatly with time. But the possibility should be recognized.

TABLE 1. LANE DISTRIBUTIONS FOR LEVELS OF SERVICE

LANE	FOUR LANES		SIX LANES			
	LEVEL OF SERVICE		LEVEL OF SERVICE			
	A	B	A	B	C	D
Shoulder	95	90	28	26	28	35
Center			45	43	38	32
Median	5	10	27	31	35	33

Damage Factors

An important attribute in determining the equivalent axleloads is the damage factor of individual axleloads or of various vehicle types. The damage factor is a measure of damage to the pavement relative to the damage caused by an 18-kip axleload (Damage Factor = 1.0). Damage factors may be determined in the following ways.

1. If axle-weight distributions on various axle configurations are known, damage factors may be obtained from Figure 3. Axle-weight distributions may be based on statewide data or on distributions obtained from loadometer stations selected to be representative of the project under consideration. If site-specific distributions are available, they should be used to obtain damage factors.

2. Historical data contained in W-4 tables may be used to determine average damage factors of vehicles in each classification type. If a weigh station is located near the facility under consideration and if the expected traffic stream is approximately the same, the analysis should be based on that specific loadometer station. Otherwise, the statewide averages, or averages of sites providing similar services, may be more appropriate. Data in W-4 tables do not distinguish between two-tired front axles and four-tired rear axles. Assume that all front axles are in the lighter weight ranges and will be assigned damage factors from Figure 3 for two-tired axles. When the number of these "front" axles equals the total number of vehicles weighed, the remaining single axles are assigned damage factors for the four-tired single axles.

To obtain a weighted average damage factor for each vehicle classification, the product of the number of axles in each weight range and the associated damage factor from Figure 3 is obtained. This product is then divided by the total number of vehicles of that classification. The result is the average damage factor for the vehicle type.

3. In the absence of specific data upon which to base the determination of average damage factors for each vehicle classification, Table 2 may be used. Damage factors in this table are based on typical statewide averages.

4. Adjustments may be made to damage factors for tandem and tridem axles obtained from Figure 3 to account for a nonuniform distribution of weights among the axles of a group. Preliminary analyses of Kentucky data show that the damage factor for nonuniformly loaded tandem axles is approximately 40-percent greater than the damage factor for a uniformly loaded tandem axle group having the same total load.

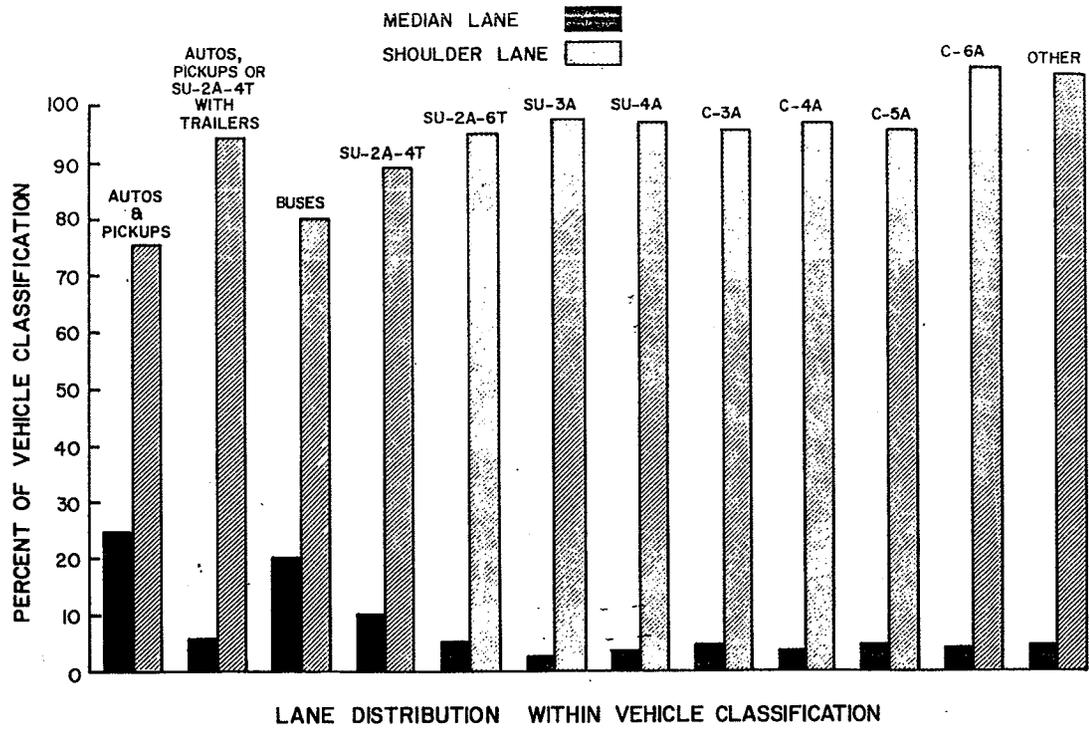


Figure 2a. Vehicle Classifications by Lane; Four-Lane Facility, Level of Service A.

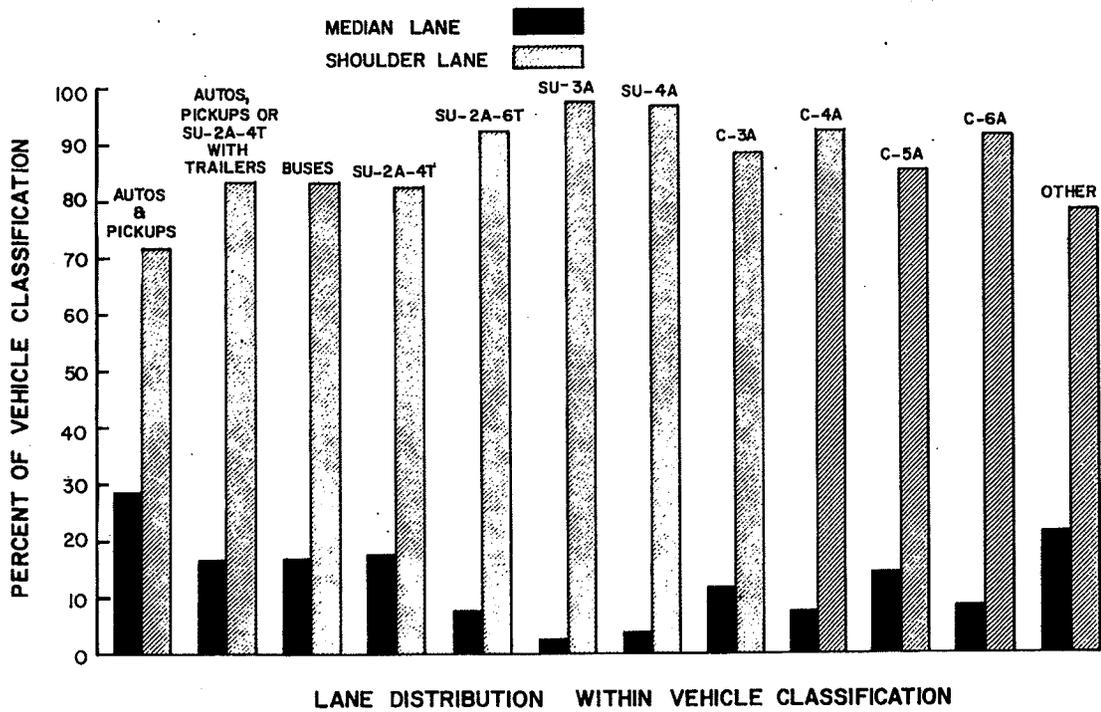


Figure 2b. Vehicle Classifications by Lane; Four-Lane Facility, Level of Service B.

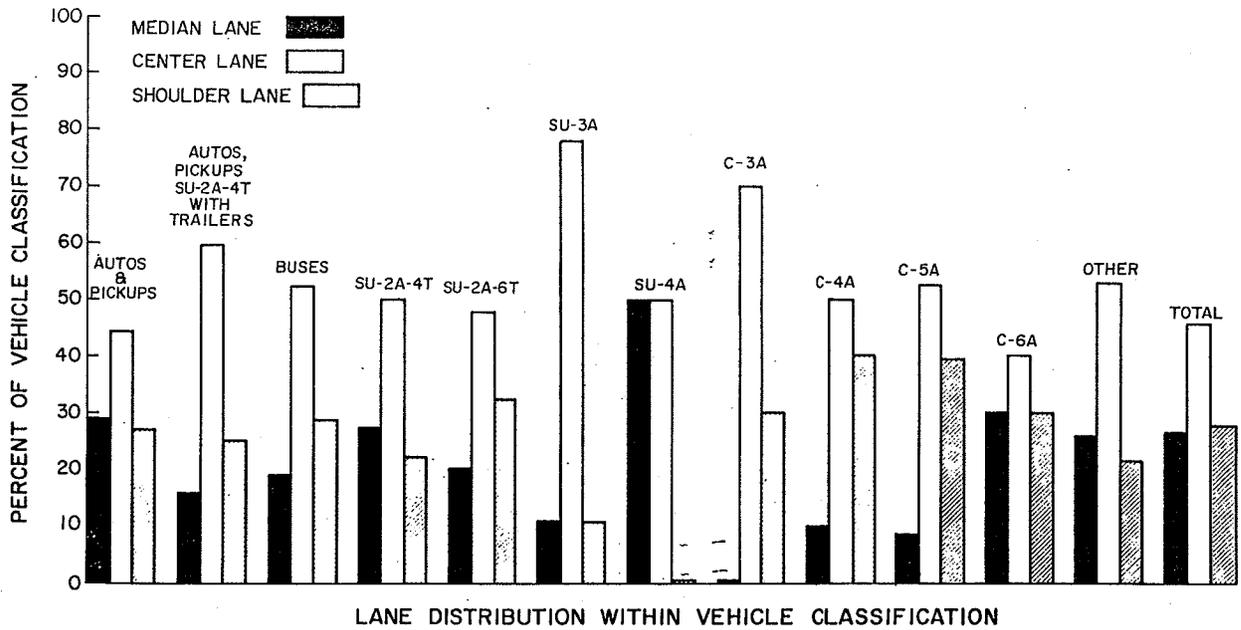


Figure 2c. Vehicle Classifications by Lane; Six-Lane Facility, Level of Service A.

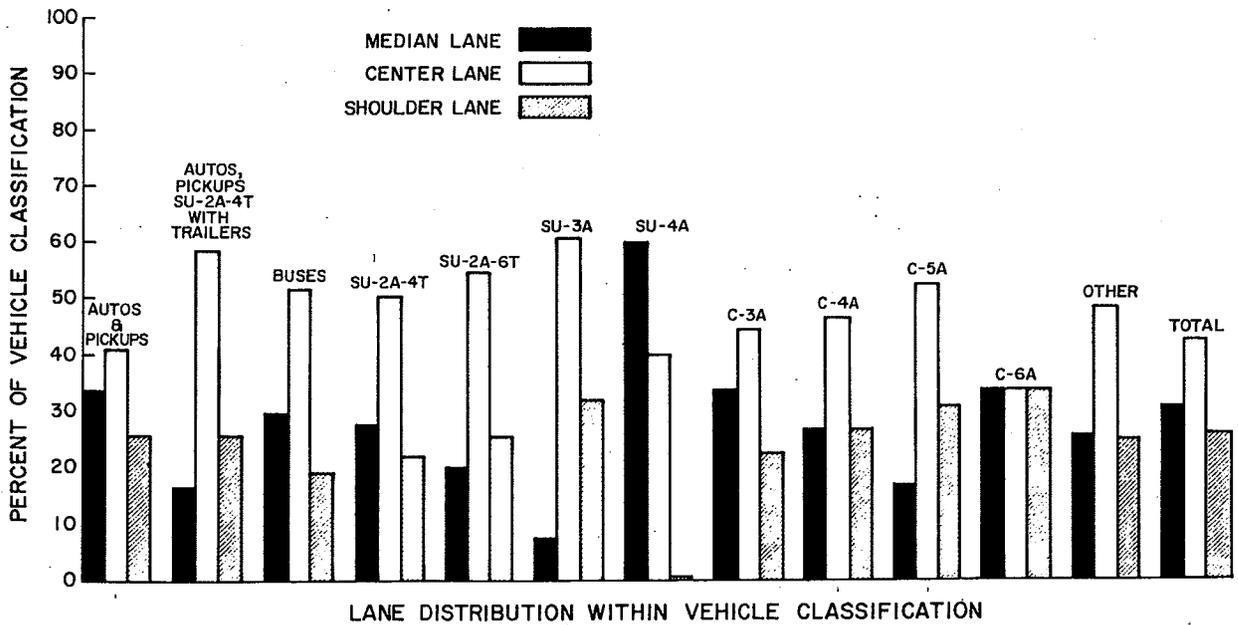


Figure 2d. Vehicle Classifications by Lane; Six-Lane Facility, Level of Service B.

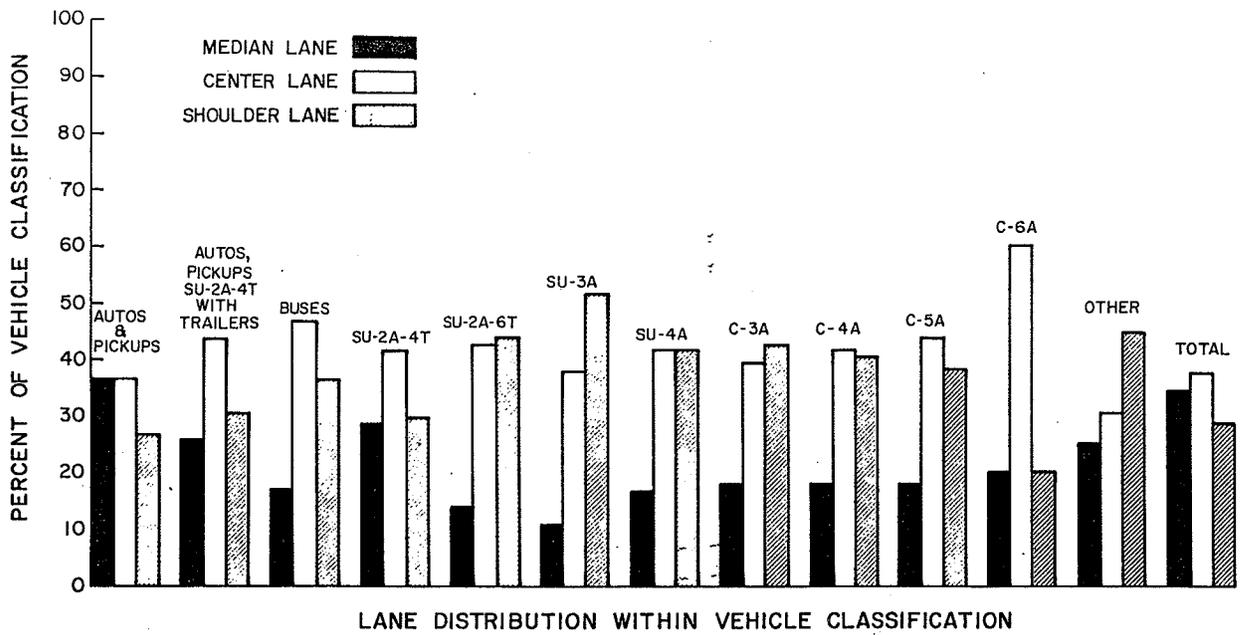


Figure 2e. Vehicle Classifications by Lane; Six-Lane Facility, Level of Service C.

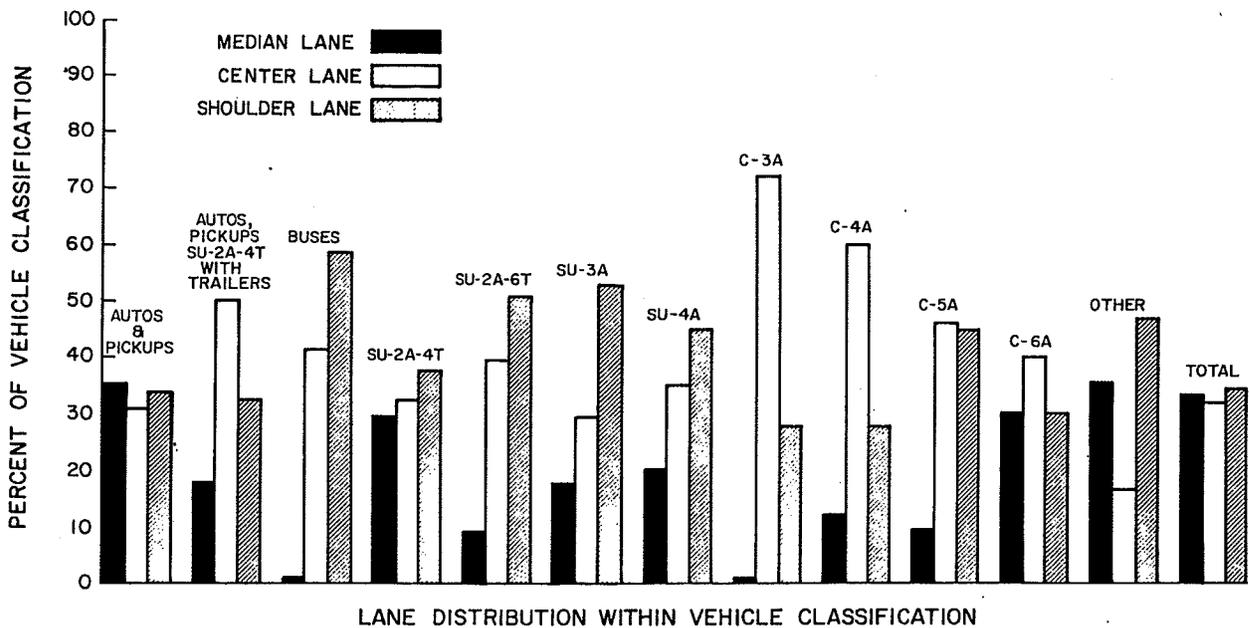


Figure 2f. Vehicle Classifications by Lane; Six-Lane Facility, Level of Service D.

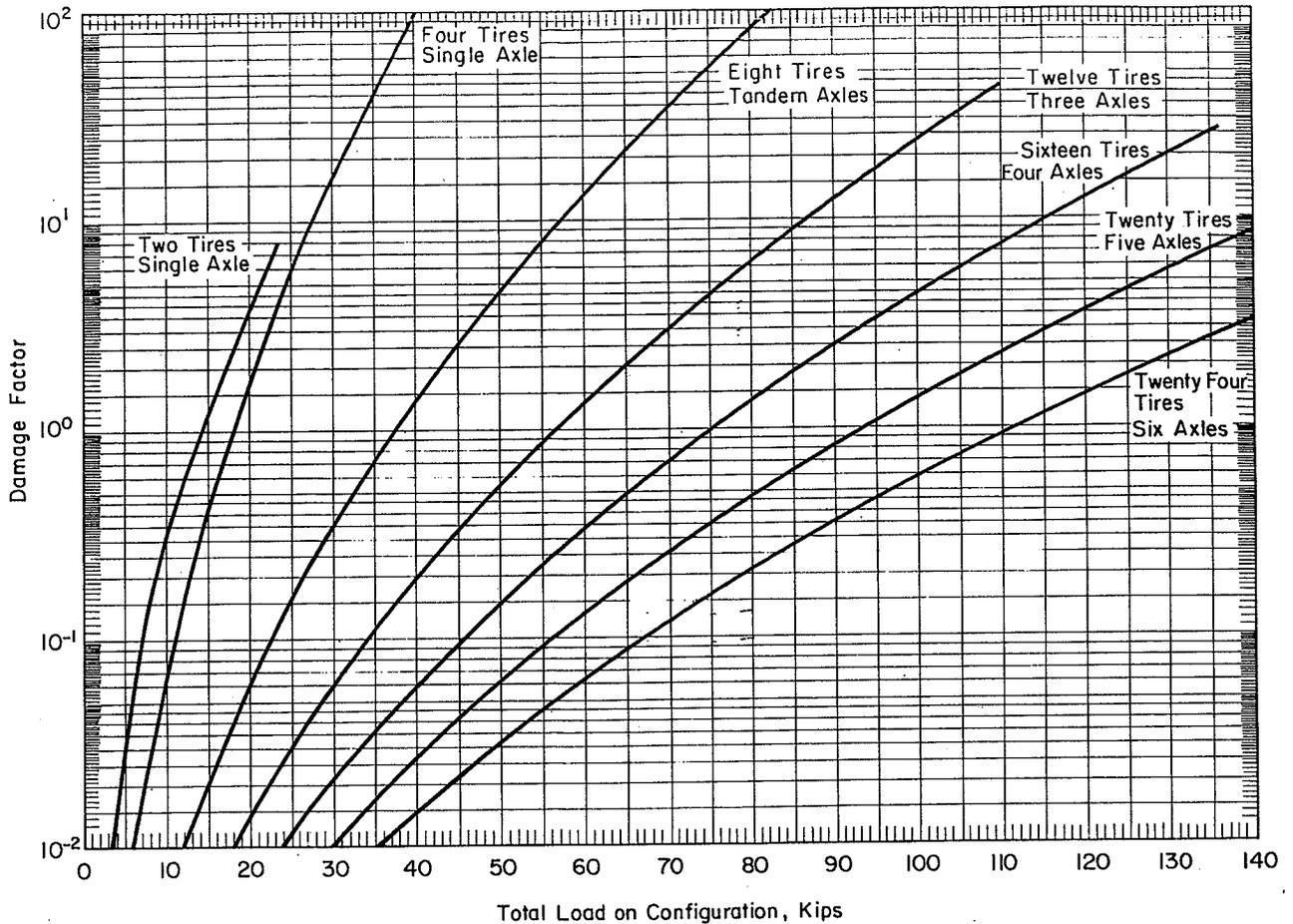


Figure 3. Damage Factors for Various Axle Configurations as a Function of Total Load on Axle Configuration.

TABLE 2. DAMAGE FACTORS BY VEHICLE CLASSIFICATION FOR ASPHALTIC CONCRETE PAVEMENTS

VEHICLE TYPE	AVERAGE EQUIVALENT 80-KN(18-KIP) AXLELOADS PER VEHICLE	DAMAGE FACTOR* BY YEAR	
		M	B
Single Unit	0.0605	0.008310	-1.81212
2 Axles, 4 Tires	0.2953	0.008400	-1.19876
Single Unit	0.6386	0.042940	-2.75730
2 Axles, 6 Tires	0.6353	0.008466	-0.83429
3 Axles	0.7514	0.009622	-0.56825
Combination Unit	0.6267	0.012298	-0.60687
4 Axles	0.0501		
Combination Unit			
5 Axles			
Automobiles and Pickups			

*DAMAGE FACTOR (YEAR) = M (YEAR - 1959) + B (FOR YEARS AFTER 1958)
NOTE: DATA FROM KENTUCKY W-4 TABLES FOR 1959-1973, EXCEPT FOR AUTOMOBILES AND PICKUPS

Equivalent Axleloads

The results of the analyses indicated above are used to calculate the design EAL's:

$$EAL = \sum 365 \times AADT_j \times$$

$$\sum [C_i \times DF_i \times LD_i],$$

in which EAL = equivalent axleload for the design period,

AADT_j = annual average daily traffic for year j,

C_i = ratio of vehicles in classification group i,
DF_i = weighted average damage factor for vehicles of type i, and

LD_i = ratio of vehicles of type i in the design lane.

DESIGN CBR

CBR test values reflect the supporting strength of soil. Moreover, the test procedure intentionally conditions the soil -- by soaking -- to reflect its least or minimum supporting strength; this is presumed to be representative of soil strength during sustained wet seasons when the ground is saturated or nearly so. At other times, the soil may be much stronger; and pavements would be capable then of withstanding heavier loads. If pavements were not designed for the minimum capabilities of the foundation soil, it would be necessary to impose restrictions seasonally on axleloads to prevent premature failures.

The CBR value does not assure immunity against frost heave; however, CBR does have a compensating effect in the design of the pavement structure. Greater pavement thicknesses are required for low-CBR soils than for high-CBR soils; and it is usually the low-CBR soils that are more sensitive to frost. Usually, it will not be economical or practical to eliminate frost-sensitive soils. Very high-type pavements are usually of such thickness that the supporting soil lies below the freezing line. Of course, this is not true for thinner pavements; therefore, the structure providing the greatest template depth is preferred where frost-sensitive soils are encountered. Pavements less than 6 inches in thickness or having less than 4 inches of asphaltic concrete should be regarded dubiously from this point of view. Rock subgrade is recommended where suitable materials are economically available.

Factors logically guiding the selection of the design value(s) are those which would weigh the costs of additional thicknesses of pavement against the costs of improving the subgrade foundation. Estimates may be made as follows:

1. Cost of improving the foundation will depend upon the availability of superior soils, haul distances, royalties, etc., and total cost of substitution for otherwise-inferior materials. It may be presumed that the substitution would include the upper 12 inches to 2 feet of the foundation (embankment). This cost, per square yard, minus the cost of the otherwise-inferior material, divided by the difference in CBR, yields the cost of improvement.

2. Pavement thicknesses required over the improved and the inferior soils should be determined as outlined in the guides herein. Additional thicknesses (inches) of layers multiplied by respective estimated costs per square yard per inch yield the additional cost of pavement -- that is, cost of not improving the CBR.

Treatments of inferior soil with portland cement or other soil solidifiers or modifiers may be considered as an alternative to substitution. Evaluating the equivalent CBR and durability of treated soils may become overly consuming and may complicate construction unless allowances are made for curing times. On the other hand, well-planned construction strategies may prove some treatments to be favorable.

The foundation for a pavement may be soil, gravel, or crushed rock. Bearing strength or stiffness generally increases from low to medium to high in the same sequence. Crushed rock foundation may be achieved at the top of an embankment if the excavations for the roadway yield sufficient rock to be fragmented and hauled to nearby fills in the desired order. Usually the top two feet of the embankment is specified. The rock is less erodible and will sustain other construction traffic. The principal advantage lies in savings of materials (thickness) otherwise needed in the pavement structure. If there were no need for some leveling and correction of other imperfections in this type of foundation, the pavement could be laid directly on it. The thickness of pavement then would be reduced in a significant proportion. However, confidence in the quality of rock subgrade achieved is sometimes not high enough to permit full advantage to be realized. Shales and unsoundness of the rock (poor resistance to weathering) are feared.

In terms of CBR values, soils range up to 15; gravels range up to 65; and crushed rock range from 65 upward. A CBR of 100 or greater typifies crushed rock base material.

Undercutting bedrock in cut sections is practiced to assure drainage of any basins created by blasting and excavations. Refilling with coarse rock and leveling with dense-graded aggregate may suffice altogether for a foundation for a full-depth pavement.

DESIGN MODULUS OF ASPHALTIC CONCRETE

Generally, the modulus of elasticity of bituminous concrete mixtures falls within a very limited range. The effective moduli of asphalt-bound layers depend upon pavement temperature and time of

loading. As design systems begin to take into account to greater degrees the range of pavement temperatures and time of loading, the modulus selected for design purposes becomes more and more significant. Analysis

of the performance of Kentucky pavements in comparison with theoretical computations indicate that bituminous concretes used in Kentucky typically have an apparent modulus of elasticity of about 480 ksi; this

corresponds to the modulus at about 64° F (the annual mean pavement temperature) obtained from an independent correlation between modulus and average pavement temperature.

REFERENCES

1. *AASHTO Interim Guide for the Design of Flexible Pavement Structures*, AASHTO Subcommittee on Roadway Design, 1972.
2. Deacon, J. A.; and Deen, R. C.; *Equivalent Axle Loads for Pavement Design*, Record 291, Highway Research Board, 1969.
3. Southgate, H. F.; Deen, R. C.; Havens, J. H.; and Drake W. B.; *Kentucky Research, A Flexible Pavement Design and Management System, Proceedings*, Fourth International Conference, Structural Design of Asphalt Pavements, University of Michigan, 1977.

ANNOTATED PROCEDURE

- I. **Select a tentative design period (and design life); record inclusive dates.**

Note 1: The design period is the inclusive dates; the number of intervening years is the design life.

Note 2: The design life normally shall be 20 years. Pavements may be designed for a 20-year life but "stage" constructed; for instance, the initial stage might be based on an 8- or 10-year design period. Low class roads may be stage designed or merely designed for a proportionately shorter life. Usually, it will not be practical to design pavements for low class roads to last 20 years. Economic analysis or limitations of funds may dictate the design period. In any case, the design period should be documented and justified.

Note 3: Staged designs may require commitments of funds or other assurances that succeeding stages will be constructed.

- II. **Obtain route description and relevant traffic information.**

Note 1: Ideally, a listing of estimated AADT's for each calendar year of the design period is desired. Otherwise, a growth curve must be assumed. In the absence of specific guiding information, a constant yearly increase factor may suffice -- typified by the compound interest equation $A = P(1 + i)^n$, in which A = AADT in the nth year, P = beginning AADT, i = yearly growth factor, and n = number of years from the beginning. (If i = 0.05, the AADT will double in 14.2 years.) Thus, the AADT for each year may be calculated and then summed through n years; or an "effective"

average AADT may be calculated by $(P + A)/2$ -- which, when multiplied by the number of years, yields the same end result. Errors will arise if the long-term average or "effective" AADT is used in making computations for fractional design periods.

Note 2: AADT's are normally based on two-directional traffic volumes and may be reduced to one direction only (divide by 2, unless there is reason to suspect directional inequality). Because of previous precedents respected in the method of estimating EWL's, it may be desirable to compute two-directional EAL's and to adjust those values to a single-lane basis.

- III. **Estimate design EAL's using methods included herewith.**

Note: If a design life of less than 20 years is to be considered or if "staged" design and construction is envisaged, determine EAL's for the staged design period. Use additional determinations for second-stage design periods.

- IV. **Analyze soil survey information and resolve design CBR values for project or sections therein.**

Note 1: Ideally, analysis of soil surveys and exploration reports will not only assure rejection of soils ineligible for service as subgrade (foundation under pavements) but may enable some additional selectivity of the more competent soils. Soils having high CBR's may even be reserved from cuts and used as the final lift throughout a section of roadways; however, because of the necessity of stockpiling and double handling, this may not always prove to be economical. It is re-

commended, of course, that the designer consider comparative costs of design alternatives and exercise due judgment.

Note 2: Soil surveys may indicate wide variations in CBR's along the length of a specific project. It is presumed that adequate pavement thicknesses will be provided throughout the project. The designer must, therefore, consider the contiguity of the soils and perhaps sectionalize the project according to minimum CBR's. An analog graph may be helpful. The designer must respect all minimums or else some sections of pavement will be "underdesigned;" "overdesigns" must be admitted as a natural consequence therefrom. Here again, subjective judgment is admissible. For example, consider two high-CBR sections having relatively long lengths separated by an intervening short section having a low CBR. The designer is privileged to decide whether to require the low-CBR section to be "upgraded" to the same quality as the abutting high-CBR sections or to make a separate design for the low-CBR section. Of course, the designer should consider relative economics of the two alternatives, but he may also consider continuity and uniformity of pavement section and construction control as pertinent factors. Usually, it is impractical to vary the design thickness within short distances.

Note 3: It is recommended that soils having CBR's of less than 3 be considered ineligible and unsuitable for use as pavement foundations.

Note 4: Test values of CBR's shall be determined and the minimum bearing ratio selected for design purposes.

V. Determine layer thicknesses from design graphs.

Note: The modulus of elasticity of the asphaltic concrete should be taken to be 480 ksi (see appended design curves).

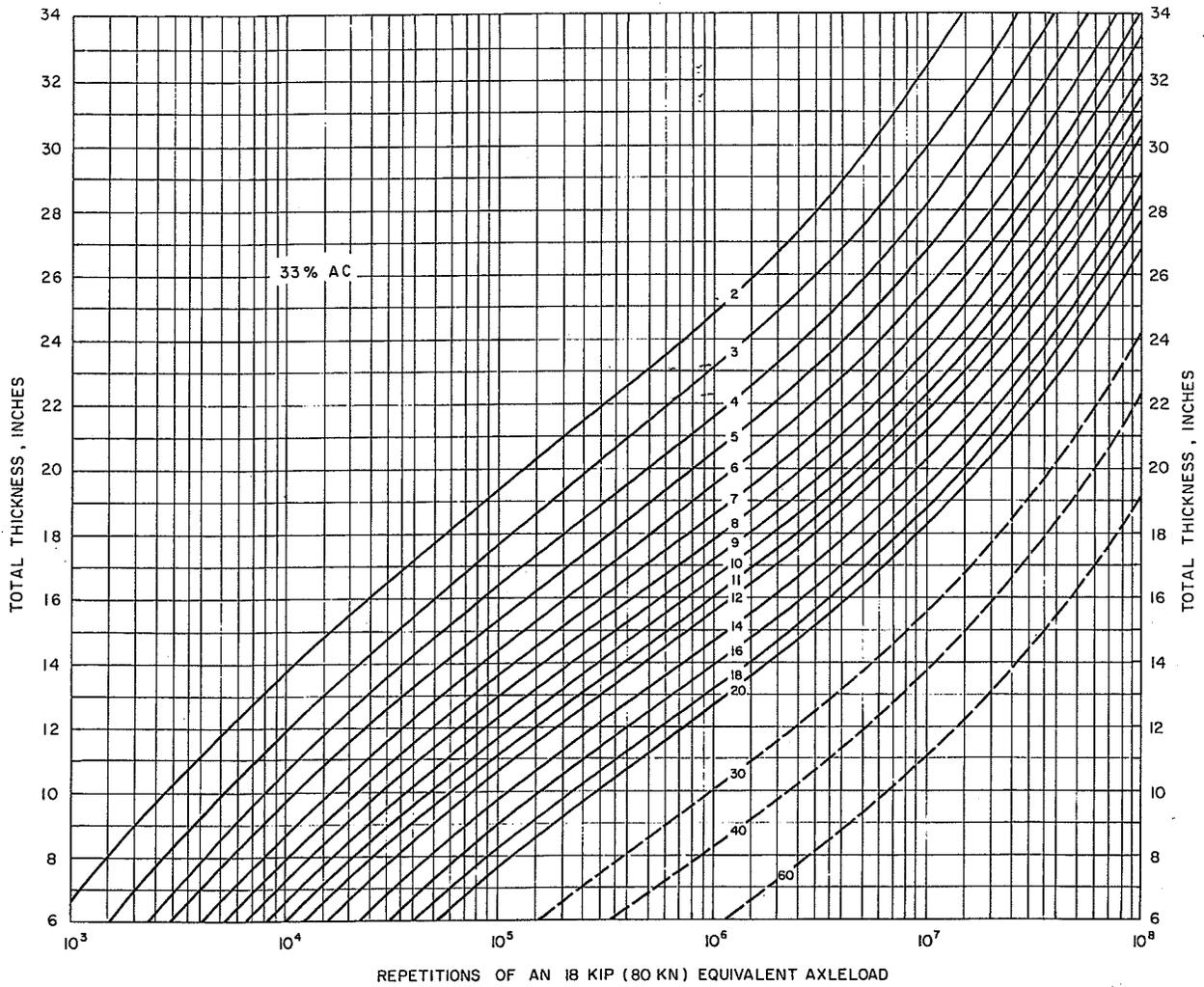
VI. Determine alternative thicknesses from the design graphs. Analyze the several alternatives from the standpoint of engineering and economic feasibility.

Note 1: Alternatives excluded by policy or pre-disposition may be omitted at the outset unless there is some likelihood the analysis might prove to be persuasive or preemptive.

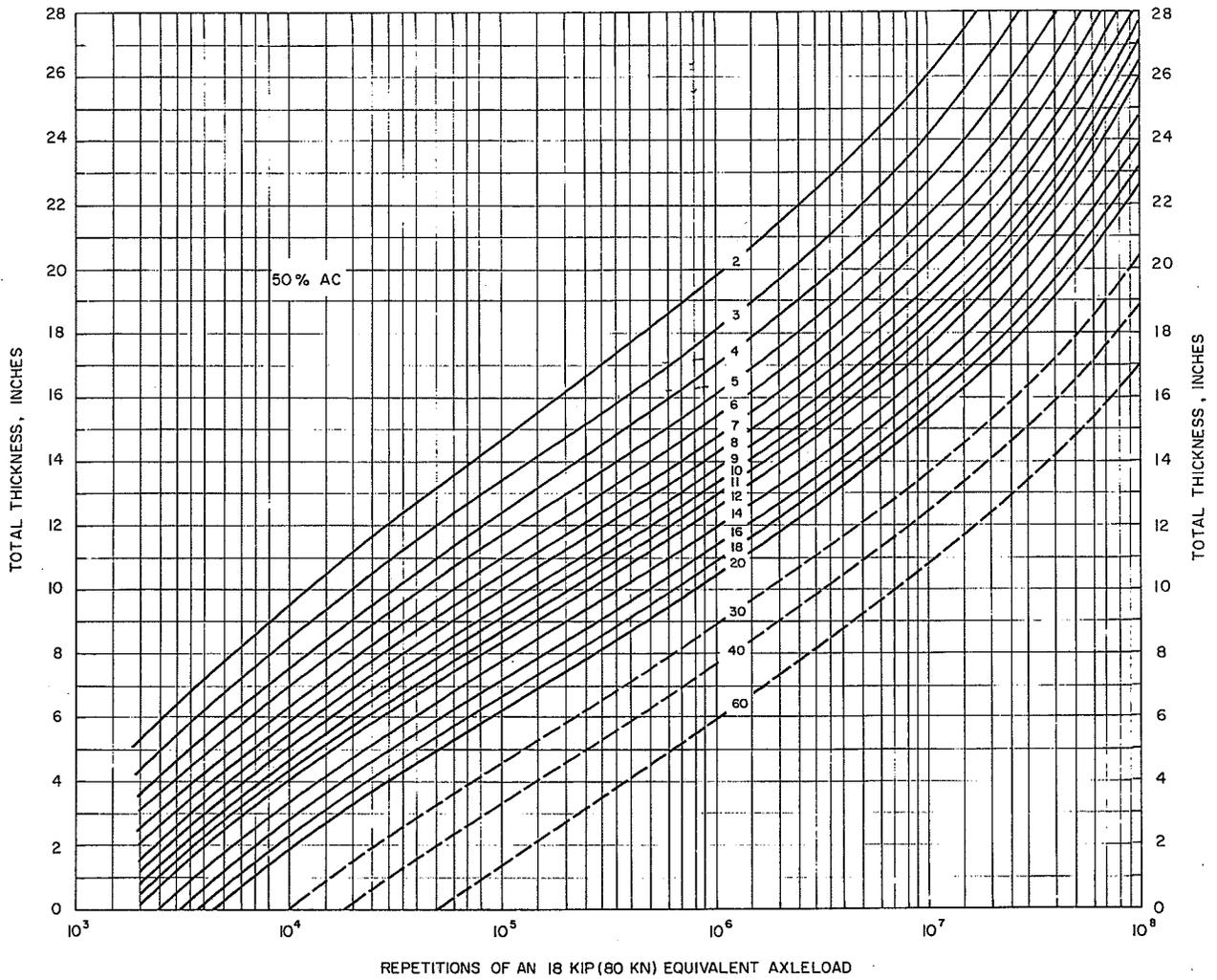
Note 2: Surface renewal for deslicking or protecting an otherwise adequate pavement structure during a 20-year tenure in service is highly probable; leveling courses may be needed to compensate for settlement and subsidence. "Staged" design and construction offers off-setting benefits. Whereas surface renewal and wedging are otherwise accounted as maintenance, staging should be conceived not as a disguised form of maintenance but rather as an alternative to be evaluated and employed if found advantageous.

Note 3: Whereas the basic design curves provide equal assurances against rutting throughout all ranges of EAL's, greater rutting is tacitly and progressively admissible in some inverse relationship to EAL's. It has been presupposed that no additional rutting should be allowed in pavements designed for more than 4×10^6 EAL's. On the other hand, it seemed that pavements designed for 7.8×10^3 EAL's or less might be allowed to rut in a completely uncontrolled manner. Weightings in proportion to EAL's permitted charts to be devised with "built-in" rutting control.

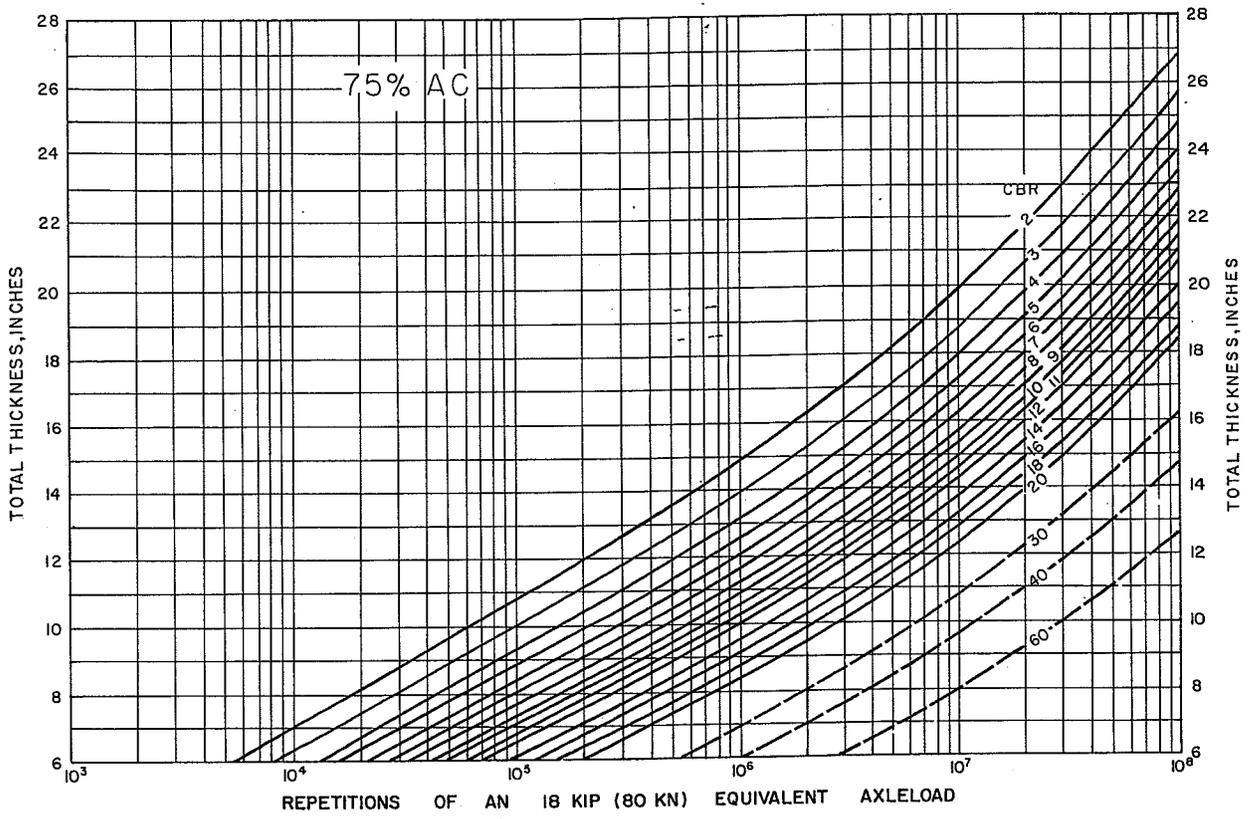
Note 4: Neither the design charts nor the EAL parameters are discretely applicable to the structural design of shoulder pavements. Shoulder pavements, in one sense, are analogous to "hard stands;" in another sense, they might be compared to low-class roads. Designs for 7.8×10^3 EAL's (equivalent to 1.07 18-kip axles per day or 7,800 repetitions in 20 years) may result in "overdesign." On the other hand, if it were necessary to divert main-line traffic onto the shoulder to do maintenance on the main line, the 20-year quota of repetitions might be accumulated in a few days. For this reason, thickness design of the shoulder should include some reserve capabilities. However, in the absence of more definitive criteria, it is suggested that curves for 3.1×10^4 EAL's be used for guidance. Further reductions in thickness may be justified on the basis that shoulders are repairable. Design practices involving "daylighting" base courses to the embankment slopes are overriding considerations.



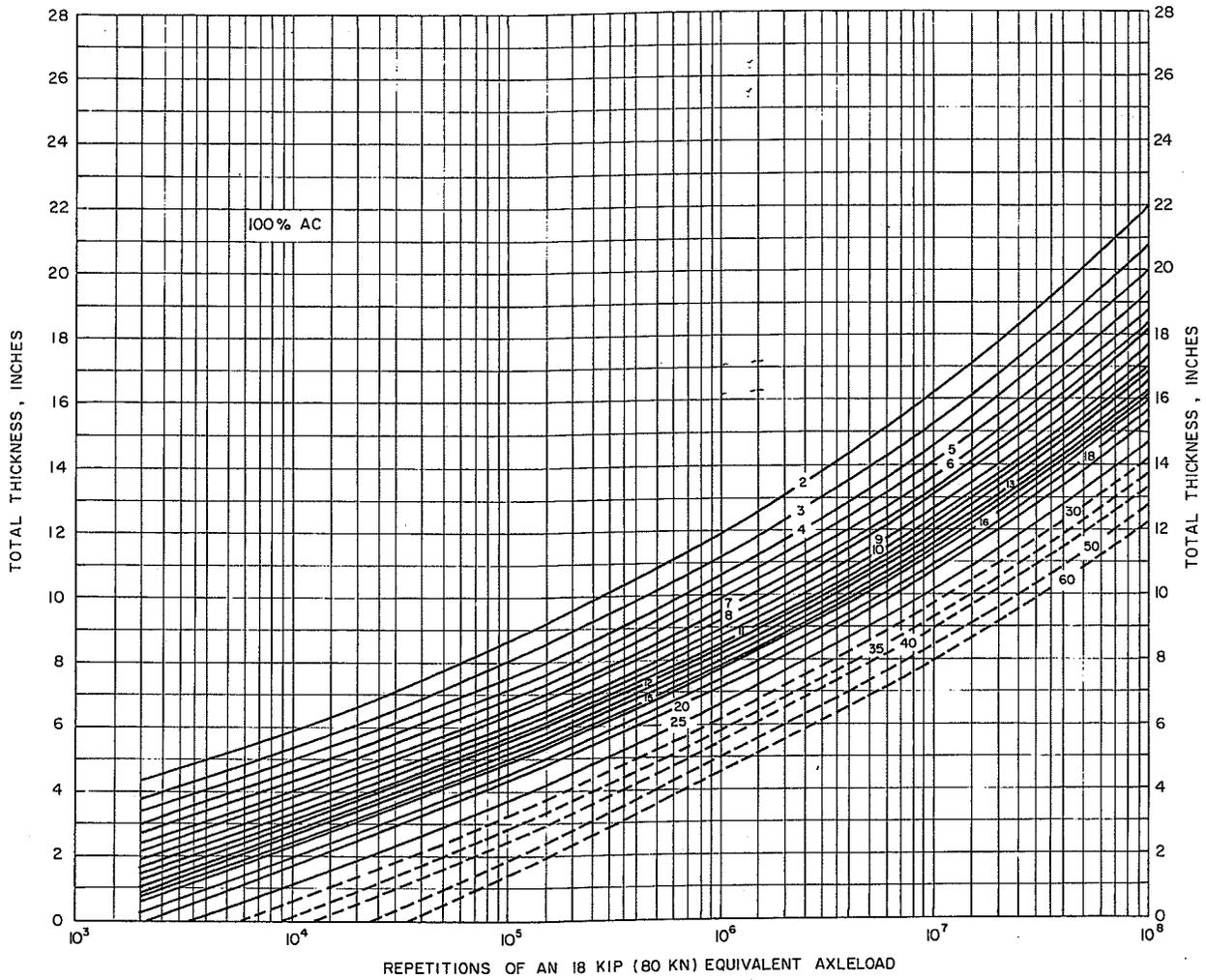
Thickness Design Curves for Pavement Structures Having 33 Percent Asphaltic Concrete Thickness of the Total Pavement Thickness.



Thickness Design Curves for Pavement Structures Having 50 Percent Asphaltic Concrete Thickness of the Total Pavement Thickness.



Thickness Design Curves for Pavement Structures Having 75 Percent Asphaltic Concrete Thickness of the Total Pavement Thickness.



Thickness Design Curves for Pavement Structures Having 100 Percent Asphaltic Concrete Thickness of the Total Pavement Thickness.

ESTIMATE OF EQUIVALENT 18-KIP AXLE LOADS (EAL'S) FOR THE
STRUCTURAL DESIGN OF BITUMINOUS CONCRETE PAVEMENTS
(Method 1)

PROJECT IDENTIFICATION(S) _____

ROUTE NUMBER _____ COUNTY(S) _____

TERMINI _____

DESIGN PERIOD (show inclusive dates) _____ to _____; NO. OF YEARS _____

BEGINNING AADT _____ REFERENCE _____

AADT AFTER _____ YEARS _____

(Note: Beginning AADT may be expanded by use of compound interest equation, $A = P(1 + i)^n$, where A = AADT in nth year, P = beginning AADT, i = yearly increase factor, and n = number of years from beginning; i varies from about 0.03 to 0.08; cite reference or justification for value of i chosen _____; otherwise use 0.05)

$$A = \text{_____} (1 + \text{_____})^{\text{_____}} = \text{_____}$$

AVERAGE EFFECTIVE NUMBER OF VEHICLES PER DAY $[(P + A)/2]$ _____

TOTAL NUMBER OF VEHICLES IN DESIGN PERIOD $[\text{No. of Years} \times 365 \times (P + A)/2]$ _____

COMPUTATION OF EAL'S

TYPE OF VEHICLE	PERCENT* 100	TOTAL NUMBER OF VEHICLES	EAL'S PER VEHICLE**	TWO-DIRECTION EAL'S	DIREC-TIONAL DISTRI-BUTION	ONE-DIRECTION EAL'S	LANE DISTRI-BUTION	UNIT EAL'S
Cars	_____ x	_____ x	0.0002 =	_____ x	_____ =	_____ x	_____ =	_____
Buses	_____ x	_____ x	0.4000 =	_____ x	_____ =	_____ x	_____ =	_____
SU-2A-4T	_____ x	_____ x	_____ =	_____ x	_____ =	_____ x	_____ =	_____
SU-2A-6T	_____ x	_____ x	_____ =	_____ x	_____ =	_____ x	_____ =	_____
SU-3A	_____ x	_____ x	_____ =	_____ x	_____ =	_____ x	_____ =	_____
C-3A	_____ x	_____ x	_____ =	_____ x	_____ =	_____ x	_____ =	_____
C-4A	_____ x	_____ x	_____ =	_____ x	_____ =	_____ x	_____ =	_____
C-5A	_____ x	_____ x	_____ =	_____ x	_____ =	_____ x	_____ =	_____
Other	_____ x	_____ x	_____ =	_____ x	_____ =	_____ x	_____ =	_____
Other	_____ x	_____ x	_____ =	_____ x	_____ =	_____ x	_____ =	_____
Other	_____ x	_____ x	_____ =	_____ x	_____ =	_____ x	_____ =	_____
			Σ =	_____	Σ =	_____	Σ =	_____

COMMENTS: _____

*From Figure 1 or from other source _____

**From Table 2 or from other source _____

ESTIMATE MADE BY _____

DATE _____