

DR 80-3 Adoption of Paving Thick-  
ness Design Manual.

# ACTION

COMMITTEE		DATE
M.A.P.C.	<u>approved</u>	<u>1-30-80</u>
B.C.C./B.C.C.E.	<u>Approved</u>	<u>3-11-80</u>
B.C.C.	<u>Approved</u>	<u>3-19-80</u>

DR 80-3 Adoption of Pavling Thick-  
ness Design Manual.

October 12, 1981

Kenneth H. Bengston  
250 Rockborough Building  
260 North Rock Road  
Wichita, Kansas 67206

Dear Ken:

Thank you for your letter concerning the results of the Paving Technical subcommittee's work. Attached is a redraft of the paving manual that I have been holding in terms of readopting until we had some subcommittee work completed. This draft, as I remember, pretty well represents the conclusions and revisions agreed to about a year ago. Would you please look it over and see what items might particularly need to be further revised as a result of your subcommittee report. The only thing that I can think might be needed would be in relation to the 4-1/2 inch gutter section and 2-1/2 inch asphalt base in terms of the cross sections. The other issue that obviously would be affected would be changing back to a 31 foot standard width in subdivisions rather than the current 29 and 35 foot basic sections.

As I discussed with you in the hallway the other day, I am a little surprised to see this as a recommendation of the committee, as I am of the opinion the cross section should be functional in design. Although design work and staking might be easier and thereby creating savings, I cannot believe that those savings would outweigh the additional cost in paving width that would occur by changing to a 31 foot standard. I simply don't understand 31 foot as it has no functional basis any place within the system that we have been discussing the last few years. If only one standard is to be used, the 29 foot one seems to be more appropriate to me. I believe there is a need for the wider streets where people are not willing to provide the additional off-street parking. As you suggested it may be appropriate to have further discussions on this with the technical subcommittee prior to scheduling this before the Ad Hoc Committee at large.

1-5  
Kenneth H. Bengston  
October 12, 1981  
Page 2

Please let me know what your thoughts are on this, and how you would like to proceed.

Sincerely,

Robert A. Lakin  
Director of Planning

RAL:rms  
Attachment



250 Rockborough Building  
260 North Rock Road  
Wichita, Kansas 67206  
316/686-7303

RECEIVED

SEP 25 1981

METROPOLITAN PLANNING  
ROUTE  \_\_\_\_\_

\_\_\_\_\_

September 24, 1981

Mr. Robert A. Lakin  
Director of Planning  
City Hall - 10th Floor  
455 North Main  
Wichita, Kansas 67202

Dear Mr. Lakin:

Per your letter of November 17, 1980, the Paving-Technical Subcommittee has actively pursued its assigned task of examining current and proposed pavement design and construction. I believe some real positive results and ideas are coming forth and some of these have been presented and used on City projects. Some of these ideas are:

1. The use of up to 15% recycled asphalt
2. Saw joints in curb and gutter set at 15 feet
3. Use of and testing of Fly Ash and Preheater fines

In our latest meeting we discussed the following items:

1. The practical problems of constructing the 7" pavement section
2. Advantages and disadvantages of multiple choice of pavement widths
3. The use of hydraulic wideners
4. Value Engineering

of this last list the following recommendations were set forth:

1. Try a 4 1/2" gutter section on a 2 1/2" asphalt base so cross section slopes would be maintained at 3/8" / 1"
2. Consider a standard width of 31 foot in subdivisions rather than mix 29 and 35 foot sections. Expected resultant should be that design, staking and construction should be easier and more error free, thereby creating savings.
3. Stay with present policy prohibiting the use of hydraulic wideners
4. If a contractor comes up with cost saving ideas let's test them and implement them if positive results occur. Perhaps some share in the savings would go to the party making the recommendation.

Respectfully submitted on behalf of a good committee.

Sincerely,  
VAN DOREN-HAZARD-STALLINGS

By: *Kenneth H. Bengtson*  
Kenneth H. Bengtson  
Partner

cc: John Kraus  
Steve Lackey  
Charles Freund  
Tom Ritchie  
George Tomlin  
Claud Shelor  
Joel Pollack

*Drug*

DESIGN MANUAL  
FOR  
PAVEMENT THICKNESS  
FOR  
RESIDENTIAL STREETS  
WITHIN THE  
WICHITA METROPOLITAN AREA

December 1980

## CONTENTS

	<u>Page</u>
FOREWORD	1
SECTION I PAVEMENT DESIGN PROCEDURES	
A. Soils Investigation	
1. General	3
2. Preliminary Soils Survey, Tests and Report	4
B. Traffic Consideration	6
C. Pavement Type and Thickness Selection	7
1. Flexible Pavement	7
2. Rigid Pavement	12
SECTION II QUALITY CONTROL	
A. Pavement Subgrade	17
B. Pavement Materials and Construction Control	18
1. General	18
2. Rigid Pavement	19
3. Flexible Pavement	23

### Table Of Figures

<u>Fig.</u>		
1-1	Approximate Relationship of Soil Bearing Value	6
2-1	Design for Flexible Pavement	9
2-2	Local Residential Streets-Recommended Sections	10
2-3	Collector Residential Streets Recommended Sections	11
2-4	Design Graph for Rigid Pavement	14
2-5	Local Residential Streets-Recommended Sections	15
2-6	Collector Residential Streets-Recommended Sections	16

#### FOREWORD

The purpose of this Pavement Thickness Design Manual is to provide design criteria based on the findings and the recommendations of the report "Pavement Design and Feasibility Study for Residential Streets Within the Wichita Metropolitan Area", dated April 1979 (hereinafter referred to as the Paving Report) prepared by Professional Engineering Consultants Inc., Wichita, Ks.

During the preparation of the Paving Report, meetings were held with the City and County Departments of Public Works and it was determined that the criteria and methodology utilized in establishing pavement thicknesses was acceptable to both agencies. The report was accepted as meeting the requirements of the Consultant's engineering agreement, however the consultant was instructed to and did prepare a supplementary design manual based on the following conditions:

1. The 40-year pavement design life (minimum) as recommended by the Consultant in the Paving Report was satisfactory.
2. Additional preliminary testing of subgrade soils and additional project site inspection and testing above the present levels could be utilized for pavement design and control of construction materials.

3. More than a single pavement thickness standard was acceptable, but some limitation was preferred. This would permit the engineer greater latitude in the design process, which hopefully will provide the most economical section for a given location within the Study Area.

In this era of spiraling construction costs resulting in very high special assessments in newly developed areas, it is apparent that more engineering is necessary to conserve materials and energy, reduce construction costs, and to improve quality control. It is the engineer's responsibility to keep abreast of new techniques, products and equipment which will provide a cost effective facility for any required service and to provide proposals to the governing bodies for change to these criteria as good engineering practice dictate.

Therefore, the design engineer should be cautioned that the design and recommendations presented in this Manual are valid only for the local area residential streets and are not to be considered as permanent in regard to time.

SECTION I  
PAVEMENT DESIGN PROCEDURES

A. Soils Investigation

1. General -

It is determined that a subgrade support value having a CBR of 10 for design purposes could be attained without changing specifications or design procedures for residential streets of the City of Wichita existing prior to 3-11-80. This includes using 95% ASTM D-698 as the standard for compaction. A CBR of 20 can be expected if the compaction effort was increased in the specification to 90 percent of maximum dry density as determined by ASTM D-1557-70. To obtain CBR value greater than 10, 90% max dry density ASTM D-1557-70 shall be used.

It is recommended that CBR values of subgrade support greater than 20 should not be utilized for residential street design purposes. Therefore thickness less than five and one-half inches in thickness shall not be permitted. As higher CBR values are used, the possibilities

of having localized areas of deficient subgrade support increases and can result in not obtaining the design or service life of the pavement. The formulas do not take into consideration any loss of pavement strength due to weathering over the 40-year design life and the problems of frost penetration into the subgrade. For these reasons, the five and one-half inch thickness is considered as the minimum or bottom for 40-year design life.

2. Preliminary Soils Survey, Tests and Report -  
Field sampling and laboratory testing of soils for pavement subgrade shall be conducted by experienced personnel familiar with standard test procedures. Slight variations in testing procedures can have significant effect on the reliability of test results which could affect the pavement service life.

The personnel conducting the soils survey should have preliminary street plans and profiles so that the actual frequency of spacing and depths of soils borings can be determined in the field. The boring locations are discretionary and are to be adjusted to the size of the project and field observations of change in the soil types.

The number of tests to be conducted on the soil samples depends on the level of history and documentation of soil classifications in the project area. A particle size analysis ASTM D-422-63, liquid limit ASTM D-423-66, and plastic limit ASTM D-424-59, is to be run to determine the general classification of each soil expected to be found in the subgrade.

For CBR value greater than 10, similar samples as determined by the above analysis should be combined and tests run to determine maximum dry density in accordance with ASTM D-1557-70 and CBR values as provided in ASTM D-1883-73 (96-hour soaked sample) for each soil type. Obvious clay soils shall be tested to establish the required lime content and the parent soil treated accordingly prior to conducting the density and CBR tests.

A summary or report of the soil survey shall be submitted to the design engineer so that a final determination can be made on the pavement thickness and subgrade stabilization required for the project. CBR values can be converted to approximate plate bearing values or modulus of subgrade reaction "k" by use of Table 1-1. However, verification of this table could be accomplished by conducting plate bearing tests on the final subgrade.

TABLE 1-1  
 APPROXIMATE RELATIONSHIP OF SOIL BEARING VALUES

RESISTANCE VALUE - R																					
	20				30					40			50	55	60						
MODULUS OF SUBGRADE REACTION - k psi per in.																					
	100				150					200			250	300	400	500	600	700	800		
CALIFORNIA BEARING RATIO - CBR																					
2	3	4	5	6	7	8	9	10		15	20	25	30		40	50	60	70	80	90	100

B. Traffic Consideration

A review of Section IV.A.2.c. and d. in the Pavement Design and Feasibility Study For Residential Streets April 1979, prepared by Professional Engineering Consultants, P.A. Engineer, is necessary for establishing the number of applications of equivalent 18-kip single axle loads for Local and Collector residential streets over the 40-year design life is established as 117,000 and 290,000 respectively for the two categories of residential streets. A line has been added and labeled at these points on the design graphs for rigid and flexible pavement as presented in this manual (Fig. 2-1 & 2-4).

Although it is possible these values are on the high side as an average for each category of residential street, some compensation for loss of serviceability due to weathering is provided in the thickness design. The formulas as provided in the AASHO Interim Guide and utilized in the design graphs are based on straight line dynamic loading repetitions for loss in serviceability without regard to losses for weathering of the pavement structure.

C. Pavement Type and Thickness Selection

1. Flexible Pavement -

From review of the design graphs for flexible and rigid pavement (Fig. 2-1 & 2-4), it is apparent that the flexible pavement thickness is much more susceptible to subgrade support than is the rigid pavement. This is to be expected since flexible pavement thickness is based on a component layer concept while rigid pavement is based on a concept of development of internal bending stresses within the pavement slab. Therefore, the design engineer is cautioned that variations in subgrade support for flexible pavement cannot be tolerated to the extent permitted for rigid pavement. Thus the preliminary soils investigation and job-site quality control should

both be more detailed where flexible pavements are proposed.

After receipt of the soils survey, the minimum CBR value to be used for pavement thickness is established. Utilizing the "Design Graph for Flexible Pavement" (Fig. 2-1), proceed vertically up the lines labeled for either Local or Collector residential street to the point of intercept with the given CBR value of subgrade support; then horizontally to the required thickness of asphalt pavement as shown in Figure 2-1. It is intended for the indicated thickness of flexible pavement to contain a two-inch surface course with the remainder as base course(s). Both surface and base course shall have the specified minimum Marshall stabilities noted in Figure 2-1.

For a Local residential street, a subgrade having a CBR of 10 requires 7 inches of asphalt pavement and a subgrade with a CBR of 20 requires 5-1/2 inches of asphalt pavement or a difference of 1-1/2 inches. It should normally be more feasible to modify the subgrade by stabilization or treatment to attain a CBR in the 10 to 20 range for residential streets as discussed previously in Paragraph A.1 of Section I than to use the considerably greater pavement thicknesses required for low CBR values.

DESIGN GRAPH FOR FLEXIBLE PAVEMENT ( $P_f = 2.0$ )

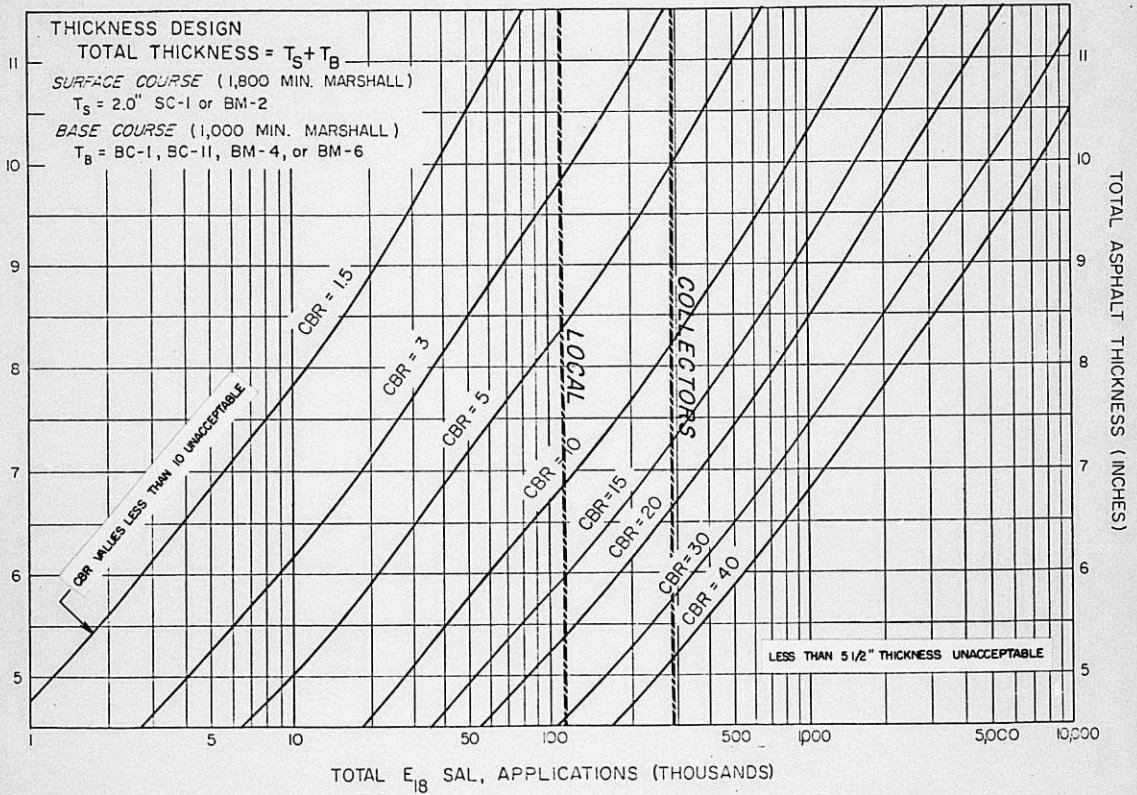
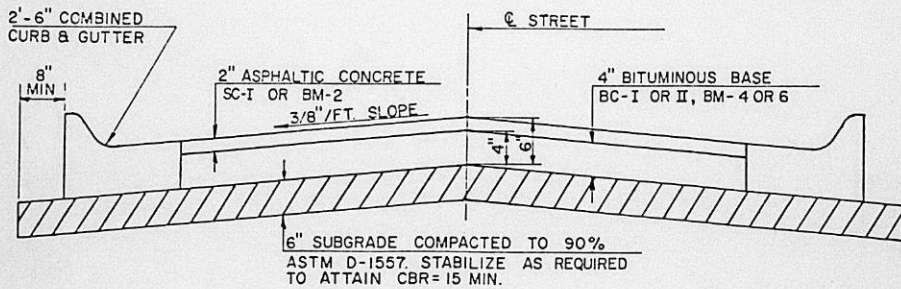
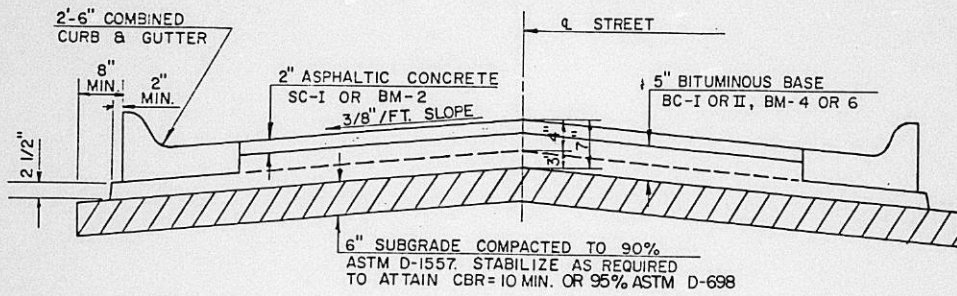


FIG 2-1

-9-

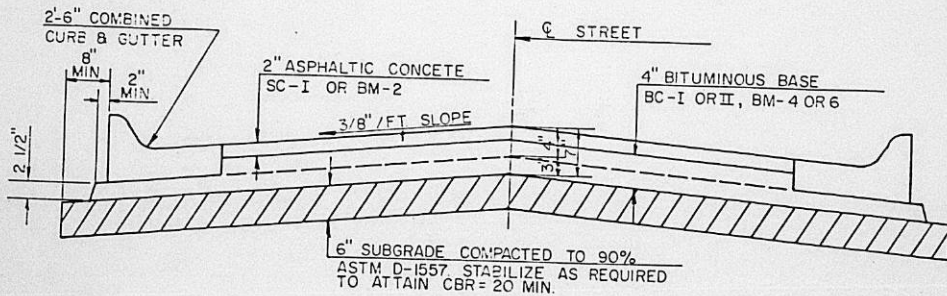
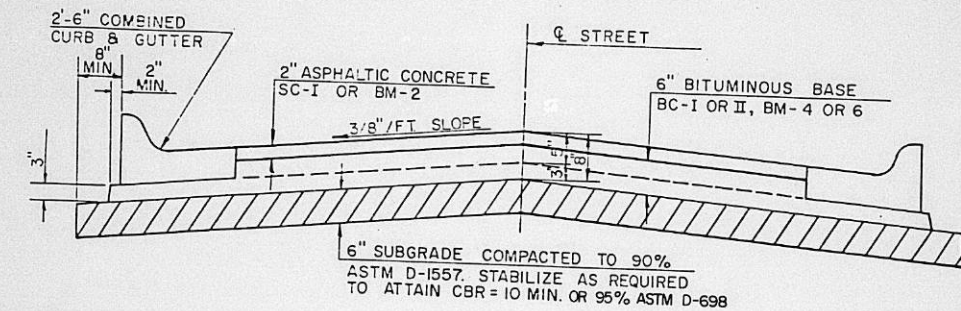
LOCAL RESIDENTIAL STREETS  
RECOMMENDED SECTIONS



FLEXIBLE PAVEMENT

FIG. 2-2

COLLECTOR RESIDENTIAL STREETS  
RECOMMENDED SECTIONS



FLEXIBLE PAVEMENT

FIG 2-3

Typical sections for Local and Collector residential streets are shown in Figures 2-2 and 2-3 respectively for flexible pavement. It should be noted that when the thickness of asphalt pavement drops below 7' the possibility of having a portion of bituminous base below the curb and gutter section ceases. It is acknowledged that placing the curb and gutter over bituminous base has many advantages; however, it should not be a condition for determining the pavement thickness.

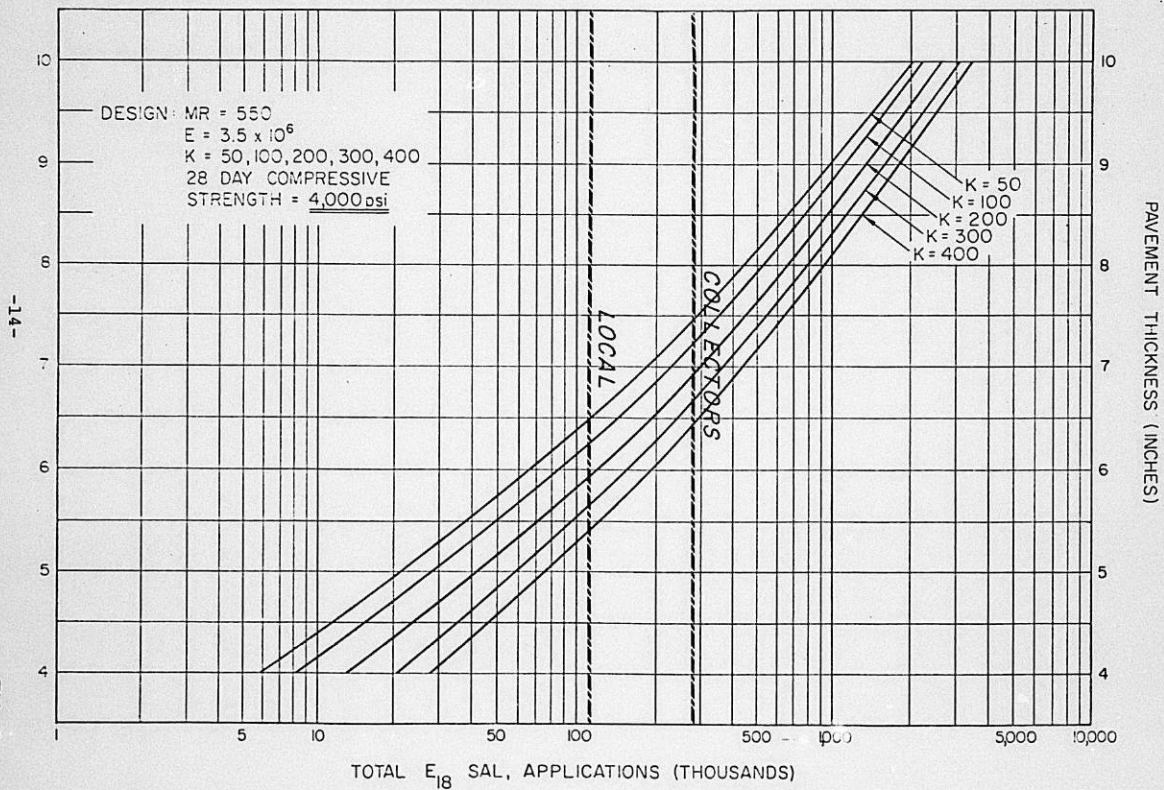
2. Rigid Pavement -

From a review of the "Design Graph For Rigid Pavement" (Fig. 2-4), it can be seen that for a given application of equivalent 18-kip single axle loads the difference in pavement thickness amounts to approximately one inch over the whole range of subgrade support values; whereas for flexible pavement (Fig. 2-1), the difference in thickness is approximately five and one-half inches. This illustrates that rigid pavement is not as sensitive to subgrade support variations as is flexible pavement. However, rigid pavement is more prone to problems from shrink-swell conditions and frost heaving conditions within the subgrade.

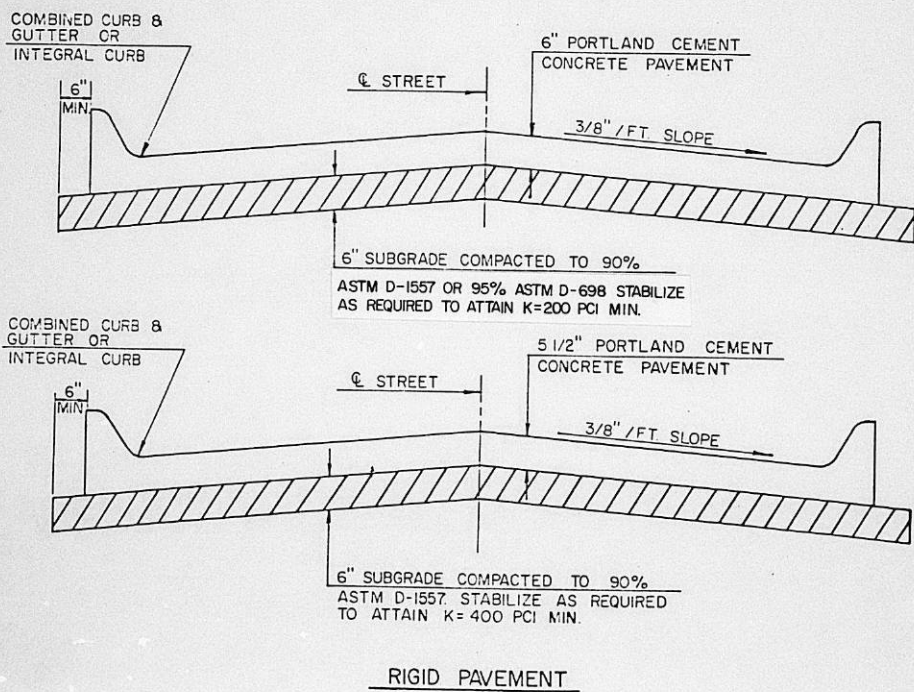
After the minimum "k" value of subgrade support for the project is established, the concrete thickness can be determined by use of Design Graph for Rigid Pavement (Fig. 2-4). This is accomplished by proceeding up the vertical lines labeled either Local or Collector residential street to the point of intercept with the given "k" value of subgrade support; then horizontally to the required thickness of concrete pavement. The thickness should be rounded off to the nearest one-half inch increment.

As discussed in Paragraph A.1., it is normally more feasible or desirable to modify the subgrade by stabilization or treatment to attain a "k" value of 200 minimum. Typical sections for Local and Collector residential streets are shown in Figures 2-5 and 2-6 respectively, for rigid pavement.

DESIGN GRAPH FOR RIGID PAVEMENT ( $P_t = 2.0$ )  
NO LOAD TRANSFER



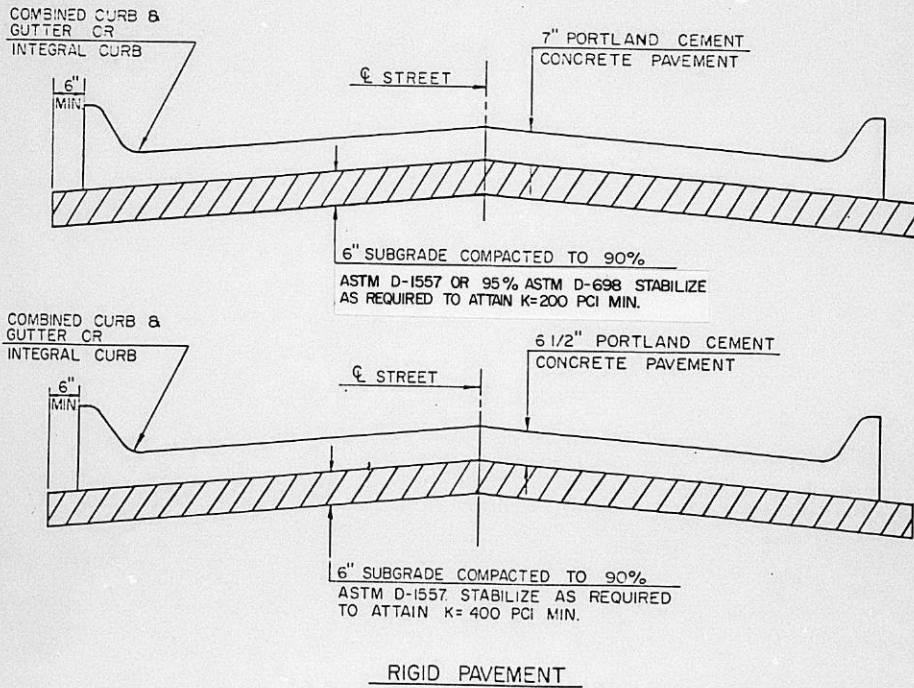
LOCAL RESIDENTIAL STREETS  
RECOMMENDED SECTIONS



-15-

FIG. 2-5

COLLECTOR RESIDENTIAL STREETS  
RECOMMENDED SECTIONS



-16-

FIG. 2-6

SECTION II  
QUALITY CONTROL

A. Pavement Subgrade

The project field representative shall be given a copy of the project Soils Report along with a set of plans and specifications. This should enable him to anticipate some problems that may be peculiar to the project site for obtaining specific densities and subgrade support values.

For a given soil or treated material, the CBR value or Modulus of Subgrade Reaction ( $k$ ) is primarily a function of the degree of compaction. Soft areas or areas of undesirable subgrade soils, if present in the project site, will normally become apparent during the rolling or compaction process. It is therefore imperative for the project representative (inspector) to be present for full time observation of the compaction process. Unsuitable subgrade material shall be removed and replaced with suitable material as directed by the project representative. Density tests shall be conducted as determined necessary by the field engineer.

If lime treatment of the subgrade is required for the project, plasticity index tests shall be run on samples

taken from treated subgrade material on intervals selected by the field engineer.

B. Pavement Materials and Construction

1. General

Section I, Pavement Design, includes the standards for thicknesses for both rigid and flexible pavements to be used on Residential "Local" and "Collector" streets. These standards were based on the assumption that materials and construction details for the pavements will meet certain minimum requirements.

Utilization of materials and construction details contained herein should prevent sacrifice of quality and performance of the pavement regardless of the pavement type selected. The proper requirements are to be provided for in the specifications to assure control of all materials and construction methods incorporated in the work. Strict attention shall be given to laboratory and field testing of materials and to providing adequate inspection of the construction to assure compliance with the specifications in regard to quality of the work.

2. Rigid Pavement

a. Portland Cement - Cements complying with the requirements of ASTM C-150 shall be used. Type II cement is preferred for street construction due to its greater uniformity but Type I cement can be used satisfactorily. Alkali content of the cements should be limited.

Type II cement shall be used, however when unavailable Type I cement may be used with the Engineer's written approval. Type III cement may be permitted with the Engineer's written approval.

b. Fine Aggregate - Fine aggregates used in the mix shall comply with ASTM C-33.

c. Coarse Aggregate - Coarse aggregates, 3/4 inch maximum size (ASTM Size No. 67) may be used in the mix to comply with ASTM C-33 with the following additional requirement: Absorption - Maximum of 3.5 percent.

d. Admixtures - This group of materials is defined as any ingredient other than portland cement, aggregate and water that is introduced into the concrete mixture to modify its properties and make the concrete more suitable for the work at

hand. Several of these materials can provide significant benefits and should be considered for street pavement construction.

Air entrainment is the formation of millions of very small, finely dispersed air bubbles within the fresh concrete. The presence of these bubbles, with proper size and spacing, provides the hardened concrete with greatly increased resistance to freeze-thaw action. Also the concrete is less susceptible to the corrosive attack by deicing chemicals. Air entrainment is provided by introducing into the mix an approved material complying with ASTM C-233. Neutralized vinsol-resin is widely used as an air-entraining agent.

Water Reducing Agents (WRA) are materials which, when introduced into the concrete mixture, reduce the amount of mixing water required to produce a given workability (slump). WRA may be of three types: (1) Water-Reducing; (2) Water-Reducing and Set-Retarding; and (3) Water-Reducing and Set-Accelerating. All types are covered by ASTM C-494 and materials may be used. Accelerators are materials which increase the rate of hardening and strength gain of the concrete. By far the most prevalent used accelerator is calcium chloride.

This material is normally added to the concrete mixture in solution with a portion of the mixing water. For concrete placement during periods of cold weather (temperatures below 45°F) the use of an accelerator can be beneficial. The hydration of portland cement is affected by temperature and does not occur at normal rates with temperatures of the mix below 50°F. Calcium chloride appears to act as a catalyst when added to the concrete under such conditions and in many cases allows the hydration of the cement to proceed at normal rates with lower air temperatures.

Retarders are materials which inhibit the initial hardening of the plastic concrete by slowing down the initial rate of hydration of the portland cement. Widely used retarders are sulfonated lignins, hydroxylated carboxylic acids, and hydroxylated polymers. The latter two types of retarders generally do not contain any calcium chloride. Use of retarders can be of significant benefit for street pavement construction during hot weather. Their use can frequently provide the time needed to properly finish the pavement surface before initial set of the concrete occurs.

e. Proportioning - The design standard assumed a Modulus of Rupture (MR) at 28 days of 550 psi. This will normally equate to a 28 day compressive strength of about 4000 psi. Minimum cement factor would be 6.5 bags per cubic yard and maximum water cement ratio of 5.5 gallons per bag. Maximum slump would be 3 inches. Concrete would be air-entrained with air content of 5 to 8 percent. Total aggregate in the concrete mixture to contain 30 to 60 percent material retained on the No. 4 screen.

f. Construction Details - The recommended design standard is based on plain or reinforced concrete without load-transfer dowels at transverse joints. If reinforcing steel is used it should be uniformly distributed across the pavement section. Spacing of transverse contraction joints should be based on the slab thickness and the amount (if any) of reinforcing provided. Expansion joints would be placed at intersections, structures, and significant changes in horizontal alignment. Joints would be sealed with Hot-Pour joint sealant. Curing of the finished slab for a minimum of 3 days by approved methods would be required.

3. Flexible Pavement

a. Asphalt Cement. For Flexible pavement Penetration Grades asphalt cement complying with AASHTO M 20 shall be used. A penetration grade of 60-70 is suggested; however, the penetration grades of 40-50 and 85-100 can be used successfully. Use of viscosity graded asphalt AC-10 or as determined by ASTM D-3381 shall be used when viscosity graded asphalt is preformed in lieu of penetration graded asphalt.

b. Asphaltic Mixtures. Aggregates and mixtures complying with the requirements of ASTM D 3515, Hot-Mixed, HotLaid Bituminous Paving Mixtures, with modifications for use of local materials to the extent feasible shall be used. This includes limitations on absorption and deleterious substances in the aggregates and the provision for Marshall stability requirements.

c. Construction Methods. The mixing, spreading and compaction of bituminous mixtures shall require a compaction of 95 percent of a voidless mixture of Marshall test densities.

It is necessary to have the course aggregate hard enough to minimize fracturing or breakdown under compaction or traffic. Therefore desirable the Los Angeles Abrasion Test Method for maximum wear of 40 percent and a sodium sulfate weighted loss of not more than 15 percent shall be specified.

Bituminous mixtures for base courses being designed by Marshall tests are to be used. The recommended Marshall requirements tested in accordance with ASTM D 1559 are:

Stability (Minimum)	1000 lbs.
Flow	0.08 to 0.16 inch
Percent voids in compacted sample	3 to 7
Percent voids filled with asphalt	70 minimum

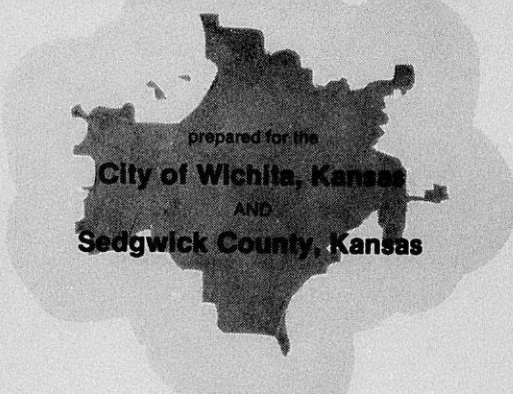
With regard to surface course bituminous mixture, the BM-2 gradation provides better control for stability than does the SCI master gradation limits.

It is recommended that the specifications for the surface course include the Marshall requirements as follows:

Stability (Minimum)	1600 lbs
Flow	0.08 to 0.16 inch
Percent voids in Compacted Sample	3 to 5
Percent voids filled with asphalt	70 minimum

**PAVEMENT DESIGN**  
AND  
**FEASIBILITY STUDY**

for  
**RESIDENTIAL STREETS**  
within the  
**WICHITA METROPOLITAN AREA**



prepared for the  
**City of Wichita, Kansas**  
AND  
**Sedgwick County, Kansas**

prepared by

**Board of County Commissioners**  
Resolution # 56-1980  
March 19, 1980

**Board of City Commissioners**  
Ordinance # 36-572  
March 26, 1980

PAVEMENT DESIGN  
AND  
FEASIBILITY STUDY  
FOR RESIDENTIAL STREETS  
WITHIN THE  
WICHITA METROPOLITAN AREA

PREPARED FOR THE  
CITY OF WICHITA, KANSAS  
AND  
SEDGWICK COUNTY, KANSAS

PREPARED BY  
PROFESSIONAL ENGINEERING CONSULTANTS, P. A.  
ENGINEERS



APRIL, 1979



TABLE OF CONTENTS

PAGE NO.

LIST OF FIGURES	
LIST OF TABLES	
GLOSSARY OF TERMS	
I INTRODUCTION	
A. Study Requirements	1
B. Purpose	2
C. Scope of Study	2
II SUMMARY AND RECOMMENDATIONS	
A. Summary	4
B. Recommendations	12
III SOILS	
A. Soils History	14
B. Soils Types	17
C. Compaction and Stabilization	18
IV PAVEMENT DESIGN PROCEDURES	
A. General	21
B. Flexible Pavement Design	31
C. Rigid Pavement Design	35
V FIELD EVALUATION OF RIGID PAVEMENT	
A. General	39
B. Structural Performance	40
C. Maintenance	41
D. Discussion	41
VI FIELD EVALUATION OF FLEXIBLE PAVEMENT	
A. General	43
B. Structural Performance	44
C. Maintenance	45
D. Discussion	46
VII PAVEMENT MATERIALS AND CONSTRUCTION	
A. General	47
B. Rigid Pavement	47
C. Flexible Pavement	56
VIII ANNUAL PAVEMENT COSTS	
A. General	64
B. Residential Collector Streets	75
C. Residential Local Streets	78
D. Effect of Street Maintenance Costs on City Taxes	81

APPENDIX

Supplementary Pavement Thickness Design Manual

LIST OF FIGURES

<u>FIGURE</u>	<u>TITLE</u>	<u>FOLLOWS PAGE</u>
2-1	Recommended Sections, Flexible Pavement	12
2-2	Recommended Sections, Rigid Pavement	13
3-1	Soils Subgrade Map of Sedgwick County	17
4-1	Marshall Stability	33
4-2	Flexible Pavement Nomograph	34
4-3	Flexible Pavement Design Graph	35
4-4	Rigid Pavement Design Graph	37
7-1	Flexible Pavement Serviceability Index	69

LIST OF TABLES

<u>TABLE</u>	<u>TITLE</u>	<u>PAGE</u>
4-1	Approximate Relationship of Soil Bearing Values	25
4-2	Street Classification	30
7-1	Current Pavement Costs in the City of Wichita	70
7-2	Current Pavement Costs in Sedgwick County	71
7-3	Current Maintenance Costs	73
7-4	Summary of Initial and Annual Costs of Residential Collector Street Pavement Alternates	78
7-5	Summary of Initial and Annual Costs of Residential Local Street Pavement Alternates	81

## GLOSSARY OF TERMS<sup>1</sup>

**PAVEMENT STRUCTURE** - a combination of subbase, base course and surface course placed on a subgrade to support the traffic load and distribute it to the roadbed.

**FLEXIBLE PAVEMENT** - a pavement structure which maintains intimate contact with and distributes loads to the subgrade and depends on aggregate interlock, particle friction, and cohesion for stability.

**RIGID PAVEMENT** - a pavement structure which distributes load to the subgrade, having as one course a portland cement concrete slab of relatively high bending resistance.

**ROADBED** - the graded portion of a highway between top and side slopes, prepared as a foundation for the pavement structure and shoulder.

**SUBGRADE** - the top surface of a roadbed upon which the pavement structure and shoulders are constructed.

**ROADBED MATERIAL** - the material below the subgrade in cuts and embankments and in embankment foundations, extending to such depth as affects the support of the pavement structure.

**SELECTED MATERIAL** - a suitable native material obtained from a specified source such as a particular roadway cut or borrow area, of a suitable material having specified characteristics to be used for a specific purpose.

**SUBBASE** - the layer or layers of specified or selected material of designed thickness placed on a subgrade to support a base course (or in the case of rigid pavements, the portland cement concrete slab).

**BASE COURSE** - the layer or layers of specified or selected material of designed thickness placed on a subbase or a subgrade to support a surface course.

**SURFACE COURSE** - one or more layers of a pavement structure designed to accommodate the traffic load, the top layer of which resists skidding, traffic abrasion, and the disintegrating effects of climate. The top layer of flexible pavements is sometimes called "wearing course."

**AXLE LOAD** - the total load transmitted by all wheels whose centers may be included between two parallel transverse vertical planes 40 inches apart, extending across the full width of the vehicle.

**SERVICEABILITY** - the ability at time of observation of a pavement to serve high-speed, high-volume automobile and truck traffic.

**PRESENT SERVICEABILITY RATING (PSR)** - the mean value of the independent subjective ratings by members of a special Panel for the AASHO Road Test as to the serviceability of a section of highway. The members of the Panel included highway specialists representing many fields of interest and concern in highways.

<sup>1</sup>Source - AASHO Interim Guide for Design of Pavement Structures - 1972.

PRESENT SERVICEABILITY INDEX (p) - a number derived by formula for estimating the serviceability rating from measurements of certain physical features of the pavement.

PAVEMENT PERFORMANCE - trend of serviceability with loads applications.

STRUCTURAL NUMBER (SN) - an index number derived from an analysis of traffic, roadbed soil conditions, and regional factor which may be converted to thickness of flexible pavement layers through the use of suitable layer coefficients related to the type of material being used in each layer of the pavement structure.

LAYER COEFFICIENT ( $a_1, a_2, a_3$ ) - the empirical relationship between structural number (SN) and layer thickness which expresses the relative ability of a material to function as a structural component of the pavement.

SOIL SUPPORT (S) - an index number which expresses the relative ability of a soil or aggregate mixture to support traffic loads through a flexible pavement structure.

REGIONAL FACTOR (R) - a numerical factor that is used to adjust the structural number for climatic and environmental conditions.

MODULUS OF SUBGRADE REACTION (k) - Westergaard's modulus of subgrade reaction for use in rigid pavement design (the load in pounds per square inch on a loaded area of the subgrade or subbase divided by the deflection in inches of the subgrade or subbase, psi/in.)

TRAFFIC EQUIVALENCE FACTOR (e) - a numerical factor that expresses the relationship of a given axle load to another axle load in terms of their effect on the serviceability of a pavement structure. In this report all axle loads are equated in terms of the equivalent number of repetitions of an 18,000-pound single axle.

PUMPING - the ejection of foundation material, either wet or dry, through joints or cracks, or along edges of rigid slabs resulting from vertical movements of the slab under traffic.

PANEL LENGTH - the distance between adjacent transverse joints.

CRACK - a fissure or open seam not necessarily extending through the body of a material.

EXPANSION JOINT - a joint located to provide for expansion of a rigid slab, without damage to itself, adjacent slabs, or structures.

CONTRACTION JOINT - a joint normally placed at recurrent intervals in a rigid slab to control transverse cracking.

LONGITUDINAL JOINT - a joint normally placed between traffic lanes in rigid pavements to control longitudinal cracking.

CONSTRUCTION JOINT - a joint made necessary by a prolonged interruption in the placing of concrete.

LOAD TRANSFER DEVICE - a mechanical means designed to carry loads across a joint in a rigid slab.

**DOWEL** - a load transfer device in a rigid slab, usually consisting of a plain round steel bar.

**TIE BAR** - a preformed steel bar or connector embedded across a joint in a rigid slab to prevent separation of abutting slabs.

**REINFORCEMENT** - steel embedded in a rigid slab to resist tensile stresses and detrimental opening of cracks.

**DEFORMED BAR** - a reinforcing bar for rigid slabs conforming to "Requirements for Deformations," in AASHO Designations M31, M42 or M53.

**WELDED WIRE FABRIC** - a two-way reinforcement system for rigid slabs fabricated from cold-drawn steel wire, having parallel longitudinal wires welded at regular intervals to parallel transverse wires and conforming to "Specifications for Welded Deformed Steel Wire Fabric for Concrete Reinforcement," AASHO Designation M 221.

## SECTION I - INTRODUCTION

### A. STUDY REQUIREMENTS

This report presents the findings, conclusions and recommendations of a study relating to the design and construction of Residential streets for the Greater Wichita Metropolitan area.

Under the present regulations<sup>(1)</sup> governing development inside the Wichita Corporate Limits and within three miles thereof, the Wichita City Engineer is designated as the "Engineer of Record" and establishes the criteria for construction of new facilities.

At the present time a substantial portion of the new development in the Metropolitan Area is occurring outside of the Wichita Corporate Limits but within the 3-mile ring referenced above. Thus, while the Sedgwick County Department of Public Works and the Sedgwick County Engineering Department are the agencies responsible for the design, contract administration, and construction inspection of these projects, the City Engineer for the City of Wichita is the approving authority.

The design criteria utilized by the City of Wichita Department of Public Works for Residential Streets is not the same as that used by the Sedgwick County Department of Public Works for similar facilities.

(1) Subdivision Regulations W-SC MAPC

To facilitate development of design standards acceptable to both City and County agencies for Residential street construction, Professional Engineering Consultants, P.A. was retained to make an economic feasibility study of street design criteria and prepare recommendations for future design of residential streets, local and collector, within the Metropolitan Area.

B. PURPOSE

The purpose of the study is to develop design standards for residential street pavements that will be acceptable to both the City of Wichita and the Sedgwick County Departments of Public Works.

C. SCOPE OF STUDY

The scope of the study was specified to include the following items.

1. Investigation and tabulation of principal soils groups within the project area.
2. Develop proposed designs for both flexible and rigid residential street pavements within the project area.
3. Evaluation of existing pavements as constructed in accordance with design standards being utilized by the City and by the County.
4. Evaluate the cost effectiveness of both existing and proposed pavement designs including consideration of anticipated maintenance costs.

5. Summarize the findings and conclusions resulting from the evaluations and cost studies.

6. Present recommendations covering pavement types and designs for local and collector residential streets within the project area.

## SECTION II - SUMMARY AND RECOMMENDATIONS

### A. SUMMARY

1. Soils and Subgrade. The soil types present within the Study Area are discussed in Section III and are mapped on Figure 3.1.

Four general soil types are defined and located. All four types of soils are suitable for use as subgrade for residential street paving.

Soil Types I and II can in general be utilized as subgrade with only compaction being required.

Soil Types III and IV will in general require some stabilizing agent such as lime to be combined with the soil to provide a suitable pavement subgrade.

It is apparent from field inspection of existing pavements that significant variations of subgrade stability have occurred on numerous projects. It is extremely important that the pavement subgrade uniformly provides the support assumed in the design analysis if the pavement is to provide its anticipated service life.

2. Drainage. The provision for adequate handling of surface water (runoff) is a critical part of residential street design.

4. Pavement Thicknesses. Thickness for flexible and rigid pavements for 40-year and 20-year designs for each street classification (collector and local residential) were discussed and determined in Section IV. Thicknesses were determined through the use of formulas provided in the publication, "AASHO Interim Guide for Design of Pavement Structures", 1972.

Review of another study, National Highway Research Program Report No. 128, "Evaluation of AASHO Interim Guides for Design of Pavement Structures", 1972, established the following:

- a. Design Criteria - 32 of the 52 Highway Agencies made direct use of the Interim Guide either in its entirety or with modification.
- b. Loading - 41 of the Highway Agencies use some form of traffic equivalence factor, and the 18-kip<sup>1</sup> single-axle load was the most commonly used standard.
- c. Soil Support - most Agencies use soil tests to determine soil support with 19 Agencies using CBR's for flexible pavement and 38 Agencies using k-values for rigid pavement design.
- d. Flexible Pavement Design - 38 Agencies use some regional factor concept and 34 Agencies use the structural layer coefficients as presented in the Interim Guide or with some modification.

<sup>1</sup>  
One "Kip" equals 1000 pounds

e. Rigid Pavement Design - the most commonly used procedures for determining working stress in concrete pavement were: 20 Agencies used the Interim Guide's method, 6 used the PCA method, 4 used the California method and 4 used an assumed constant value.

Continued research is sponsored by the American Association of State Highway and Transportation Officials to further refine the design procedures used in the Interim Guide. The Transportation Research Board has cooperated with AASHTO to conduct additional research and studies on pavement design and performance.

It is therefore necessary to keep abreast with new ideas on design procedures by perusing reports published by these agencies or other agencies and to modify pavement design and thicknesses when it is deemed appropriate.

5. Pavement Cost Effectiveness. Initial pavement costs for each design type and classification and maintenance costs were analyzed in Section VIII to determine the most cost-effective pavement type and thickness for the Study Area.

In general it was determined that the 20-year designs for both flexible and rigid pavements were slightly more cost-effective than the 40-year design for each classification of residential streets. It was also established that flexible pavement is more cost-effective than rigid pavement.

However, particularly when the cost differentials are slight, other considerations are necessary in the overall selection process to determine the most suitable pavement design and they are as follows:

a. Residential city streets are normally of the curb and gutter section with storm sewer drainage, which is generally preferred in urban areas. This type of section does not adapt itself to overlays due to constraints imposed by the curb and gutter, storm water inlets, entrances or driveways, manholes, and abutting drainage patterns. These problems magnify in proportion to the number of overlays and therefore to commence with stage construction concepts in the initial design would be unwise.

b. Maintenance costs, funding of same, and the ability of the responsible governmental unit to provide these services are of concern.

It was demonstrated in Section VIII that the maintenance costs for 40-year designs were considerably less than maintenance costs of 20-year designs. If funding of maintenance costs is from the same source as the initial construction cost, then this difference would be of no further consequence other than as annualized costs. This is not the case for the Study Area however.

Within the City limits of Wichita the initial construction costs of residential streets are assessed against the benefiting district, except for intersections which are against the City-at-Large. Residential streets are maintained, including any future overlays, by the City of Wichita with funds derived from gasoline taxes and possibly ad valorem taxes for maintenance crews and equipment, which is against the City-at-Large.

Outside the City limits and within the Study Area the initial construction costs of residential streets are assessed against the benefiting district. Since these streets are not County Roads, they will be maintained by the respective townships until such time the City of Wichita annexes the area. Since the time frame for annexation is unknown, the possibility of expensive maintenance or overlays could place a hardship on the townships which do not have the forces or funds to provide this service. This is potentially a dangerous situation and therefore it would not be desirable to reduce the initial construction cost without regard to future maintenance problems and costs.

c. Reconstruction of residential street pavements is inevitable after some time period that is usually referred to as the service life. The longer the service life can

be extended the better the chances are that the same property owner will not be affected by the costs of reconstructing the pavement. The City of Wichita will have to contend with this problem as the age of the City progresses and so some precautions are necessary to avoid unnecessary strain with the public. One possible approach would be to utilize existing legislation (KSA 13-1042) which enables the City Engineer in Cities of over 95,000 population to condemn a given street after a period of ten years since initial construction and order reconstruction of the street. All costs or some proportion of the costs of reconstruction would be borne by the abutting property owners or a stipulated benefit district in accordance with current practice.

It is not anticipated that condemnation of a street constructed under current City Standards would normally be required in less than 40 to 50 years. However, it is suggested that consideration be given to establishing a City policy relative to this matter for residential streets.

d. Private individuals or developers may prefer a particular type of residential street either of asphalt or concrete, due to aesthetics or for some other reason, regardless of the cost differential.

It is also important to stress the fact that the determination of the most cost-effective pavement, presented in Section VIII, was based on current construction costs within the Study Area. These costs could be subject to wide variations in the future for unforeseen reasons. It is therefore necessary to monitor the trends in construction costs, construction methods, and availability of basic material to determine their effect on the comparative pavement economics. For instance, in the near future should the initial construction cost of rigid pavement decrease \$1.00 per square yard and the initial construction cost of flexible pavement increase \$2.00 per square yard (with maintenance costs remaining the same), the annual cost of residential streets would be the same for either flexible or rigid pavement.

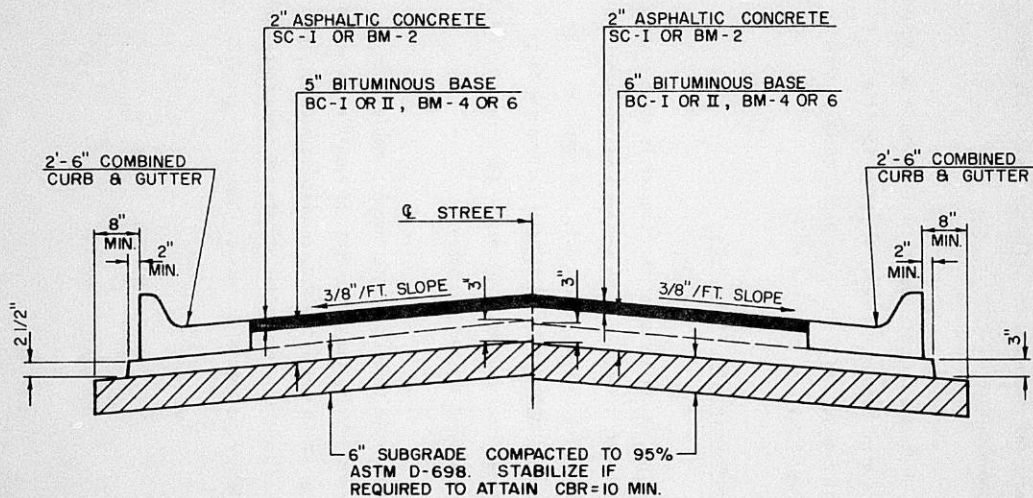
B. RECOMMENDATIONS

1. Flexible Pavement (See Figure 2-1)

a. The top six inches of the subgrade should be stabilized or treated, if necessary, to achieve a minimum CBR of 10 when compacted to 95 percent of ASTM D-698. It is also recommended that the City of Wichita and Sedgwick County consider increasing their compaction requirements in the near future by using 90 percent of ASTM D-1557.

b. Bituminous Base should be composed of material meeting the requirements as specified in Section VII.C. Thickness of

RESIDENTIAL STREETS  
RECOMMENDED SECTIONS



ONE - HALF SECTION  
LOCAL

ONE - HALF SECTION  
COLLECTOR

FLEXIBLE PAVEMENT

FIG. 2-1

Bituminous Base shall be five inches for Local Residential Streets and six inches for Collector Residential Streets as shown in Figure 2-1.

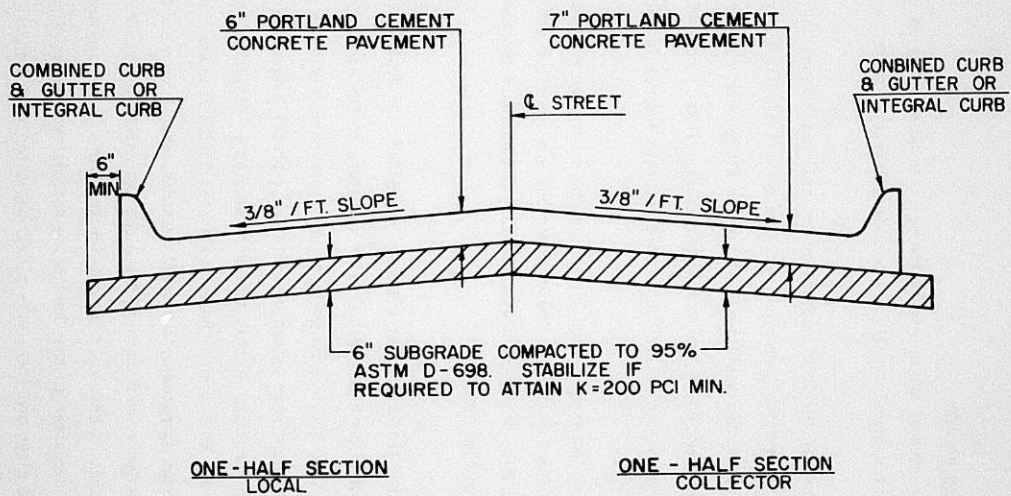
c. Asphaltic Concrete wearing surface should be composed of material meeting the requirements as specified in Section VII.C. and shall be two inches thick as shown in Figure 2-1.

2. Rigid Pavement (See Figure 2-2)

a. The top six inches of the subgrade is to be stabilized or treated, if necessary, to achieve a minimum modulus of subgrade reaction of  $k = 200$  pci, when compacted to 95 percent of ASTM D-698. It is again recommended that consideration be given to increasing the compaction requirements as stipulated in Item 1.a. above.

b. Portland Cement Concrete Pavement should be composed of material meeting the requirements as specified in Section VII.B. Thickness of the P.C. concrete pavement shall be six inches for Local Residential Streets and seven inches for Collector Residential Streets as shown in Figure 2-2.

RESIDENTIAL STREETS  
RECOMMENDED SECTIONS



RIGID PAVEMENT

FIG. 2-2

### SECTION III - SOILS

#### A. SOILS HISTORY

A brief review of the origin of the soils to be encountered in the Study Area is of value since all soil behavior is related to the soil derivation.

The history of the local topography and soil deposition, while seemingly simple, is relatively complex. For the sake of simplicity it might be said there are two basic soils within the Study Area; sands "west" of the river and clays on the eastern higher areas. This is not entirely accurate, but a brief history will lead to more accurate and meaningful generalities.

The "rock" formations which lie within the study area are the Wellington and the Ninescah Shale. These formations are comprised primarily of thick deposits of silts, clays, combinations of these two and two thin argillaceous limestones.

At the time the Wellington Shale was deposited, the Central Lowlands was one gigantic marsh somewhat similar in nature to the now present Cheyenne Bottoms. The "Wellington Bottoms" were however nearly devoid of plant and animal life and most probably existed as a brackish marsh near sea level. The Rocky Mountains at that time were also at or slightly above sea level. Twice during this period these "Wellington Bottoms" became inundated by Permian Seas as noted by the two limestones, the Carlton and Hollenberg, both of which contain much of the plant and animal life associated with shallow seas of that era. Except for the above noted limestones, the material deposited in the "Wellington Bottoms" was fine grained material, silts and clays and these were slowly deposited to considerable depths of as much as 500 feet.

The overlying and somewhat younger Ninnescah Shale is slightly more coarse grained containing sandstones. Some few discontinuous sandy zones may be found in the Wellington Shale but represent only a very minor portion.

Subsequent depositions amounting to several thousand feet of sediment, including the Dakota Formation and Pierre Shale, were piled on top of the Wellington "muds". This weight, amounting to some 200 tons per square foot, squeezed the fluids from the clays and consolidated them to near zero air voids condition.

The land mass then began a slow emergence from the seas and erosion took place. This erosion removed all of the overlying formations and developed a drainage pattern similar to what is present today. At the beginning of the Pliocene Period the Arkansas River was established along with most of its tributaries, all of which were actively engaged in wearing away the Shale Formations.

Next came the Ice Age or Pleistocene Period. As more and more of the earth's water was tied up in massive continental glaciers, the base level of the oceans was greatly lowered causing the streams to flow faster, erode more rapidly and become more entrenched in their channels. The presence of these ancient channels is evidenced by driller's logs which show a considerable variation in the depth to bedrock from about 40 feet to as great as 190 feet. On the east side of Wichita, Sleepy Hollow Creek shows alluvial depths of as much as 90 feet.

At this point in time one can imagine that the land surface was nearly stripped bare of any alluvial materials except for isolated pockets

of pliocene sands and gravels and the Arkansas River valley extended from about West 119th eastward to Hillside.

Then the glacier ice began to melt and the seas raised in level. This resulted in "drowned" valleys. Instead of the streams rushing to the sea they now became sluggish and meandering. They began to deposit the soils they were eroding from the Rocky Mountains, as well as glacial melt, and the valleys became choked and filled with sands. Due to the distance from the source in the Rocky Mountains, only the finer grained sands were deposited in the Wichita area.

The more the valleys filled, the more the streams meandered, the slower they became, and the finer became their deposits. Simultaneous with this deposition the Wellington highlands along the tributaries were being washed by rains. The resulting muddy waters mixed with the major streams or simply flooded out over the lowlands depositing layers of silt and clays in random patterns, thicknesses and locations forming the "Terrace Deposits". This pattern is still continuing at the present time, with the more advanced primates attempting to keep the streams as they are.

Thus it may now be generalized that in the major valleys the dominant soil is granular, predominantly medium to fine grained, interspersed with silts and clays. While the uplands contain residual clays and silts derived from the Wellington Shale, these are bisected by streams containing slope wash as well as some sand.

The general tilt or slope of the land in this area was west to east with most rivers, the Arkansas included, flowing to the east. The Arkansas

River flowed eastward until it bumped into the Nemaha Mountains, or as we know them now, the Flint Hills. Since it could not flow over this obstruction it turned southward as it still does today and flowed along the flank of these mountains, turning southeastward through Oklahoma and Arkansas to its confluence with the Mississippi River south of Memphis, Tennessee.

B. SOILS TYPES

To assist in evaluation of the various soils with respect to their suitability for roadway foundations, the predominant materials in the Study Area have been categorized into four (4) types which are located within the Study Area as shown on Figure 3-1.

1. TYPE 1 - Recent Alluvium. These are channel fillings in and adjacent to the present river valley and consist primarily of granular materials. Plasticity Index (PI) should be in the 0-10 range.

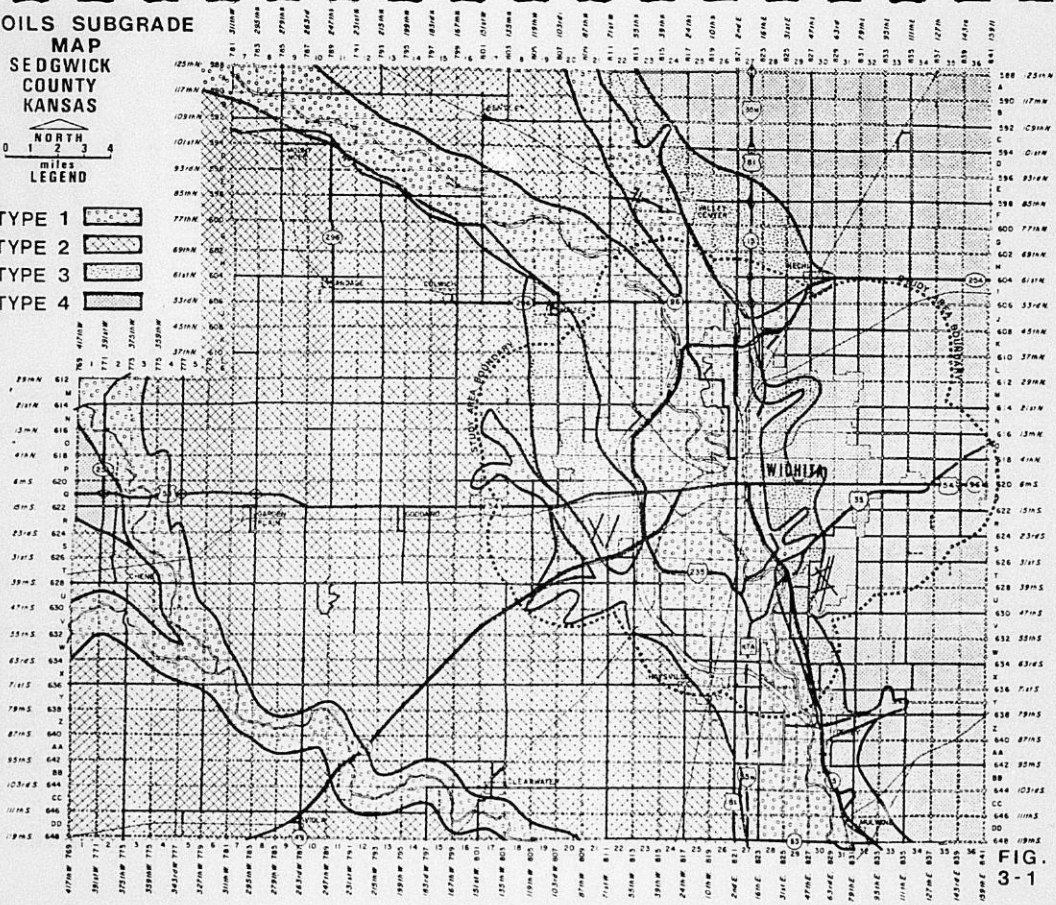
2. TYPE 2 - Post - Pleistocene Terrace Deposits. These materials cover the greatest areal extent within the Study Area and are composed of silty sands, clayey silts and clayey sands. They are mostly granular but with sufficient minus-200 screen size material to produce a PI generally in the 10 to 20 range.

3. TYPE 3 - Pre-Pleistocene Terrace Deposits. These are found along the eastern boundary of the river valley and in some of the "low lying" Upland areas west of the present river flood plain.

**SOILS SUBGRADE  
MAP  
SEDGWICK COUNTY  
KANSAS**



- LEGEND**
- TYPE 1
  - TYPE 2
  - TYPE 3
  - TYPE 4



**FIG.  
3-1**

These are composed of silty clays and sandy clays more often than not with a pink or reddish coloration. These soils have a slightly higher percentage of minus 200 particle size material than Type 2 soils and a PI in the 20 range.

4. TYPE 4 - Upland Clays. These are residual soils derived from the Wellington Shale and the Shale itself and generally produce a PI in the 20 to 40 range.

C. COMPACTION AND STABILIZATION

1. GENERAL - A soil is composed of solids and voids which may or may not contain water. Thus, if a soil is compacted so as to reduce the voids, the bearing strength of the soil is increased due to its decreased compressibility.

With the exception of high clay content soils, which will be discussed later, the best stabilization for a moderately well graded soil is compactive effort to reduce the voids. The amount of compactive effort applied has a significant effect on final stability.

For example, a soil consisting of nearly equal parts sand, silt, and clay (such as Type 2 soils) compacted to 100 percent of maximum dry density as determined by ASTM D-698 (AASHTO T-9) will yield a CBR of about 10 or slightly less, while the same material compacted to 100 percent of maximum dry density as determined by ASTM D-1557-70 (AASHTO T-180) will yield a CBR of about 30 or above. ASTM D-698 requires 18,562.5 ft. lbs. of compactive effort per cubic foot,

while ASTM D-1557 requires 56,250 ft. lbs. compactive effort per cubic foot; about three times greater. Thus a higher stabilization has been achieved without addition of outside agents and time consuming manipulation, but simply with addition of increased compactive effort.

While it is not suggested that 100 percent compaction be advocated, it is strongly recommended that pavement subgrades be compacted to a minimum of 90 percent of maximum dry density as determined by ASTM D-1557-70. This density will yield a subgrade with a CBR of 20+ in soils of Types 1 and 2 with no further stabilization agents required. In many cases Type 3 soils can be compacted to yield a subgrade CBR of 10 to 20 without stabilization agents.

2. CLAY SOILS - Soil Type 4 and in some instances Type 3, are soils containing 50 percent or more clay size (-2 micron) material, most of which in the Study Area will be composed of clay minerals. Clay minerals are materials which have a mineralogical structure such that they have an affinity for any positive-charge ion, which includes most water. When such materials absorb water their mineral structure expands and usually with considerable force. This phenomenon causes the vertical movement frequently observed in pavements constructed on clay soils.

It has been found that these clay materials, when placed in the presence of calcium ( $Ca^{++}$ ) ions, attract and "trap" these ions in the mineral structure of the clay. The result of this action is that the clay material has now satisfied its affinity for positive ions and the

particle size of the material has been enlarged from clay size (-2 micron) to silt size. Thus the material is changed to a stable silt as opposed to a slippery, unstable clay.

Clay minerals are plate-like submicroscopic particles. It is due to this plate structure that they tend to slide, and when surrounded by water even in small quantities, are slippery. It is because of these characteristics when exposed to water that untreated clay has a poor performance record as a pavement subgrade material.

The calcium ( $\text{Ca}^{++}$ ) required for stabilization of clay soils is normally obtained by mixing lime with the clay material. A clay which has been over-treated with lime ( $\text{Ca}^{++}$  Ions) has had all the clay mineral altered to silt size particles. This material, while no longer slippery or expansive, becomes like a pile of marbles which want to roll around and not stay put. It is necessary, therefore, when chemically treating a clay soil to produce a stabilized subgrade material, that some of the clay mineral be left as clay mineral to glue the "marbles" together. A residual P.I. of 10 to 15 should be maintained after lime treatment.

Ideally for highway subgrade stabilization the treated clay should, after treatment, still retain 15 to 25 percent clay material. A clay so treated will easily yield a CBR in excess of 20 when compacted to 92 percent of maximum dry density as determined by ASTM D-1557-70, whereas the untreated material would have a CBR of 2 to 3.

In most instances 2 to 4 percent lime by weight is all that is needed for adequate roadway stabilization. Pre-heater fines or portland cement could be used in lieu of lime.

#### SECTION IV - PAVEMENT DESIGN PROCEDURES

##### A. GENERAL

The Portland Cement Association, Asphalt Institute, and Kansas Department of Transportation were contacted to obtain current publications on design procedures and their opinions concerning any anticipated changes in concept for materials, mixes, or pavement designs.

Many reports available from the American Association of State Transportation Officials, Transportation Research Board, and publications by States and Municipalities were researched to find an appropriate design procedure for the Study Area.

After extensive study of reports and publications published by the above agencies, it was determined that the "AASHO Interim Guide for Design of Pavement Structures", 1972, provided the most suitable formulas for both flexible and rigid pavement. These formulas were derived from the AASHO Road Test and supplemented by existing design procedures and theory. The formulas also provided for consideration of traffic loading and subgrade support, could be adjusted for local conditions and materials, and were readily adjustable for serviceability or design life.

Other publications relied upon for substantiation of design criteria and procedures are as follows:

National Cooperative Highway Research Program Report No. 128, "Evaluation of AASHO Interim Guides for Design of Pavement Structures", 1972.

National Cooperative Highway Research Program Synthesis of Highway Practice Report No. 27, "PCC Pavement for Low-Volume Roads and City Streets", 1975.

American Concrete Paving Association (ACPA) publication, "Municipal Concrete Pavement Manual", July 1974.

Portland Cement Association (PCA) publications, "Design of Concrete Pavement for City Streets", 1974; "The Design of Concrete Pavements for City Streets", 1963, and "Concrete Pavement Manual", 1975.

The Asphalt Institute publications, "Thickness Design - Asphalt Pavement Structures for Highways and Streets", (MS-1), October 1963; and "How to Design Full-Depth Asphalt Pavements for Streets", (IS-96), May 1974.

The engineering staff and laboratory personnel of both the City of Wichita and Sedgwick County were interviewed with regard to their specifications and current thinking on local materials and mix designs for both rigid and flexible pavements. Test reports were studied to evaluate performance and possible changes for materials or mix designs. These evaluations are reviewed and discussed further in Section VII of this report.

1. Subgrade Support

- a. Soil Types

As discussed in Section III, the Study Area was surveyed to determine general soils types for subgrade support for pavement design. From review of Fig. 3-1 it can be seen that most of the Study Area consists of Type 1 (Recent

Alluvium) within the Arkansas River Valley followed by Type 3 (Pre-Pleistocene Terrace Deposits) and Type 4 (Upland Clays) having about the same coverage. Type 2 (Post-Pleistocene Terrace Deposits) represents the least areal extent within the Study Area.

b. Drainage and Frost Characteristics

Since city streets are generally constructed with curb and gutter sections, it is necessary to use adequate grades and storm sewers to provide proper drainage. In addition to the design considerations, proper maintenance of joints and cracks should be provided to minimize seepage of surface water into the pavement subgrade. Type 1 soil, being a granular material, would perform as the best subgrade under adverse drainage conditions of the four types identified. However, with severe cold weather a Type 1 subgrade could be subject to frost penetration. As can be expected, Type 4 soil would perform the poorest under adverse drainage conditions if the subgrade material is not stabilized to minimize shrink and swell characteristics usually attributed to clay soils. Also, this Type IV material would pose serious frost penetration problems since clay is generally an impervious material which tends to hold the moisture within the subgrade.

c. Subgrade Support Values

From review of Section III-C, Compaction and Stabilization, it becomes readily apparent that a CBR of 20 could be used for the entire study area with 6 inches of compaction to a

pavement has total failure it may be more economical to reconstruct the street pavement rather than patch and overlay and thereby it has no value, future serviceability or service life, except for salvage.

The AASHO Test Road assigned a range of 0 through 5 for serviceability ratings with 5 the highest index. Selection of terminal serviceability index ( $p_t$ ) is based on the lowest index that will be tolerated by traffic at the end of the design life. The AASHO Interim Guide recommends that a  $p_t$  of 2.5 be used for major highways and a  $p_t$  of 2.0 for minor highways and streets.

A design life of 20 years was requested by Sedgwick County and the City of Wichita requested a period of 40 years. These requests are not unusual since they reflect different thinking with regard to facility types constructed, maintenance, and financing by each governmental unit.

Sedgwick County's primary function in past history was for construction of county and secondary highways on section and quarter-section lines with geometrics similar to rural state highways, i.e., open-ditch drainage, paved roadways and shoulders. This type of construction adapts itself readily to stage construction with future overlays as the need arises.

Monies for initial construction and maintenance of these types of facilities are usually not assessed against any benefit district. From review of data from several State Highway Departments and the AASHO Interim Guide it appears that a 20-year design life is the predominating design period.

The City of Wichita normally requires streets to be paved with curb and gutter and storm sewers for drainage regardless of the facility types. This is generally preferred in most urban areas. This type of geometrics does not lend itself to stage construction due to constraints imposed by the curb and gutter section, driveways and abutting property drainage. In addition, residential street construction costs, both local and collector, are assessed against the benefiting district, except that intersections and the extra width of pavement for collectors are against the City-at-Large as is the case in most municipalities. Maintenance of residential streets, however, is against the City-at-Large through the operation and maintenance budget.

With this concept for street improvements, it is understandable that a longer design life is desirable to minimize maintenance costs. The 1963 PCA guide for design of city streets states that fifty years is commonly used for residential streets since they are rarely subject to relocation or realignment. The design life shown in the graphs of the 1974 PCA pamphlet is for 35 years or 50 years.

b. Analysis Period

Due to the above considerations, it would be unrealistic to recommend an analysis period of any time period less than 40 years. This time frame would also be necessary for comparison of the 20-year design life to the 40-year design life of pavements.

c. Traffic

Mixed traffic on residential streets generally consists of automobiles with about 1 percent to 2 percent of heavy commercial vehicles and up to 4 percent heavy commercial vehicles on residential collectors. Heavy commercial vehicles found on residential streets with axle loads greater than automobiles are motor homes, trash trucks, construction trucks, delivery trucks, moving vans, service vans, public transit busses, church or school busses, and occasionally overloaded pickup trucks.

The AASHO Interim Guide developed equations which convert mixed axle loads to equate to damage generated by repetitions of 18-kip single axle loads. Separate equations for flexible and rigid pavements are presented with tables showing several thicknesses for  $p_t = 2.5$  and  $p_t = 2.0$ . Traffic equivalence factors indicated may be used to convert data from loadometer stations to equivalent 18-kip single-axle loads within a given time period. This data can then be projected to forecast equivalent 18-kip single axle load applications for any given design year period on an average or straight line basis.

The City of Wichita suggested an ADT or Vpd of 2000 for residential streets and 3000 to 5000 Vpd for collector streets with 1 percent to 2 percent trucks on residential streets. It was acknowledged, however, that the traffic generated on a residential street is dependent on the number of lots or houses served. For instance a short street with a cul-de-sac at the end would not generate considerable traffic or equivalent 18-kip single axle load applications. In this case the minimum pavement thickness would control since requirements to resist deterioration by the weather would be the determining factor. Table 4-2 below was extracted from the 1974 Portland Cement Association pamphlet, "Design of Concrete Pavement for City Streets", and is proposed for use to determine the number of heavy commercial vehicles for a given classification of a city street in the absence of any traffic survey for a particular facility.

TABLE 4-2  
STREET CLASSIFICATIONS

Street Classification	Vpd or ADT 2-way	Lots, No.	Heavy Commercial vehicles, 2-axle, 6-tire and heavier	
			Percent	No. per day
Residential	300-700	60-140	1-2	5-11
Residential Collector	700-1,500	140-300	1-2	11-23
Collector	2,000-6,000		3-5	80-240
Minor arterial	3,000-7,000		10	300-700
Arterial	6,000-13,000		5-7	360-780
Major arterial	14,000-28,000		5	700-1,400
Business	11,000-17,000		3-5	440-680
Industrial	2,000-4,000		15-20	350-700

The higher values of ADT proposed by the City of Wichita is concurred with for use in determining the total equivalent 18-kip single-axle load applications. Some additional thickness allowance is necessary since the formulas presented by the AASHO Interim guide, and herein, do not take into consideration any loss of serviceability due to weathering of pavement during the design life. It is therefore suggested that the minimum pavement thickness for residential streets within the Study Area be not less than five inches regardless of the pavement type, design life, and subgrade support.

d. Design Loading

In the absence of any loadometer data from the Study Area for residential streets and from review of traffic equivalence factors for  $p_t = 2.0$ ,  $SN = 3$  for flexible pavements and  $D = 6$

inches for rigid pavement, a value of 0.20 for an average traffic equivalence factor should be acceptable and used for residential and collector streets. This value is used and shown in the Municipal Concrete Pavement Manual published by the ACPA.

Total Equivalent 18-kip single axle loads ( $E_{18}$  SAL) are as follows:

From Table 4-2, Heavy Commercial vehicles per day for 2,000 vpd is 80 and for 5,000 vpd is 200.

#### Residential Street

80 (HCVPD) x .5 (One Way) X 0.2 x 365 days x 20 years

= 58,400 Total  $E_{18}$  SAL (20 years)

= 116,800 Total  $E_{18}$  SAL (40 years)

#### Collector Street

200 (HCVPD) x .5 (One Way) X 0.2 x 365 days x 20 years

= 146,000 Total  $E_{18}$  SAL (20 years)

= 292,000 Total  $E_{18}$  SAL (40 years)

### B. FLEXIBLE PAVEMENT DESIGN

#### 1. Design Formula

The AASHO Interim Guide developed the following formula for design of flexible pavements (See page 58 of the Interim Guide):

$$\log W_{t18} = 9.36 (SN+1) - 0.20 + \frac{G_t}{0.4 + \frac{1094}{(SN+1)} 5.19}$$
$$+ \log \frac{1}{R} + 0.372 (S_1 - 3.0)$$

$$\text{and } G_t = \log \frac{(4.2 - P_t)}{(4.2 - 1.5)}$$

Where the above symbols are:

$G_t$  = a function of the ratio of loss in serviceability at time  $t$   
to the potential loss taken to a point where  $p_t = 1.5$

$p_t$  = serviceability at end of time  $t$

$W_{t18}$  = number of 18-kip single-axle load ( $E_{18}$  SAL) applications to time  $t$

SN = Weighted structural number of the pavement section which is  
the sum of the products of the layer coefficient  $a_1$  or  $a_2$  times  
the respective layer thicknesses.

R = Regional Factor

$S_i$  = soil support value for any condition "i".

## 2. Value For Variables

From previous discussions in Paragraphs A.1 and A.2 in this Section, a determination was made for the total number of 18-kip single-axle load ( $E_{18}$  SAL) applications in a time period of 20 years and 40 years and a subgrade soil support value having a CBR of 10+ was assigned for the Study Area.

a. Figure 28, Correlation Chart For Estimating Soil Support (S), in Report No. 128, "Evaluation of AASHO Interim Guide for Design of Pavement Structures", was used as a method to establish a value of S for a CBR of 10 which was found to be 6. Values from this figure for CBR and Group Index were also plotted for corresponding S values on the nomograph reproduced from the AASHO Interim Guide for  $p_t = 2.0$  (See Fig. 4-2). The Group Index relies on the Atterberg limits and the minus 200 material for a given soil and is based on the following formula,

$$\text{Group index} = 0.2a + 0.005 ac + 0.01 bd$$

in which

a = that portion of percentage passing No. 200 sieve greater than 35 percent and not exceeding 75 percent, expressed as a positive whole number (1 to 40)

b = that portion of percentage passing No. 200 sieve greater than 15 percent and not exceeding 55 percent, expressed as a positive whole number (1 to 40)

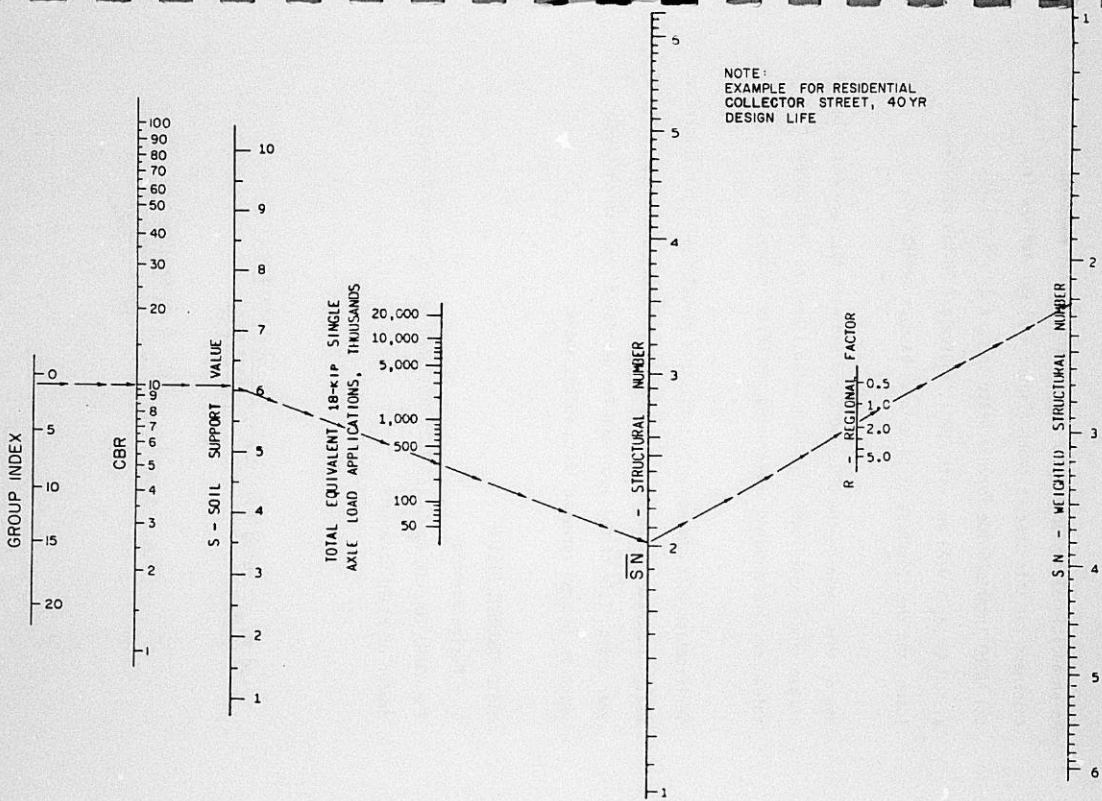
c = that portion of the numerical liquid limit greater than 40 and not exceeding 60, expressed as a positive whole number (1 to 20)

d = that portion of the numerical plasticity index greater than 10 and not exceeding 30, expressed as a positive whole number (1 to 20)

Use of the Group Index provides another means for determining a value of S without establishing the CBR value.

b. Figure 29, "Contours of Equal Regional Factors" in Report No. 128 proposes a value between 1.5 and 2.0 for this area. A value of 1.75 is recommended as this value would provide for one-fourth of the average year as the spring freeze-thaw cycles including two normal wet cycles per year for early summer and fall.

c. Values for layer coefficients shown for use with asphaltic concrete ( $a_1$ ) and bituminous base ( $a_2$ ) as they relate to Marshall Stability are indicated on Fig. 4-1. The values shown on each graph are slightly less than the values reflected in Figures 23 and 26 of Report No. 128. After review of test



NOTE:  
 EXAMPLE FOR RESIDENTIAL  
 COLLECTOR STREET, 40YR  
 DESIGN LIFE

FIG. 4-2

Design Chart for Flexible Pavements,  $p_t = 2.0$

As an additional design aid for determining asphalt pavement thickness for this area, a graph (Figure 4-3) was derived from the AASHO Interim Guide formula based on  $p_t = 2.0$ ,  $R = 1.75$ ,  $a_1 = 0.42$ ,  $a_2 = 0.23$  and with CBR's, equivalent 18-kip single-axle loads, and the thickness of bituminous base as variables.

Use of this graph on the CBR = 10 curve and with the same equivalent 18-kip single axle loads ( $E_{18}$  SAL) establishes the same pavement thickness as determined above using the Design Formula.

Verification with the Asphalt Institute's Manual (MS-1) for Thickness Design indicates asphalt thicknesses of 6.5 inches and 6 inches for 20 year design life of Collector and Residential Streets respectively which is in near agreement with values above.

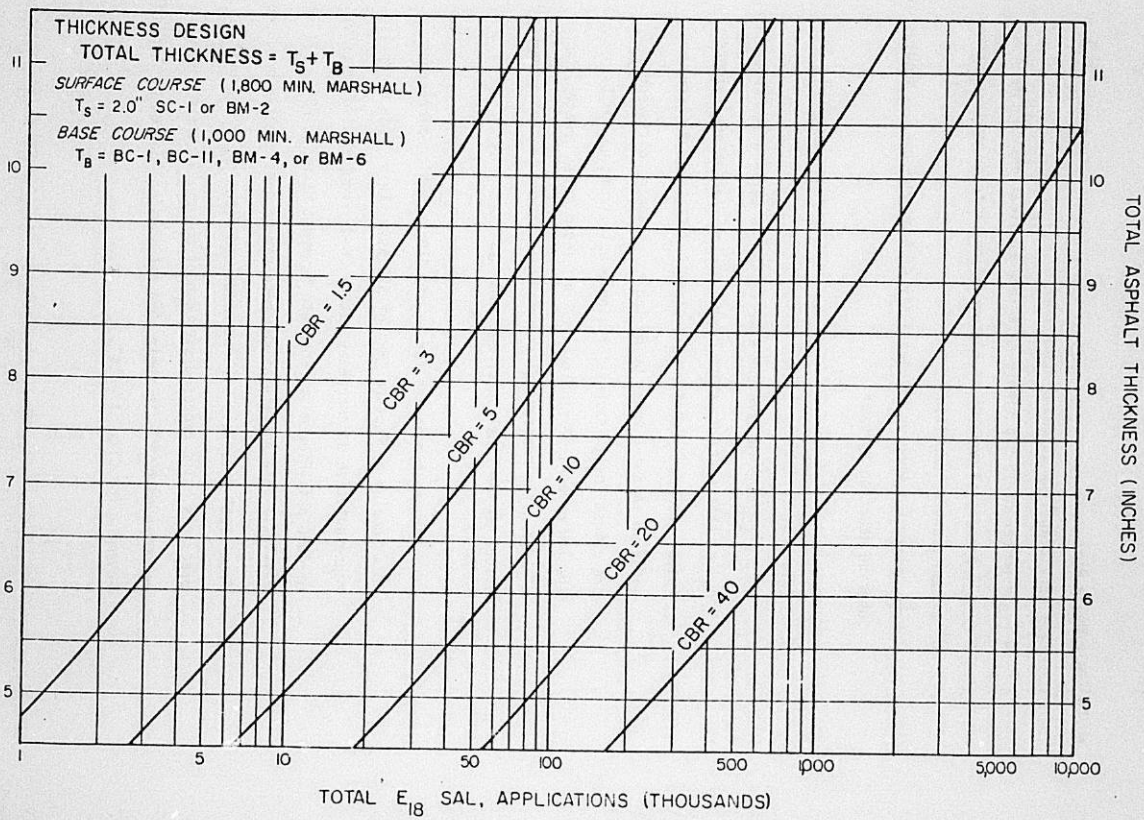
#### C. RIGID PAVEMENT DESIGN

##### 1. Design Formula

The AASHO Interim Guide (p. 103) developed the following formula for design of rigid pavements:

$$\text{Log } W'_{18} = 7.35 \text{ Log } (D+1) - 0.06 + \frac{\text{Log } 0.333(4.5-p_t)}{1 + \frac{1.624 \times 10^7}{(D+1)^{8.46}}} + (4.22 - 0.32p_t) \left[ \text{Log} \left( \frac{S'_c}{215.63 J'} \right) \left( \frac{D^{0.75} - 1.132}{D^{0.75} - \frac{18.42}{2.025}} \right) \right]$$

DESIGN GRAPH FOR FLEXIBLE PAVEMENT ( $P_t = 2.0$ )



where the symbols are:

$P_t$  = serviceability at end of time  $t$

$W'_{t18}$  = number of 18-kip single-axle load applications to time  $t$

$S'_c$  = 75 percent of modulus of rupture of concrete or working stress

$J'$  = load transfer condition

$Z = \frac{E}{k}$  where  $E$  = Modulus of Elasticity of Concrete and  $k$  = Modulus of Subgrade Reaction (gross)

## 2. Values of Variables

a.  $W'_{t18}$  should have the same values as derived in Paragraph A.2 of this section, since review of the Traffic Equivalence Factors for  $p_t = 2.0$  for both Rigid and Flexible Pavement as shown in the Interim Guide Tables indicates differences are almost insignificant for single-axle loads up to 20-kips. The low numbers of single-axles or tandem axles greater than 20-kips using residential streets are assumed to have a negligible effect on the final total equivalency.

b. The value proposed for  $S'_c$  is 410 psi which corresponds to a Modulus of Rupture ( $M_R$ ) of 550 psi. This value of  $M_R$  is representative of concretes with a 28-day compressive strength of 4000 psi (Figure 6, "Concrete Pavement Manual", PCA). It is felt that this quality of concrete can be consistently produced from local materials without major modification of current practices. The proposed strength of 550 psi is the minimum recommended by PCA in their 1974 publication "Design of Concrete Pavement for City Streets".

c. Load transfer condition is the ability of the pavement structure to transfer a portion of the wheel loads across a pavement discontinuity or joint. A value of 2.2 is used for continuously reinforced pavement and 3.2 is used for jointed pavement with mechanical transfer such as dowels or large, hard aggregate. However, the ACPA proposes 4.2 in its manual for streets. It is understandable to use the higher value for street pavement, particularly in this area where the crushed rock is marginal in regard to size, hardness and durability when considering the 40-year design life. For this reason, the value proposed for residential streets in the Study Area is 4.0.

d. A value suggested for E is  $3.5 \times 10^6$  which relates to the  $M_R$  value discussed in Paragraph b. above.

e. In accordance with previous discussion in Paragraph A.1.c., it is recommended to use  $k = 200$  for design within the Study Area. From review of Report No. 128 it is noted that "k" used in the Interim Guide was the gross "k" which is about 1.77 times lower in value than the normal elastic "k" used in soils analysis, so this ratio needs to be used in determining Z or

$$Z = \frac{3.5 \times 10^6 (1.77)}{200} = 30,975$$

### 3. Concrete Pavement Thicknesses

By substitution of the above values in the Design Equation taken from the Interim Guide or the graph (Figure 4-4), derived from this equation for  $P_t = 2.0$ , the required pavement thicknesses are as follows:

- a. Residential Collector (40 yr)  $W'_{t18} = 292,000$   
Thickness = 7"
- b. Residential Collector (20 yr)  $W'_{t18} = 146,000$   
Thickness = 6.2" or 6"
- c. Residential Street (40 yr)  $W'_{t18} = 117,000$   
Thickness = 6"
- d. Residential Street (20 yr)  $W'_{t18} = 58,000$   
Thickness = 5.3" or 5 1/2"

In using Figure 4-4 it should be noted that the values of "k" shown on the graph are the normal elastic value used in soils analysis. Thus for the examples a value of  $k = 200$  was used.

Comparison of these values was made using the Portland Cement Association publication, "Design of Concrete Pavement for City Streets" 1974. The variables used were: number of heavy commercial vehicles based on 2000 ADT and 5000 ADT (two way); MR = 550; and 35-year design life. The thicknesses required were 6.5" for a collector street and 6.25" for a residential (local) street.

DESIGN GRAPH FOR RIGID PAVEMENT ( $P_f = 2.0$ )  
NO LOAD TRANSFER

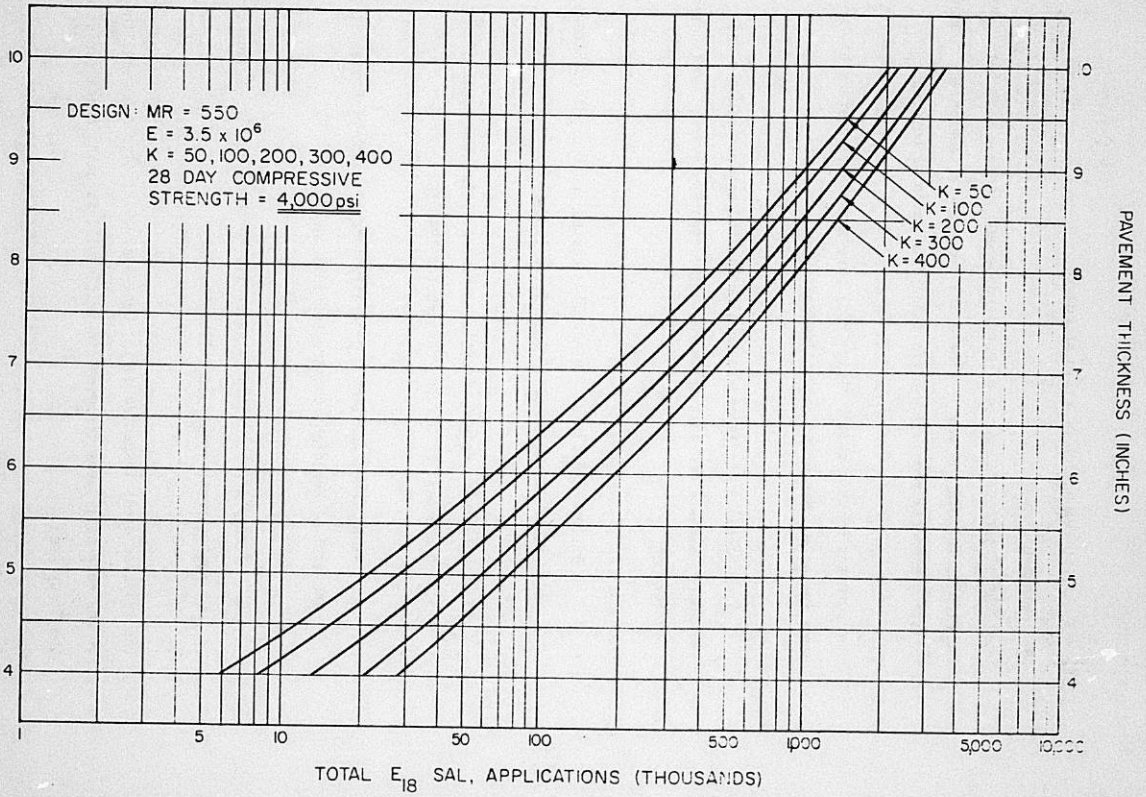


FIG. 4-4

## SECTION V - FIELD EVALUATION OF RIGID PAVEMENTS

### A. GENERAL

Residential street pavements of portland cement concrete have been constructed in Wichita for over 40 years. There are therefore a substantial number of existing projects from which performance data could be obtained.

For purposes of this study, rigid (PCC) pavements in five areas of the City were inspected, including the following.

1. Schweiter Addition - generally located between Lincoln and Harry Streets and west of George Washington Boulevard; constructed 1942-48.
2. Builder's Addition - generally located south of Harry Street and east of Oliver Street; constructed 1950-55.
3. University Heights Addition - generally located north of 13th Street and east of Oliver; constructed 1948-50.
4. Pawnee Park Addition - generally located north of Pawnee Street and east of Meridian; constructed 1956-60.
5. Memory Acres Addition - generally north of 9th Street and west of West Street; constructed 1958-59.

The selected areas inspected during June-July 1978, also represent three of the four soil types discussed in Section III as being characteristic of the Study Area.

The Schweiter, Pawnee Park and Memory Acres Additions are constructed in areas of Type 1 soils; Builder's Addition is in areas of Soil Types 3 and 4; and University Heights Addition is in a Type 4 soil area.

The five additions represented pavements which have been in service from 18 to 36 years. Surface drainage in the areas varied from quite good in the Builder's Addition to quite poor in Schweiter and Memory Acres Additions.

Review of the City specifications in force during the period indicates that no special subgrade preparation was done in any area at that time. "Proof-Rolling" with a 3000-lb. roller to locate soft-spots was required for the pavement subgrade. It was not until 1967 that the Standard City Specifications were revised to require specific compacted densities for all PCC pavement subgrades.

B. STRUCTURAL PERFORMANCE

The majority of the PCC pavements included in the field inspection were 6 inches thick with monolithic curb. Transverse contraction joints were spaced at about 30 foot centers with expansion joints normally at the entrance to each intersection or about 120 foot centers, maximum.

The pavement performance to date has in general been very good, with only limited amounts of structural cracking which was attributable to traffic loading. Most frequently noted deficiencies were horizontal splitting of the monolithic curbs, spalling at transverse joints and vertical deflection (settlement) adjacent to storm drain inlets or similar underground structures.

Also observed at several locations was surface scaling, particularly in the intersections.

In one area, east of George Washington between Lincoln and Harry, some rather significant D-Cracking was observed.

C. MAINTENANCE

On the PCC pavements inspected it appeared that only minor maintenance work had been done since their construction. Some joint re-sealing was observed and some spalled areas at joints had been filled with bituminous material.

D. DISCUSSION

From an overall viewpoint the PCC pavements inspected as a part of this study have in general performed very well under a wide variety of soil and traffic conditions.

It is apparent that maintenance work on PCC pavements has not been done to the extent necessary to obtain maximum serviceability from the pavements. Even under these conditions however, PCC pavements have, with little if any maintenance expenditure, already served for 20 to 30 years and still maintain an acceptable Serviceability Index.

Some recent revisions to the City's PCC Pavement Specifications should also serve to decrease the problem areas. Use of standard pavement concrete for monolithic curb, in lieu of sand-mix with a high cement factor and water content, should reduce the horizontal splitting frequently observed.

Transverse joints, particularly expansion joints, are now being constructed so as to better accommodate longitudinal movement.

Improved joint sealants are now being specified and should minimize the intrusion of debris and foreign materials into the joints which result in spalling. In this regard a scheduled program of cleaning and resealing joints in PCC pavement would appear to be a very cost-effective investment.

With reference to joint distress it was noted that several residential streets exhibited joint distress at a much higher frequency than that occurring on adjacent pavements of similar type and age. Further investigation indicated that the distressed streets were being used as MTA bus routes and the repeated heavy loads were accelerating the joint problem. This is a normal occurrence where public transit buses use the residential streets on a regular basis.

SECTION VI - FIELD EVALUATION OF FLEXIBLE PAVEMENTS

A. GENERAL

The current designs for flexible pavements in both the City and County Departments of Public Works are based on "Full-Depth" asphaltic concrete sections.

This pavement section, while now acknowledged to be superior to other flexible pavements, has not been extensively utilized in past years for residential street construction. The Kansas Department of Transportation (KDOT) has employed "Full-Depth" asphalt pavements on rural and urban highways for over 30 years. Sedgwick County has also used "Full-Depth" asphalt on arterial County roads for over 25 years.

In both of these cases, however, the use of the "Full-Depth" asphalt was limited to arterial roads and highways which were projected to receive a substantial volume of truck traffic.

For residential streets within the Study Area, two general types of flexible pavement were normally employed; (1) a granular base composed of crushed limestone overlaid with a 2 to 3 inch thick asphaltic concrete mat; and (2) a similar section except that the crushed limestone base was replaced with a Portland Cement Concrete (PCC) base, usually 5 inches in thickness.

Over the years the crushed stone base section demonstrated a lack of stability, primarily due to the inability of the limestone to withstand freeze-thaw action while saturated.

Since about 1950, the Asphaltic Concrete mat on a PCC base has been the principal type of flexible pavement used in the Study Area for residential streets.

In recent years the performance of the Asphalt mat-PCC base pavements has not been up to desired standards due to excessive uncontrolled cracking of the base.

To improve performance of flexible pavements for residential streets the City Department of Public Works has, for the past 5 years, utilized a "Full-Depth" asphaltic concrete section.

B. STRUCTURAL PERFORMANCE

Due to the relatively recent change to a Full-Depth asphalt section as standard for residential streets, it was difficult to establish any long-term performance evaluation.

One project, 18th Street from Porter to Lisa Lane, was constructed in 1963 using a "Full-Depth" asphalt section. A second smaller project, the southbound lane of Woodchuck from Central to Red Barn, was also constructed in 1963 with a similar section.

On the 18th Street project, records indicate that it received major maintenance in 1971 consisting of crack filling and a slurry seal. When inspected in June 1978 the pavement exhibited significant cracking, both longitudinal and transverse, which should be sealed. No rutting, shoving or similar distress attributable to failure of the base or surface material was observed.

The Woodchuck project also showed some cracking, primarily tranverse, when inspected in June 1978. Records do not indicate that this pavement has received any maintenance since its construction in 1963. Of particular interest is the comparison of surface condition between the southbound lane, constructed of full-depth asphalt, and the northbound lane constructed about 1958 with rolled stone base. The stone-base section exhibits significantly greater distress, both cracking and surface failure, than does the full-depth asphalt section.

The Willowesque Addition, located east of Ridge Road and north of Maple Street, constructed in 1973, was one of the first subdivisions to utilize the full-depth asphalt section being promulgated by both the City and the County for residential streets.

Inspection of the Willowesque streets in June 1978 found them to be in excellent condition after 4 to 5 years of use.

Similar residential street construction was also employed in the Brookhollow Second Addition located north of Douglas and east of Tara; and Cedar Lakes First Addition located south of Harry and East of Rock Road. The streets in both of these subdivisions are also 3 to 5 years old and all were generally in very good condition when inspected in June 1978.

C. MAINTENANCE

As noted previously, the residential streets using an asphaltic surface course over PCC base required significant maintenance due to cracking in the base.

numerous  
pages  
missing

## SECTION VIII - ANNUAL PAVEMENT COSTS

### A. GENERAL

1. System Approach. Proper evaluation of pavement costs requires consideration of other factors in addition to the initial construction cost for a particular type of residential street. It is generally accepted that the higher-type streets with greater initial costs provide a facility with longer service life and less maintenance and user costs for a given moderate traffic load. Conversely, a low-type street with gravel surfacing will have less initial cost, but provides a facility having a low serviceability value with high maintenance and user costs for the same traffic volume.

A systems approach which accounts for the initial construction cost, maintenance costs, user costs, interest costs, and serviceability or terminal value at the end of the 40-year analysis period for a given traffic loading is necessary to realistically evaluate relative pavement costs on an annual basis. There are many publications and reports published which primarily elaborate on the systems approach and an operational computer program (SAMP 6) for flexible pavement systems has been developed by the Transportation Research Board. The National Cooperative Highway Research Program (NCHRP) Report 160, "Flexible Pavement Design and Management - Systems Approach Implementation", 1975, describes the result of the trial computer study (SAMP 6) undertaken by Florida, Kansas,

and Louisiana. Data input for the program utilized the AASHO Interim Guide as its structural subsystem and the predicted decrease in serviceability, with time and traffic, as developed at the AASHO Road Test.

While programs such as (SAMP 6) have been developed and utilized for management analysis of highways, no similar programs were found which were directly applicable to residential street investigations.

For the purpose of this study, which deals exclusively with residential streets, the following conditions or assumptions were made in determining relative pavement costs:

- a. Initial construction costs were determined on a square yard basis for the pavement structure, without regard to curb and gutter, storm sewers, painting, lighting, signing, excavation (except as provided for below), compaction and or subgrade stabilization. It is assumed that these costs are the same for a given street regardless of the pavement type and thickness selected.
- b. Excavation costs were considered only for the difference in thickness of pavement with the thinnest pavement section having no excavation cost input.
- c. Major and minor maintenance and rehabilitation costs were averaged on a square yard basis. Asphalt overlays, bituminous sealing, and reconstruction which restores the street to near its as-constructed condition or serviceability index were considered as major maintenance.

Major maintenance costs are on an average periodic basis as determined by local experience (see discussion below) and the Interim Guide formulas with regard to serviceability for the designated design life and pavement type.

Minor maintenance costs were evaluated on an annual basis and included monies expended for spot patching, spot sealing, and crack filling.

Costs expended for mowing, storm sewer cleaning, repainting, re-signing, lighting, and snow removal were not considered because they are not affected by the types of residential streets selected for this study.

Discussions were held with the engineering and maintenance staffs from both the City of Wichita and Sedgwick County to establish maintenance operations and respective costs. The City and County both presently contract slurry sealing of their asphalt streets.

Sedgwick County may overlay a county road with cold-mix or hot-mix with their own forces or they may contract a hot-mix overlay.

The City of Wichita has arrangements with a company which is a combination of a contract for equipment (Cutler-Repaver) personnel and material and the use of their own (City) forces

for hot-mix overlays of asphalt streets. The City contracts hot-mix asphaltic overlays of their portland cement concrete streets.

Both the City and the County utilize their own forces for spot patching, crack filling, spot sealing, and other minor street maintenance which is accomplished on an annual basis.

Due to the many variables, it is difficult to obtain any general consensus of opinion as to the desired frequency for performing various maintenance procedures. Perhaps the primary variables are the limitation of maintenance funds needed to fully optimize the life of any pavement and the severity of the weather in a given year.

It is acknowledged by both the City and the County that in many cases it is recognized that a certain street needs joint sealing, surface sealing, or an overlay but budget restraints make necessary the deferral of all but the most critical streets until the next year or year thereafter. Hopefully, the needed maintenance can be accomplished before extensive and expensive rehabilitation of a street pavement is required.

Based on past experience by the City of Wichita, Sedgwick County and ideal theoretical conditions for minimum restoration costs, the average periods or average frequencies are as follows:

(1) Rigid Pavement (Portland cement concrete) is capable of lasting 40 years before an overlay is necessary. Joints cleaned and resealed every 10 years. Asphalt overlay should last 20 years. Patching and crack sealing are on an annual basis.

(2) Flexible Pavement (Full-Depth Asphalt) should be sealed on a seven-year frequency and is capable of lasting 40 years before an overlay is required. Asphalt overlay should last 20 years. Patching and crack sealing are on an annual basis.

d. Road user costs were neglected in this study since only high-type residential streets were considered. Major and minor maintenance construction on residential streets does not cause extensive inconvenience or accidents due to low speeds and low traffic volumes.

e. As was discussed in Section IV, A.2.a, a terminal serviceability index ( $p_t$ ) of 2.0 was included in the formulas for pavement designs for the specific design life. Pavements having a 20-year design life will theoretically require an overlay at the end of 20 years to restore the structure to its original serviceability. The overlay should be of sufficient thickness to sustain the serviceability above 2.0 for the next 20-year period, or another

overlay will be required within the 40-year analysis period. However, due to curb and gutter constraints, frequent overlays are not too desirable for residential streets. Figure 7-1 presents a graphic representation of this serviceability as a function of age and major maintenance for flexible pavements. No determination will be made for the salvage values of the pavements at the termination of the 40-year analysis period, since all pavement structures will be assumed to have equal value or condition with the following exception.

For the present City of Wichita flexible pavement design thicknesses, a greater salvage value is probable and the difference in salvage values was credited to the City's current flexible pavement designs for residential streets.

f. Interest Costs have risen rapidly in recent years and have become a concern to everyone involved in financing public improvements. An interest rate of 6 7/8 percent is currently required by the Environmental Protection Agency (EPA) for comparing cost effectiveness on any project within the United States. The City of Wichita has, however, been experiencing lower interest rates than many other areas of the Country, so an interest rate of 6 percent is recommended for this study.

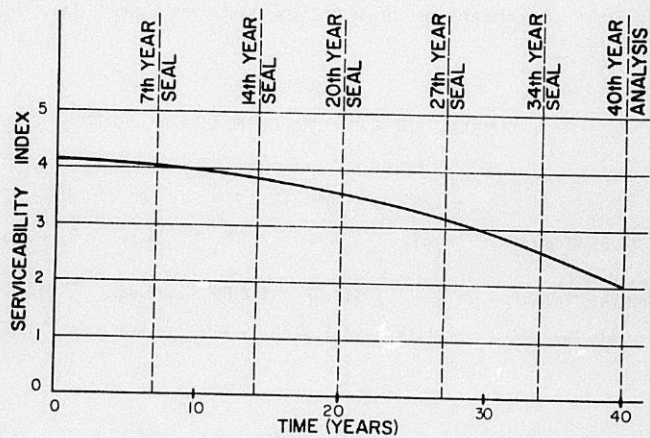
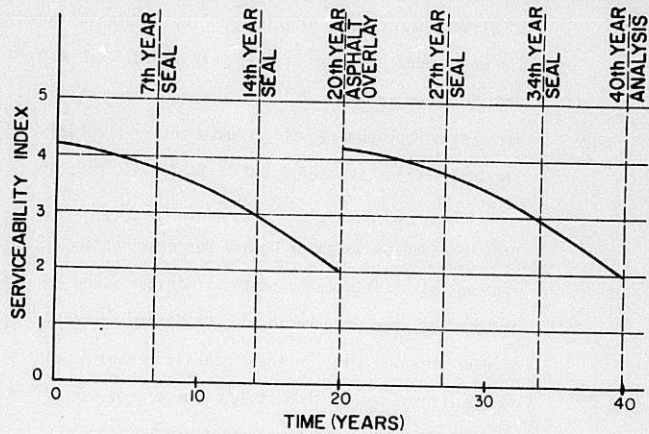


FIGURE 7-1

2. Current Construction Costs.

a. Initial Construction. Bid tabulations for construction of street improvements within the City of Wichita received in the most recent quarter of this year (1978) were averaged and are shown in Table 7-1. Only those costs which affect the cost of one square yard of pavement as proposed in the previous section are reflected in Table 7-1, however.

Bids received by Sedgwick County for construction of residential street improvements within the study area for the current year were reviewed. On County projects, asphalt streets were bid with Marshall stability requirements similar to those proposed by this study. Therefore, use of the County's most recent costs with a percentage reduction for thinner bituminous bases is proposed for the alternate pavement cost-effectiveness study. These values are shown in Table 7-2.

TABLE 7-1  
CURRENT PAVEMENT COSTS IN THE CITY OF WICHITA

	9"	8"	7"	6"	Excav.
City of Wichita	S.Y.	S.Y.	S.Y.	S.Y.	C.Y.
Reinf. P.C. Concrete Pavement	----	\$13.47	\$12.85	\$10.45	\$1.77
Asphalt Pavement	\$8.33	\$ 7.53	-----	-----	\$1.77

TABLE 7-2  
CURRENT PAVEMENT COSTS IN SEDGWICK COUNTY

	8"	7"	6"	Excav.
Sedgwick County	S.Y.	S.Y.	S.Y.	C.Y.
Asphalt Pavement	\$7.90	\$6.93	\$5.93	\$2.00

b. Maintenance Construction Costs are shown in Table 7-3 and were established as follows.

(1) Construction costs for "Cutler-Repaver" hot mix overlay for 1977 averaged \$1.36 per square yard.

This operation removes from 1/2" to 1" of existing asphalt surfacing and re-cycles it with virgin asphaltic material providing a new overlay from 1 1/2" to 2" thick. An estimate of \$1.50 per square yard for current costs is utilized herein.

(2) Construction Costs for slurry seals were \$0.50 per square yard and for chat seals \$0.52 per square yard in 1977, so a \$0.55 average per square yard is proposed for current sealing costs.

(3) Joint cleaning and re-sealing was \$1.45 per lineal foot in 1969. Discussions with local contractors indicated \$2.00 per lineal foot should be satisfactory for estimating current costs. For the current City design with joints on 30 foot centers this would be \$0.60 per square yard.

(4) A one and one-half inch overlay of hot-mix wearing course (including a tack coat over the concrete surface) is estimated at \$1.80 per square yard.

(5) Annual maintenance costs were based on data obtained from the City of Wichita for 1977. The City estimated they had 375 miles of asphalt surfaced residential streets on which they spent \$459,875.00 for maintenance, or \$1,226.33 per mile. This cost included sealing which is considered major rather than minor maintenance.

The City of Wichita also estimated they had 385 miles of rigid pavement residential streets on which they spent \$128,953.00 for maintenance or \$334.94 per mile. They acknowledged, however, that more funds were needed to properly maintain these streets.

Based on funds expended in 1977 for P.C. Concrete streets (31 feet back to back of curb) maintenance costs are approximately \$0.02 per square yard. Since this amount was in 1977 and was admittedly low, it is proposed to currently allow \$0.03 per square yard for rigid pavement.

In 1977 maintenance costs for asphalt pavements were \$0.07 per square yard including the cost of sealing. It is proposed to currently allow \$0.04 per square yard for flexible pavement as annual minor maintenance costs for patching and crack sealing.

TABLE 7-3  
CURRENT MAINTENANCE COSTS

Pavement Type	1 1/2" Hot-Mix Overlay - S.Y.	Bit. Seal S.Y.	Joint Seal S.Y.	Annual Maint. S.Y.
Rigid Pavement	\$1.80	-----	\$0.60	\$0.03
Flexible Pavement	\$1.50	\$0.55	-----	\$0.04

3. Future Construction Costs. Based on past history, the cost of both street construction and maintenance should increase in the future due to inflation. It was recently noted by our Federal government that the overall cost of goods has increased to 200 percent in the last decade (1967 to 1977). During this same period the cost of highway construction has increased to 296 percent according to an article in "Engineering News Record" dated November 30, 1978. This established that the cost of construction inflated at a higher rate than did other areas of our economy and may have been one of the primary reasons for recent high inflationary levels. Therefore, it would appear reasonable to assume that in the future construction costs should nearly align their rate of inflation with the average costs of other goods and services. This reasoning is further supported by the fact that construction costs were relatively depressed in 1966.

Mr. Robley Winfrey, an engineering economist, states in his book "Economic Analysis for Highways"<sup>1</sup> that inflation is more difficult

<sup>1</sup>Winfrey, Robley; Economic Analysis for Highways; International Textbook Company, Scranton, Pennsylvania, 1969.

to forecast than prices and introduces another uncertainty in the economic analysis. The national economy expands as inflation increases so that the effects of inflation balance out. This is another way of saying that next year's dollar is not the same as this year's dollar. Winfrey points out that, "It is preferred practice and concept to omit any inflation factor."

Since this concept is widely accepted, it is proposed that no attempt be made to estimate future construction or maintenance cost increases for the purposes of this study.

#### 4. Basis of Economic Analysis.

In this study for cost-effectiveness of the alternative pavement designs it is proposed, as discussed previously, to use current costs with current dollars and future major maintenance based on current costs and its present worth based on an interest rate of 6%. From Interest Rate and Annuity Tables the formula is:

$$\text{P.W.F.} = \frac{1}{(1 + i)^n}$$

P.W.F. = Present Worth Factor

i = Interest rate per period

n = Number of periods (years  
in period)

The average annual cost should include the Capital Recovery Factor (C.R.F.) at a 6% interest rate or from the annuity tables the formula is:

$$\text{C.R.F.} = \frac{i(1+i)^n}{(1+i)^n - 1}$$

The C.R.F. at 6% for 40-years is 0.06646.

B. RESIDENTIAL COLLECTOR STREETS

1. Flexible Pavement.

a. 9" Asphalt Pavement - Current City of Wichita Design.

Initial Construction Cost	=	\$8.33 S.Y.
Excavation 3" or 0.0833 (1.77)	=	<u>0.15</u> S.Y.
		\$8.48 S.Y.

Future Major Maintenance

Bit. Seal in 7th Year = 0.55 (.6651)	=	\$0.37 S.Y.
Bit. Seal in 14th Year = 0.55 (.4423)	=	0.24 S.Y.
Bit. Seal in 20th Year = 0.55 (.3118)	=	0.17 S.Y.
Bit. Seal in 27th Year = 0.55 (.2074)	=	0.11 S.Y.
Bit. Seal in 34th Year = 0.55 (.1379)	=	<u>0.08</u> S.Y.
		\$9.45 S.Y.

Deduct Salvage Value at end of Analysis

Period over other pavement alternates.

$\frac{8.48}{9}$	=	0.942 (.0972)	=	<u>\$0.09</u> S.Y.
				\$9.36 S.Y.

Annual Average Cost = 9.36 (.06646)	=	\$0.62 S.Y.
Annual Average Maintenance Cost	=	<u>0.04</u> S.Y.
Total Annual Cost	=	\$0.66 S.Y.

b. 8" Asphalt Pavement proposed in study for 40-year design.

Initial Construction Cost	=	\$7.90 S.Y.
Excavation 2" or 0.0555 (2.00)	=	<u>0.11</u> S.Y.
		\$8.01 S.Y.

Future Major Maintenance

Bit. Sealing (Same as 9" above)	=	<u>0.97</u> S.Y.
		\$8.98 S.Y.

Annual Average Cost = 8.98 (.06646)	=	\$0.60 S.Y.
Annual Maintenance Cost	=	<u>0.04</u> S.Y.
Total Annual Cost	=	\$0.64 S.Y.

c. 7" Asphalt Pavement proposed in study for 20-year design.

Initial Construction Cost	=	\$6.93 S.Y.
Excavation 1" or 0.0278 (2.00)	=	<u>0.06</u> S.Y.
		\$6.99 S.Y.

Future Major Maintenance

Bit. Seal in 7th Year = 0.55 (.6651)	=	\$0.37 S.Y.
Bit. Seal in 14th Year = 0.55 (.4423)	=	0.24 S.Y.
1 1/2 Overlay 20th Year = 1.50 (.3118)	=	0.47 S.Y.
Bit. Seal in 27th Year = 0.55 (.2074)	=	0.11 S.Y.
Bit. Seal in 34th Year = 0.55 (.1379)	=	<u>0.08</u> S.Y.
		\$8.26 S.Y.

Annual Average Cost = 8.26 (.06646)	=	\$0.55 S.Y.
Annual Average Maintenance Cost	=	<u>0.04</u> S.Y.
Total Annual Cost	=	\$0.59 S.Y.

2. Rigid Pavement

a. 7" P.C.C. Pavement Current City of Wichita Design and proposed in Study for 40-year design.

Initial Construction Cost	=	\$12.85 S.Y.
Excavation 1" or 0.0278 (1.77)	=	<u>0.06</u> S.Y.
		\$12.91 S.Y.

Future Major Maintenance

Joint Cleaning & Sealing in

10th Year = 0.60 (.5584)	=	\$ 0.34 S.Y.
--------------------------	---	--------------

Joint Cleaning & Sealing in

20th Year = 0.60 (.3118)	=	0.19 S.Y.
--------------------------	---	-----------

Joint Cleaning & Sealing in

30th Year = 0.60 (.1741)	=	<u>0.10</u> S.Y.
--------------------------	---	------------------

\$13.53 S.Y.

Annual Average Cost = 13.54 (.06646)	=	\$0.90 S.Y.
--------------------------------------	---	-------------

Annual Maintenance Cost	=	<u>0.03</u> S.Y.
-------------------------	---	------------------

Total Annual Cost	=	\$0.93 S.Y.
-------------------	---	-------------

b. 6" P.C.C. Pavement proposed in Study for 20-year design.

Initial Construction Cost	=	\$10.45 S.Y.
---------------------------	---	--------------

Future Major Maintenance

Joint Cleaning & Sealing in

10th Year = 0.60 (.5584)	=	\$ 0.34 S.Y.
Joint Cleaning & 1 1/2" Overlay		
in 20th Year = 2.40 (.3118)	=	0.75 S.Y.
Bit. Sealing 27th Year 0.55 (.2074)	=	0.11 S.Y.
Bit. Sealing 34th Year 0.55 (.1379)	=	<u>0.08</u> S.Y.
		\$11.73 S.Y.

Annual Average Cost = 11.73 (.06646)	=	\$0.78 S.Y.
Annual Maintenance Cost	=	<u>0.03</u> S.Y.
Total Annual Cost	=	\$0.81 S.Y.

TABLE 7-4

SUMMARY OF INITIAL AND ANNUAL COSTS OF RESIDENTIAL  
COLLECTOR STREET PAVEMENT ALTERNATES

COST S.Y.	FLEXIBLE PAVEMENT			RIGID PAVEMENT	
	9" Asphalt	8" Asphalt	7" Asphalt	7" PCC	6" PCC
Initial	\$8.48	\$8.01	\$6.99	\$12.91	\$10.45
Annual	\$0.66	\$0.64	\$0.59	\$ 0.93	\$ 0.81

C. RESIDENTIAL LOCAL STREETS

1. Flexible Pavement.

a. 8" Asphalt Pavement - Current City of Wichita Design.

Initial Construction Cost	=	\$7.53 S.Y.
Excavation 2.5" or 0.06944 (1.77)	=	<u>0.12</u> S.Y.
		\$7.65 S.Y.

Future Major Maintenance

(Same as 9" Asphalt Pavement) = \$0.97 S.Y.  
\$8.62 S.Y.

Deduct Salvage Value at end of Analysis

Period over other pavement alternates.

$\frac{7.53}{8} = 0.941 (.0972) = \underline{0.09} S.Y.  
$8.53 S.Y.$

Annual Average Cost = 8.53 (.06646) = \$0.57 S.Y.

Annual Average Maintenance Cost = 0.04 S.Y.

Total Annual Cost = \$0.61 S.Y.

b. 7" Asphalt Pavement proposed in Study for 40-Year design.

Initial Construction Cost = \$6.93 S.Y.

Excavation 1.5" or 0.0417 (2.00) = 0.08 S.Y.  
\$7.01 S.Y.

Future Major Maintenance

(Same as 9" and 8" above) = \$0.97 S.Y.  
\$7.98 S.Y.

Annual Average Cost = 7.98 (.06646) = \$0.53 S.Y.

Annual Maintenance Cost = 0.04 S.Y.

Total Annual Cost = \$0.57 S.Y.

c. 6" Asphalt Pavement proposed in Study for 20-Year design.

Initial Construction Cost = \$5.93 S.Y.  
Excavation 0.5" or 0.0139 (2.00) = 0.03 S.Y.  
\$5.96 S.Y.

Future Major Maintenance

(Same as 7" Asphalt in Item B.1.C) = \$1.27 S.Y.  
\$7.23 S.Y.

Annual Average Cost = 7.23 (.06646) = \$0.48 S.Y.

Annual Maintenance Cost = 0.04 S.Y.

Total Annual Cost = \$0.52 S.Y.

2. Rigid Pavement

a. 6" P.C.C. Pavement Current City of Wichita Design and proposed in Study for 40-Year design.

Initial Construction Cost = \$10.45 S.Y.  
Excavation 0.5" or 0.0139 (1.77) = 0.03 S.Y.  
\$10.48 S.Y.

Future Major Maintenance

(Same as 7" P.C.C. in Item B.2.a.) = 0.63 S.Y.  
\$11.11 S.Y.

Annual Average Cost = 11.11 (.06646) = \$0.74 S.Y.

Annual Maintenance Cost = 0.03 S.Y.

Total Annual Cost = \$0.77 S.Y.

b. 5.5" P.C.C. Pavement proposed in study for 20-Year design.

Initial Construction Cost =  $\frac{5.5}{6} (10.45) = \$ 9.58$  S.Y.

Future Major Maintenance

(Same as 6" P.C.C. in Item B.2.b.) = \$ 1.28 S.Y.

\$10.86 S.Y.

Annual Average Cost = 10.86 (.06646) = \$0.72 S.Y.

Annual Maintenance Cost = 0.03 S.Y.

Total Annual Cost = \$0.75 S.Y.

TABLE 7-5

SUMMARY OF INITIAL AND ANNUAL COSTS OF RESIDENTIAL  
LOCAL STREET PAVEMENT ALTERNATES

COST S.Y.	8" Asphalt	FLEXIBLE PAVEMENT		RIGID PAVEMENT	
		7" Asphalt	6" Asphalt	6" PCC	5.5" PCC
Initial	\$7.65	\$7.01	\$5.96	\$10.48	\$9.58
Annual	\$0.61	\$0.57	\$0.52	\$ 0.77	\$0.75

D. EFFECT OF STREET MAINTENANCE COSTS ON CITY TAXES.

From review of the annual costs for city residential streets, it appears that the 20-year flexible pavement designs have the lowest annual costs with \$0.59 per square yard for a collector street and \$0.52 per square yard for local streets, thereby being the most cost-effective of the alternatives studied. Also it will be noted

that there is \$0.05 per square yard difference between the second most cost-effective alternate, which is the 40-year flexible pavement designs.

However, due to historical policies for funding and maintaining residential streets in the City of Wichita, another analysis or viewpoint should also be given consideration.

As previously discussed in Section IV, initial construction costs are assessed against benefiting property owners whereas maintenance costs are absorbed by the City-at-Large. Maintenance costs are therefore budgeted annually and funds are provided by taxes.

Because taxes are not used for establishing sinking funds or for generating revenues as normal investments, all maintenance costs (taxes) are therefore more suitable for analyzing at their direct annual costs in lieu of converting future costs to present worth as previously analyzed.

As was determined in this Section, streets having the highest initial cost were not the most cost-effective, but had the lowest annual maintenance costs. Since most citizens in Wichita are concerned about property taxes (special, user and ad valorem), a compromise may be desirable for selecting alternatives having moderate initial costs and maintenance costs.

An illustrative example of difference in maintenance costs for pavements of the 20-year design versus 40-year design based on 1977 mileage of residential streets within the City is as follows:

1. 20-Year Design Life - Assume that during the past the City of Wichita would have permitted thinner pavement sections for residential street construction. These sections would have required a minimum of 1 1/2" overlays every 20-years.

a. 375 Miles of existing asphalt streets (Assume 32'B/B Avg. width with 15,840 S.Y. per mile of driving surface)

$375/20$	=	18.75 miles overlaid per year.
$375/7 - 18.75$	=	34.86 miles sealed per year.
Patching, etc.	=	375 ((15,840) S.Y. @ \$0.04 = \$237,600.00
Sealing	=	34.86 (15,840) S.Y. @ \$0.55 = \$303,700.00
Overlays	=	18.75 (15,840) S.Y. @ \$1.50 = <u>\$445,500.00</u>
Total Annual Maintenance	=	\$986,800.00

b. 385 miles of existing concrete streets (Assume 15,840 S.Y. per mile).

$192.5/10 + 19.25$	=	38.5 miles joints cleaned and resealed per year.
$385/20$	=	19.25 miles overlaid per year.
$192.5/7$	=	27.50 miles sealed per year.
Patching, etc.	=	385 (15,840) S.Y. @ \$0.03 = \$ 182,952.00
Joint maintenance	=	38.50 (15,840) S.Y. at \$0.60 = \$ 365,904.00
Overlays	=	19.25 (15,840) S.Y. @ \$1.80 = \$ 548,856.00
Sealing	=	27.50 (15,840) S.Y. @ \$0.55 = <u>\$ 239,580.00</u>
Total Annual Maintenance	=	\$1,337,292.00

c. Total annual maintenance based on 20-year design for  
existing residential streets = \$2,324,092.00

2. 40-Year Design Life - In general past street construction in  
the City of Wichita was in this category. These  
pavement sections would have requirements for an overlay  
every 40 years.

a. 375 miles of existing asphalt streets.

$375/40 = 9.38$  miles overlaid per year.

$375/7 - 9.38 = 44.19$  miles sealed per year.

Patching, etc. = 375 (15,840) S.Y. @ \$0.04 = \$237,600.00

Sealing = 44.19 (15,840) S.Y. @ \$0.55 = \$384,984.00

Overlays = 9.38 (15,840) S.Y. @ \$1.50 = \$222,869.00

Total Annual Maintenance = \$845,453.00

b. 385 Miles of existing concrete streets.

$192.5/10 + 9.63 = 28.88$  miles joints cleaned and  
resealed per year.

$385/40 = 9.63$  miles overlaid per year.

$192.5/7 = 27.50$  miles sealed per year.

Patching, etc. = 385 (15,840) S.Y. @ #0.03 = \$182,952.00

Joint maintenance = 28.88(15,840) S.Y.

@ \$0.60 = \$274,475.00

Overlays = 9.63 (15,840) S.Y. @ \$1.80 = \$274,570.00

Sealing = 27.50 (15,840) S.Y. @ \$0.55 = \$239,580.00

Total Annual Maintenance = \$971,577.00

c. Total annual maintenance based on 40-year design for  
existing residential streets = \$1,817,030.00

3. Maintenance cost comparisons between 20-year designs, 40-year designs and current maintenance expenditures, which were \$588,828.00 expended in 1977 for residential street maintenance.

20-Year design =  $\frac{2,323,756}{588,828}$  = 395% increase over current expenditures for maintenance.

40-Year design =  $\frac{1,817,030}{588,828}$  = 309% increase over current expenditures for maintenance.

Difference in maintenance costs on a square yard basis of existing streets.

$\frac{\$2,323,756 - \$1,817,030}{760 (15,840) \text{ S.Y.}}$  = \$0.042 more per S.Y. annually

4. Review of City of Wichita records show that the City acquires approximately 9 miles of improved residential streets per year representing a 1% increase  $\frac{769}{760}$ .

Difference in maintenance costs on a square yard basis of new streets.

$\frac{\$2,323,756 - \$1,817,031}{9 (15,840) \text{ S.Y.}}$  = \$3.55 more per S.Y. which is greater than \$1.00\*

\*Difference between initial costs of flexible pavements for both collector and local residential street thickness designs proposed in this study for 40-year and 20-year designs is approximately \$1.00. (See Tables 7-4 and 7-5).

Therefore, from the above example it can be seen that a change in City policy from a 40-year design to a 20-year design life for residential streets through the ensuing years could cause the City to spend \$3.55 more for maintenance of existing streets for each \$1.00 saved per square yard of new street constructed per year. Basing the design thickness on current prices for the most cost-effective designs can be hazardous when it represents only 1 percent of the aggregate total of residential streets.

In addition, it should be noted that a city pavement standard that is too loose, having double standards for pavement types and thicknesses or design life, could become subject to political pressures with an undesirable aftermath of problems for the taxpayers. It is normal for the typical residential homeowner to desire a well-drained, hard-surfaced, all-weather street at the least cost to his property regardless of the maintenance costs as long as the City maintains the riding surface. An example of how unfair this condition could become to individual taxpayers would be a homeowner having paid for six inches of concrete pavement with negligible maintenance costs having to help pay for the high maintenance costs of another homeowner down the street with only a two-inch asphalt mat. This situation would even be compounded if each homeowner's shortest route to work was over the other's street which would be reflected in their respective user costs.

Should the City reverse past policies and assess major maintenance against the benefiting property owners the problem of maintenance costs on taxes would diminish. However, due to various and numerous low to medium type residential streets presently within the City, a policy change would be difficult to administer fairly between major and minor maintenance costs.



**P**ROFESSIONAL  
**E**NGINEERING  
**C**ONSULTANTS  
PROFESSIONAL ASSOCIATION

SUPPLEMENTARY PAVEMENT THICKNESS  
DESIGN MANUAL  
FOR  
RESIDENTIAL STREETS  
WITHIN THE  
WICHITA METROPOLITAN AREA

Prepared for the  
CITY OF WICHITA, KANSAS  
and  
SEDGWICK COUNTY, KANSAS

Prepared By  
PROFESSIONAL ENGINEERING CONSULTANTS, P. A.  
ENGINEERS

October 1979

*REV - 2-19-80*

1440 EAST ENGLISH  
WICHITA, KANSAS 67211  
(316) 262-2691

SUPPLEMENTARY PAVEMENT THICKNESS  
DESIGN MANUAL  
FOR  
RESIDENTIAL STREETS  
WITHIN THE  
WICHITA METROPOLITAN AREA

Prepared for the  
CITY OF WICHITA, KANSAS  
and  
SEDGWICK COUNTY, KANSAS

Prepared By  
PROFESSIONAL ENGINEERING CONSULTANTS, P. A.  
ENGINEERS

October 1979



## CONTENTS

	<u>Page</u>
FOREWORD	i
SECTION I - PAVEMENT DESIGN PROCEDURES	1
A.    Soils Investigation	1
1.    General	1
2.    Preliminary Soils Survey, Tests and Report	2
B.    Traffic Consideration	3
C.    Pavement Type and Thickness Selection	4
1.    Flexible Pavement	4
2.    Rigid Pavement	6
SECTION II - QUALITY CONTROL	8
A.    Pavement Subgrade	8
B.    Pavement Materials and Construction Control	9

### Table Of Figures

<u>Fig.</u>	
2-1	Design Graph for Flexible Pavement
2-2	Local Residential Streets-Recommended Sections
2-3	Collector Residential Streets Recommended Sections
2-4	Design Graph for Rigid Pavement
2-5	Local Residential Streets-Recommended Sections
2-6	Collector Residential Streets- Recommended Sections

## FOREWORD

The purpose of this Supplementary Pavement Thickness Design Manual is to summarize the findings and the recommendations of the report "Pavement Design and Feasibility Study for Residential Streets Within the Wichita Metropolitan Area", dated April 1979 (hereinafter referred to as the Paving Report).

During the preparation of the Paving Report, meetings were held with the City and County Departments of Public Works and it was determined that the criteria and methodology utilized in establishing pavement thicknesses was acceptable to both agencies. The report was accepted as meeting the requirements of the Consultant's engineering agreement, but the recommended pavement section or standard for each type of pavement and category of residential street was not formally adopted.

This status quo remained until a joint meeting between the City, the County and the Consultant was held on September 19, 1979. At this meeting, areas of agreement or compromise were explored in order to reach a solution acceptable to both parties. The Consultant was instructed to prepare a supplementary design manual based on the following conditions:

1. The 40-year pavement design life (minimum) as recommended by the Consultant in the Paving Report was satisfactory.

2. Additional preliminary testing of subgrade soils and additional project site inspection and testing above the present levels could be utilized for pavement design and control of construction materials.
3. More than a single pavement thickness standard was acceptable, but some limitation was preferred. This would permit the engineer greater latitude in the design process, which hopefully will provide the most economical section for a given location within the Study Area.

In this era of spiraling construction costs resulting in very high special assessments in newly developed areas, it is apparent that more engineering is necessary to conserve materials and energy, reduce construction costs, and to improve quality control. It is the engineer's responsibility to keep abreast of new techniques, products and equipment which will provide a cost effective facility for any required service.

Therefore, the design engineer should be cautioned that the design and recommendations presented in the Paving Report and this Manual are valid only for the local area residential streets and are not to be considered as permanent in regard to time.

SECTION I  
PAVEMENT DESIGN PROCEDURES

A. Soils Investigation

1. General -

Review of Section III - Soils and Section IV.A.1. in the Paving Report is recommended to obtain suggested subgrade support values within the Study Area. It was determined that a subgrade support value having a CBR of 10 for design purposes could be attained without changing current specifications or design procedures for residential streets. It was also established that a CBR of 20 could be expected if the compaction effort was increased in the specification to 90 percent of maximum dry density as determined by ASTM D-1557-70, which is proposed herein.

It is recommended that CBR values of subgrade support greater than 20 should not be utilized for residential street design purposes. This is especially critical as the pavement thickness approaches a five and one-half inch minimum. As higher CBR values are used, the possibilities of having localized areas of deficient subgrade support increases and can result in not obtaining the design or service life of the pavement. In addition, as discussed in the Paving Report, the formulas

do not take into consideration any loss of pavement strength due to weathering over the 40-year design life and the problems of frost penetration into the subgrade. For these reasons, the five and one-half inch thickness should be considered as the minimum or bottom for 40-year design life until more experience in performance of these thinner sections is obtained.

2. Preliminary Soils Survey, Tests and Report -

Field sampling and laboratory testing of soils for pavement subgrade should be conducted by experienced personnel familiar with standard test procedures. Slight variations in testing procedures can have significant effect on the reliability of test results which could affect the pavement service life.

The personnel conducting the soils survey should have preliminary street plans and profiles so that the actual frequency of spacing and depths of soils borings can be determined in the field. The boring locations should be discretionary and can be adjusted to the size of the project and field observations of change in the soil types.

The number of tests to be conducted on the soil samples depends on the level of history and documentation of soil classifications in the project area. A particle size analysis ASTM D-422-63, liquid limit ASTM D-423-66, and plastic limit ASTM D-424-59,

should be run to determine the general classification of each soil expected to be found in the subgrade.

Similar samples as determined by the above analysis should be combined and tests run to determine maximum dry density in accordance with ASTM D-1557-70 and CBR values as provided in ASTM D-1883-73<sup>(SOAKED SAMPLES)</sup> for each soil type. Obvious clay soils should be tested to establish the required lime content and the parent soil treated accordingly prior to conducting the density and CBR tests. (R)

A summary or report of the soil survey should be submitted to the design engineer so that a final determination can be made on the pavement thickness and subgrade stabilization required for the project. CBR values can be converted to approximate plate bearing values or modulus of subgrade reaction "k" by use of Table 4-1 in the Paving Report. However, verification of this table should be accomplished by conducting plate bearing tests on the final subgrade.

B. Traffic Consideration

A review of Section IV.A.2.c. and d. in the Paving Report is necessary for establishing the number of applications of equivalent 18-kip single axle loads for Local and Collector residential streets

over the 40-year design life. This number was determined as 117,000 and 290,000 respectively for the two categories of residential streets. A line has been added and labeled at these points on the design graphs for rigid and flexible pavement as presented in this manual (Fig. 2-1 & 2-4).

It is possible these values are on the high side as an average for each category of residential street, but as noted in the Paving Report, some compensation for loss of serviceability due to weathering should be provided in the thickness design. The formulas as provided in the AASHO Interim Guide and utilized in the design graphs are based on straight line dynamic loading repetitions for loss in serviceability without regard to losses for weathering of the pavement structure.

C. Pavement Type and Thickness Selection

1. Flexible Pavement -

From review of the design graphs for flexible and rigid pavement (Fig. 2-1 & 2-4), it is apparent that the flexible pavement thickness is much more susceptible to subgrade support than is the rigid pavement. This is to be expected since flexible pavement thickness is based on a component layer concept while rigid pavement is based on a concept of development of internal bending stresses within the pavement slab. Therefore, the

design engineer is cautioned that variations in subgrade support for flexible pavement cannot be tolerated to the extent permitted for rigid pavement. Thus the preliminary soils investigation and job-site quality control should both be more detailed where flexible pavements are proposed.

After receipt of the soils survey, the minimum CBR value to be used for pavement thickness is established. Utilizing the "Design Graph for Flexible Pavement" (Fig. 2-1), proceed vertically up the lines labeled for either Local or Collector residential street to the point of intercept with the given CBR value of subgrade support; then horizontally to the required thickness of asphalt pavement as shown in Figure 2-1. It is intended for the indicated thickness of flexible pavement to contain a two-inch surface course with the remainder as base course(s). Both surface and base course shall have the specified minimum Marshall stabilities noted in Figure 2-1.

For a Local residential street, a subgrade having a CBR of 10 requires 7 inches of asphalt pavement and a subgrade with a CBR of 20 requires 5-1/2 inches of asphalt pavement or a difference of 1-1/2 inches. It should normally be more feasible to modify the subgrade by stabilization or treatment to attain a CBR in the 10 to 20 range for residential streets as discussed previously in Paragraph A.1. than to use the considerably greater pavement thicknesses required for low CBR values.

DESIGN GRAPH FOR FLEXIBLE PAVEMENT ( $P_f = 2.0$ )

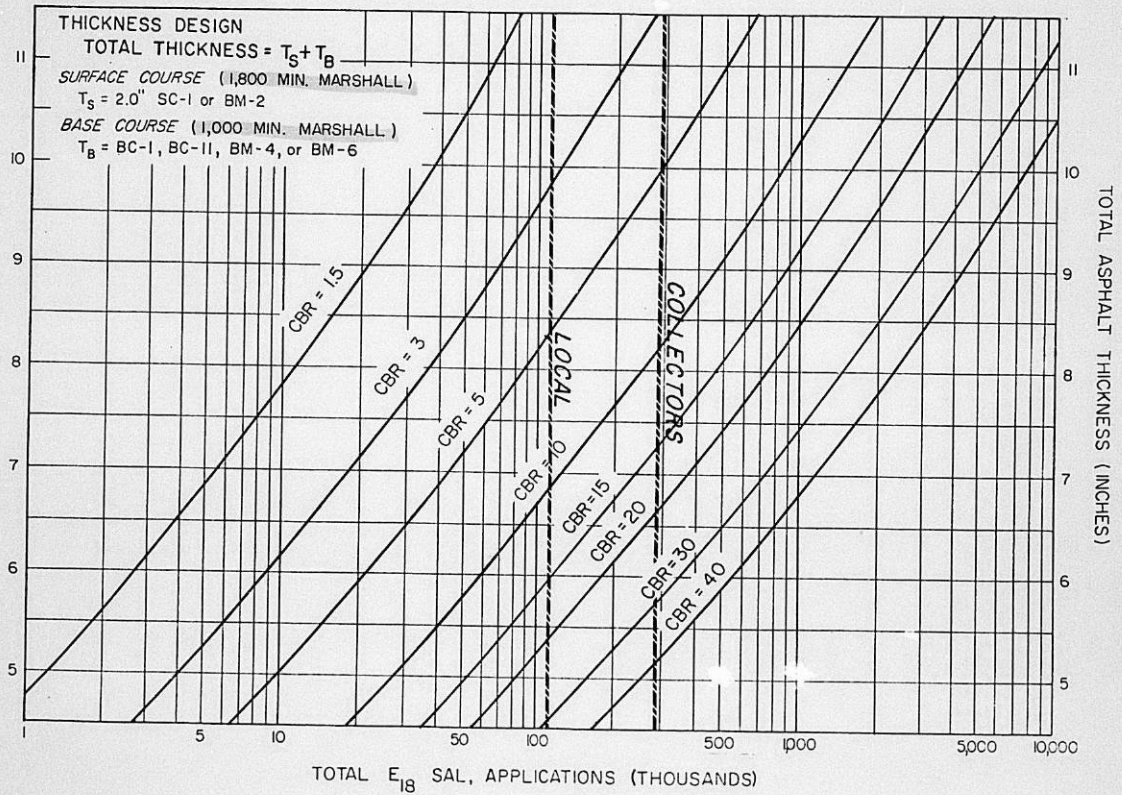
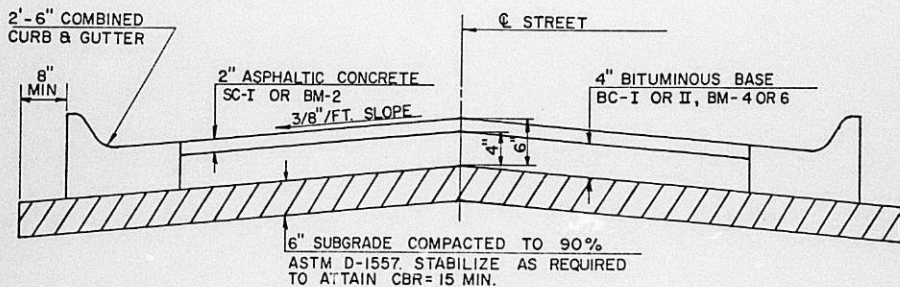
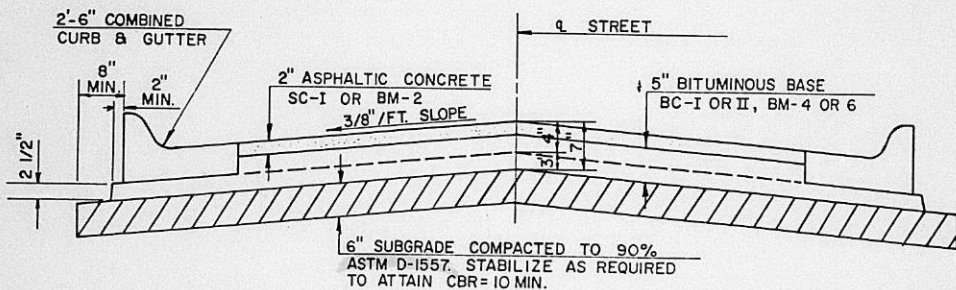


FIG. 2-1

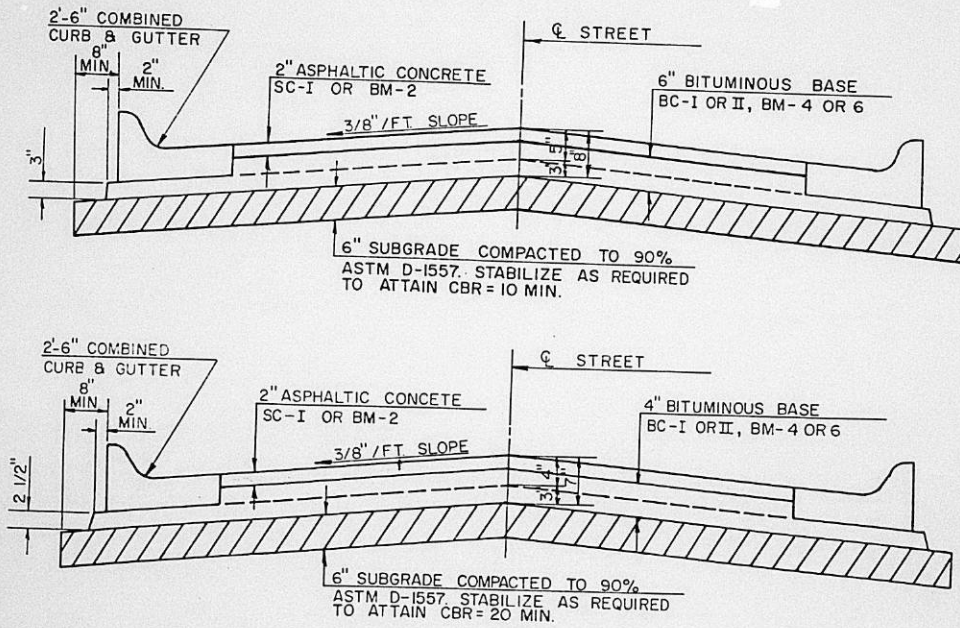
LOCAL RESIDENTIAL STREETS  
RECOMMENDED SECTIONS



FLEXIBLE PAVEMENT

FIG. 2-2

COLLECTOR RESIDENTIAL STREETS  
RECOMMENDED SECTIONS



FLEXIBLE PAVEMENT

Typical sections for Local and Collector residential streets are shown in Figures 2-2 and 2-3 respectively for flexible pavement. It should be noted that when the thickness of asphalt pavement drops below 7" the possibility of having a portion of bituminous base below the curb and gutter section ceases. It is acknowledged that placing the curb and gutter over bituminous base has many advantages; however, it should not be a condition for determining the pavement thickness.

2. Rigid Pavement -

From a review of the "Design Graph For Rigid Pavement" (Fig. 2-4), it can be seen that for a given application of equivalent 18-kip single axle loads the difference in pavement thickness amounts to approximately one inch over the whole range of subgrade support values; whereas for flexible pavement (Fig. 2-1), the difference in thickness is approximately five and one-half inches. This illustrates that rigid pavement is not as sensitive to subgrade support variations as is flexible pavement. However, rigid pavement is more prone to problems from shrink-swell conditions and frost heaving conditions within the subgrade.

After the minimum "k" value of subgrade support for the project is established, the concrete thickness can be determined by use of Design Graph for Rigid Pavement (Fig. 2-4). This is accomplished by proceeding up the vertical lines labeled either

Local or Collector residential street to the point of intercept with the given "k" value of subgrade support; then horizontally to the required thickness of concrete pavement. The thickness should be rounded off to the nearest one-half inch increment.

As discussed in Paragraph A.1., it is normally more feasible or desirable to modify the subgrade by stabilization or treatment to attain a "k" value of 200 minimum. Typical sections for Local and Collector residential streets are shown in Figures 2-5 and 2-6 respectively, for rigid pavement.

DESIGN GRAPH FOR RIGID PAVEMENT ( $P_f = 2.0$ )  
NO LOAD TRANSFER

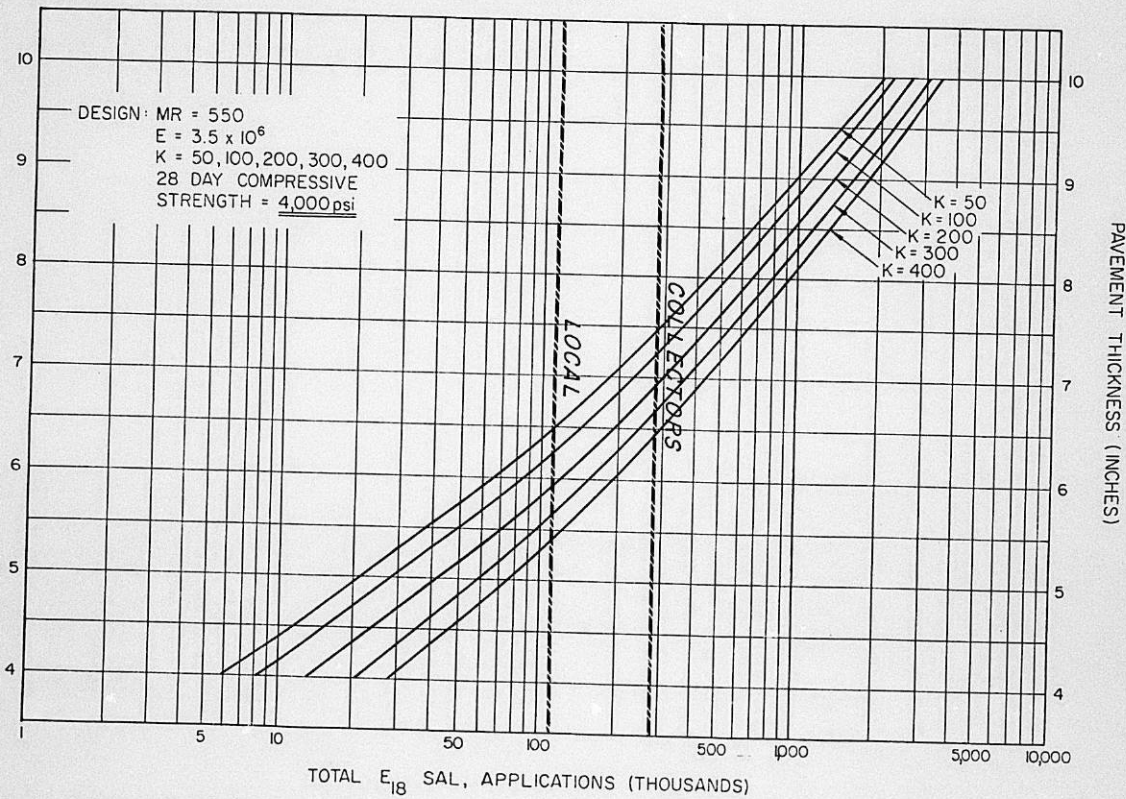
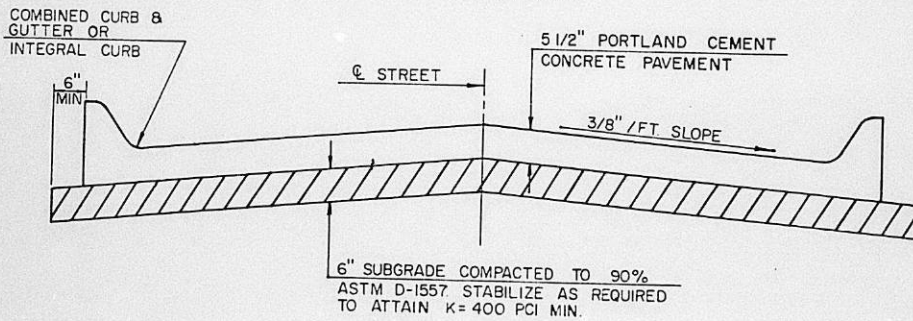
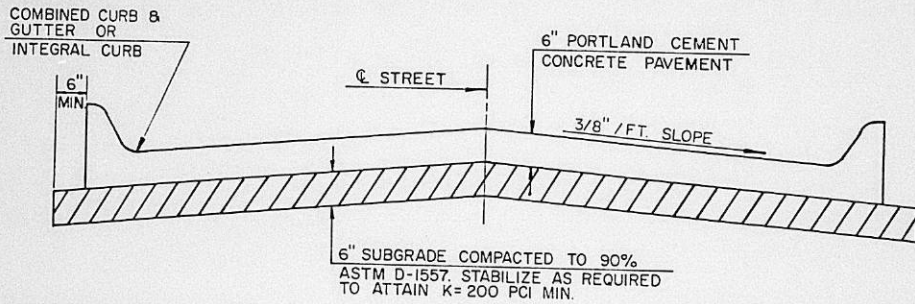


FIG. 2-4

LOCAL RESIDENTIAL STREETS  
RECOMMENDED SECTIONS



RIGID PAVEMENT

FIG. 2-5

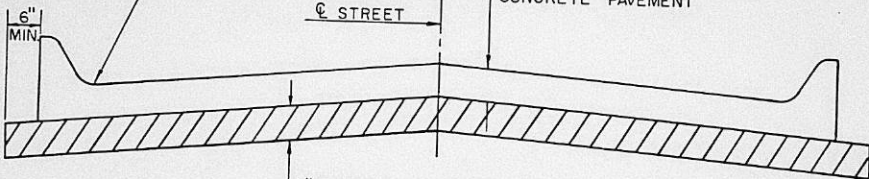
COLLECTOR RESIDENTIAL STREETS  
RECOMMENDED SECTIONS

COMBINED CURB &  
GUTTER OR  
INTEGRAL CURB

6"  
MIN.

CL STREET

7" PORTLAND CEMENT  
CONCRETE PAVEMENT



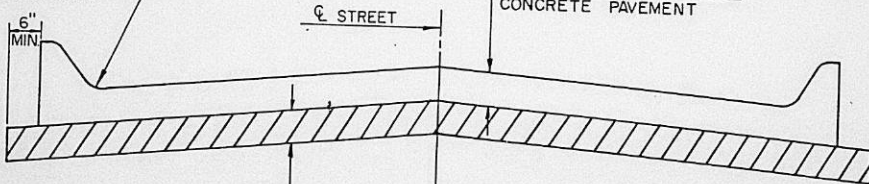
6" SUBGRADE COMPACTED TO 90%  
ASTM D-1557, STABILIZE AS REQUIRED  
TO ATTAIN K=200 PCI MIN.

COMBINED CURB &  
GUTTER OR  
INTEGRAL CURB

6"  
MIN.

CL STREET

6 1/2" PORTLAND CEMENT  
CONCRETE PAVEMENT



6" SUBGRADE COMPACTED TO 90%  
ASTM D-1557, STABILIZE AS REQUIRED  
TO ATTAIN K=400 PCI MIN.

RIGID PAVEMENT

FIG. 2-6

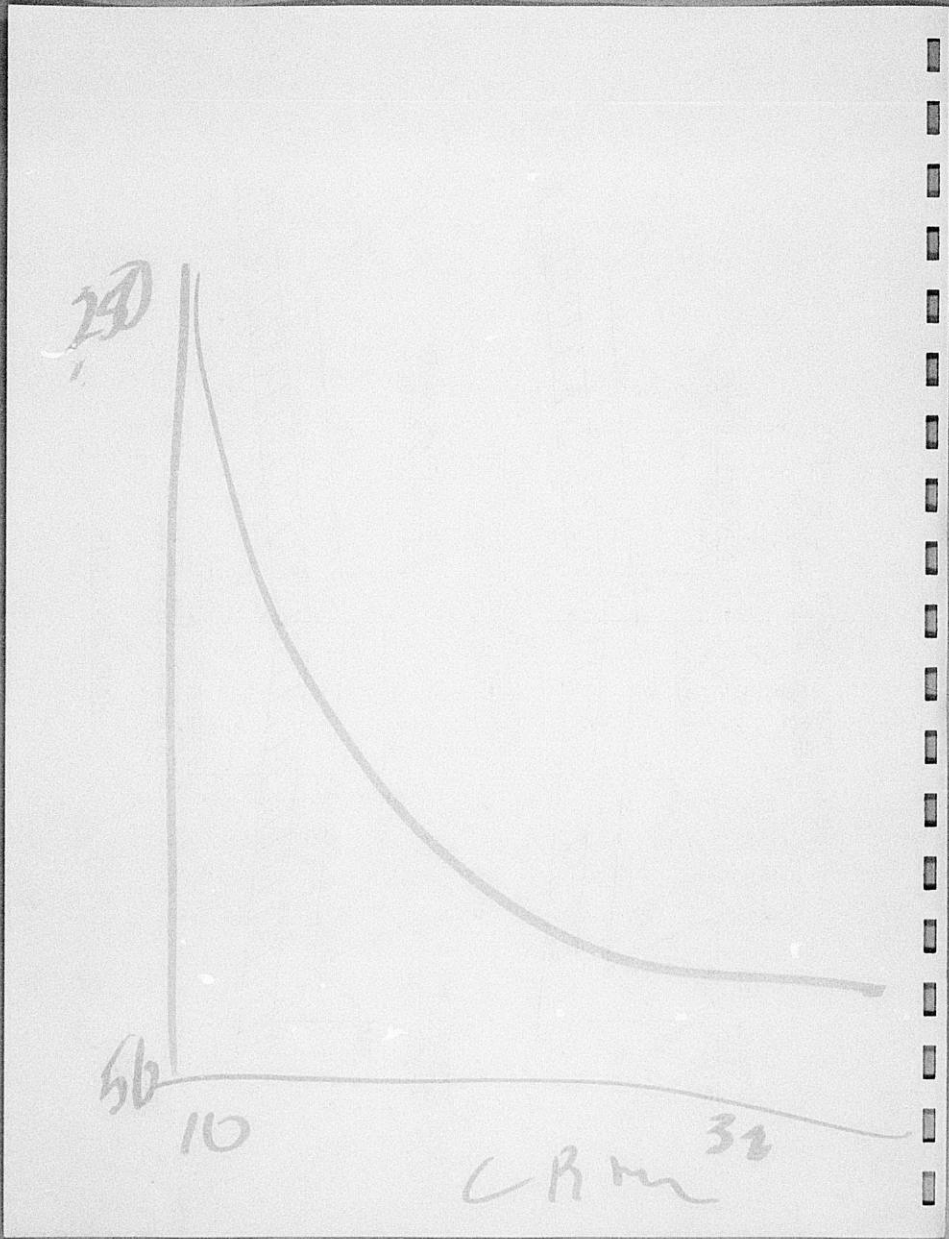
SECTION II  
QUALITY CONTROL

A. Pavement Subgrade

The project field representative should be given a copy of the project Soils Report along with a set of plans and specifications. This should enable him to anticipate some problems that may be peculiar to the project site for obtaining specific densities and subgrade support values.

For a given soil or treated material, the CBR value or Modulus of Subgrade Reaction (k) is primarily a function of the degree of compaction. Soft areas or areas of undesirable subgrade soils, if present in the project site, will normally become apparent during the rolling or compaction process. It is therefore imperative for the project representative (inspector) to be present for full time observation of the compaction process. Unsuitable subgrade material should be removed and replaced with suitable material as directed by the project representative. Density tests should be conducted every station (100 feet) along the roadway in addition to every suspected problem area and where trenching for utilities was accomplished. For flexible pavement, the spacing for density tests should be decreased to fifty feet or less for reasons previously discussed.

If lime treatment of the subgrade is required for the project, plasticity index tests should be run on samples taken from treated subgrade material on intervals of 250 to 300 feet.



B. Pavement Materials and Construction Control

As the pavement section becomes thinner for a given classification of street, the design becomes less conservative and therefore material and construction control become more critical. If this is not accomplished during construction, the product can fail as a result of construction deficiencies regardless of design excellence considering drainage, subgrade, traffic, etc.

Section VII in the Paving Report discusses pavement materials and control in some detail and makes recommendations as to required changes, so no reiteration of that discussion will be made in this manual. However, these recommendations should be considered as "minimums" and any further improvement in the product specification and control by testing is encouraged. The control of materials and construction was also discussed in Section II.A.3. of the Paving Report and review of that document is suggested prior to design of the facility.

**THE CITY OF WICHITA**

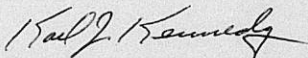
**OFFICE OF** Industrial Development      **DATE** December 15, 1980

**TO** Robert A. Lakin, Director of Planning

**FROM** Karl Kennedy, Industrial Analyst

**SUBJECT** Board of Land Use Economics -  
Approval of Design Manual  
for Pavement Thickness

The Board of Land Use Economics during its meeting of December 3, 1980, approved a motion to recommend that the Boards of City and County Commissioners adopt the modified and revised design manual for pavement thickness for residential streets within the Wichita Metropolitan area.



Karl J. Kennedy  
Industrial Analyst

KJK/st

cc: Board of Land Use Economics  
Joe E. Boyd, Economic/Industrial Development

**RECEIVED**

DEC 16 1980

METROPOLITAN PLANNING  
ROUTE  \_\_\_\_\_  
 \_\_\_\_\_



SEDGWICK COUNTY COURTHOUSE

**COUNTY OF SEDGWICK**  
**DEPARTMENT OF PUBLIC WORKS**

1015 STILLWELL  
WICHITA, KANSAS 67213

PHONE 268-7901

JOE D. FREEMAN, P.E.  
ACTING COUNTY ENGINEER

**RECEIVED**

DEC 11 1980

**METROPOLITAN PLANNING**  
Road

DATE: December 8, 1980  
TO: Robert Lakin  
FROM: Joe D. Freeman  
RE: Design Manual for Pavement Thickness

We have reviewed the revised paving manual forwarded by you on November 19, 1980. We offer the following comments:

1. If the minimum Marshall Stability requirement of the surface is 1600 lb. (changed from the original 1800 lb) the design chart (Fig 2-1) on Page 9 will need to be revised to indicate TS at 2 inch SC-1 or BM-2 at 1600 lb Marshall and TB along with the total thickness changed to reflect the change in the Marshall requirement of TS, based on the ASSHTO Road Test Equation which was the basis for the design chart. In other work this chart (Fig 2-1) may not now be valid as it is set forth.
2. The resolution for the Board of County Commissioners to act upon has been revised, a marked copy of which is attached.
3. We are developing a set of recommendations and comments on the use of Type I cement and addition testing requirements associated with its use. Type I cement is of an inferior quality when compared to Type II and therefore additional testing requirements will be needed if the quality of the finished paving section is to be assured. Those additional testing requirements need not necessarily be made a part of this manual, however I would suggest we modify paragraph 2 of page 19 to state;  
"Type II cement shall be used, however when unavailable Type I cement may be used only with the Engineer's written approval. Type II cement may be permitted only with the Engineer's written approval."

If you have any questions, please call me.

attachment:

RESOLUTION

A RESOLUTION ESTABLISHING DESIGN CRITERIA FOR URBAN RESIDENTIAL STREETS AND INSPECTION PROCEDURES THEREFOR.

NOW BE IT <sup>Resolved</sup> ORDAINED BY THE BOARD OF COMMISSIONERS OF SEDGWICK COUNTY, KANSAS, THAT:

SECTION 1. The revised <sup>edition</sup> addition of pavement thickness manual for residential streets within the Wichita metropolitan area on December 1980. Addition including appendices and design <sup>graphs</sup> ~~graphs~~ attached thereto and designated as a "Design Manual for Pavement Thickness for Residential Streets Within the Wichita Metropolitan Area" is by reference incorporated in and by this publication made a part of this resolution as fully as those <sup>by the Board of County Commissioners</sup> set forth at length herein, and is <sup>also</sup> hereby adopted as the design material and construction manual for all urban residential streets in the unincorporated area of Sedgwick County, Kansas.

SECTION 2. That the original <sup>Resolution #</sup> Section 1 of the above ~~cited resolution~~ be the same as hereby repealed.

SECTION 3. That this resolution shall take effect and be enforced from and after its adoption and publication in the official County paper.

PASSED AND ADOPTED by the Board of County Commissioners at Wichita, Kansas, this \_\_\_\_\_ day of \_\_\_\_\_, 19\_\_.

\_\_\_\_\_, Chairman  
Everett Patrick

has been adopted by the Sedgwick County Engineer under the authority of KSA 68-502 and the design specification and regulation for urban residential ~~street~~ township streets,

\_\_\_\_\_, Commissioner  
Tom Scott

\_\_\_\_\_, Commissioner  
Donald E. Gragg

ATTEST:

\_\_\_\_\_  
Dorothy K. White, County Clerk



SEDGWICK COUNTY COURTHOUSE

**COUNTY OF SEDGWICK**  
**DEPARTMENT OF PUBLIC WORKS**

1015 STILLWELL  
WICHITA, KANSAS 67213

PHONE 268-7901

JOE D. FREEMAN, P.E.  
ACTING COUNTY ENGINEER

DATE: November 24, 1980  
TO: Robert Lakin, Director of Planning  
FROM: Joe D. Freeman *JDF*  
RE: Paving Manual

I have, along with County Public Works Staff, reviewed the material that has become available on the question of Marshall Stability values for the asphalt surface course for residential streets. It is my understanding that Charles Freund, one of the authors of the original paving manual, has expressed his opinion that a 1600 lb. Marshall Stability requirement for the surface course is satisfactory. Mr. Steve Lackey had indicated the City has had no unusual maintenance problems with 1600 lb. mix.

My main concern about using the 1600 lb. mix was the possible maintenance problems in the future, but the City's experience to date has not indicated any unusual maintenance problems. Based on this additional information I will not now have objections to the use of 1600 lbs. in place of 1800 lb. for a Marshall requirement for surface course, however, this is for residential pavements only.

**RECEIVED**

NOV 26 1980

METROPOLITAN PLANNING

ROUTE

WICHITA-SEDGWICK COUNTY

DATE

METROPOLITAN AREA PLANNING DEPARTMENT

November 19, 1980

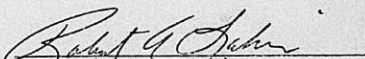
RE: AGENDA ITEM NO. 20

TO Metropolitan Area Planning Commission and  
Board of Land Use Economics  
FROM Robert A. Lakin, Director of Planning

SUBJECT Design Manual for Pavement Thickness

Several months ago the Planning Commission and the Board of Land Use Economics recommended adoption of a report on residential street design from the combined Planning Commission and Board of Land Use Economics Committee on Drainage and Streets. This report established design criteria for residential streets, and was subsequently adopted by ordinance and resolution respectively by the Board of City Commissioners and the Board of County Commissioners. Subsequent to that time, there have been additional meetings discussing potential amendments to the Design Manual. There has been agreement reached based on the amendments by the Committee and the staffs meeting with it. Input also included comments and recommendations from paving contractors. Significant amendments to the original Design Manual include modifications to compaction curves, a lowering of the stability requirements for final course asphalt, clarification on inspection procedures, and a change of general language and description of the report from a general dialogue to a set of specification requirements which provide greater clarity as to the design practices and procedures to be followed. Copies of the revised manual and proposed readopting ordinances and resolutions are attached.

It is recommended that the Metropolitan Area Planning Commission and the Board of Land Use Economics recommend to the governing bodies the adoption of the modified and revised design manual for pavement thickness for residential streets within the Wichita Metropolitan area.

  
Robert A. Lakin  
Director of Planning

RAL:rme  
Attachment

*Refer Type I-II Contract.*

DESIGN MANUAL  
FOR  
PAVEMENT THICKNESS  
FOR  
RESIDENTIAL STREETS  
WITHIN THE  
WICHITA METROPOLITAN AREA

December 1980

CONTENTS

	<u>Page</u>
FOREWORD	1
SECTION I PAVEMENT DESIGN PROCEDURES	
A. Soils Investigation	
1. General	3
2. Preliminary Soils Survey, Tests and Report	4
B. Traffic Consideration	6
C. Pavement Type and Thickness Selection	7
1. Flexible Pavement	7
2. Rigid Pavement	12
SECTION II QUALITY CONTROL	
A. Pavement Subgrade	17
B. Pavement Materials and Construction Control	18
1. General	18
2. Rigid Pavement	19
3. Flexible Pavement	23

Table Of Figures

<u>Fig.</u>		
1-1	Approximate Relationship of Soil Bearing Value	6
2-1	Design for Flexible Pavement	9
2-2	Local Residential Streets-Recommended Sections	10
2-3	Collector Residential Streets Recommended Sections	11
2-4	Design Graph for Rigid Pavement	14
2-5	Local Residential Streets-Recommended Sections	15
2-6	Collector Residential Streets-Recommended Sections	16

#### FOREWORD

The purpose of this Pavement Thickness Design Manual is to provide design criteria based on the findings and the recommendations of the report "Pavement Design and Feasibility Study for Residential Streets Within the Wichita Metropolitan Area", dated April 1979 (hereinafter referred to as the Paving Report) prepared by Professional Engineering Consultants Inc., Wichita, Ks.

During the preparation of the Paving Report, meetings were held with the City and County Departments of Public Works and it was determined that the criteria and methodology utilized in establishing pavement thicknesses was acceptable to both agencies. The report was accepted as meeting the requirements of the Consultant's engineering agreement, however the consultant was instructed to and did prepare a supplementary design manual based on the following conditions:

1. The 40-year pavement design life (minimum) as recommended by the Consultant in the Paving Report was satisfactory.
2. Additional preliminary testing of subgrade soils and additional project site inspection and testing above the present levels could be utilized for pavement design and control of construction materials.

3. More than a single pavement thickness standard was acceptable, but some limitation was preferred. This would permit the engineer greater latitude in the design process, which hopefully will provide the most economical section for a given location within the Study Area.

In this era of spiraling construction costs resulting in very high special assessments in newly developed areas, it is apparent that more engineering is necessary to conserve materials and energy, reduce construction costs, and to improve quality control. It is the engineer's responsibility to keep abreast of new techniques, products and equipment which will provide a cost effective facility for any required service and to provide proposals to the governing bodies for change to these criteria as good engineering practice dictate.

Therefore, the design engineer should be cautioned that the design and recommendations presented in this Manual are valid only for the local area residential streets and are not to be considered as permanent in regard to time.

SECTION I  
PAVEMENT DESIGN PROCEDURES

A. Soils Investigation

1. General -

It is determined that a subgrade support value having a CBR of 10 for design purposes could be attained without changing specifications or design procedures for residential streets of the City of Wichita existing prior to 3-11-80. This includes using 95% ASTM D-698 as the standard for compaction. A CBR of 20 can be expected if the compaction effort was increased in the specification to 90 percent of maximum dry density as determined by ASTM D-1557-70. To obtain CBR value greater than 10, 90% max dry density ASTM D-1557-70 shall be used.

It is recommended that CBR values of subgrade support greater than 20 should not be utilized for residential street design purposes. Therefore thickness less than five and one-half inches in thickness shall not be permitted. As higher CBR values are used, the possibilities

of having localized areas of deficient subgrade support increases and can result in not obtaining the design or service life of the pavement. The formulas do not take into consideration any loss of pavement strength due to weathering over the 40-year design life and the problems of frost penetration into the subgrade. For these reasons, the five and one-half inch thickness is considered as the minimum or bottom for 40-year design life.

2. Preliminary Soils Survey, Tests and Report -  
Field sampling and laboratory testing of soils for pavement subgrade shall be conducted by experienced personnel familiar with standard test procedures. Slight variations in testing procedures can have significant effect on the reliability of test results which could affect the pavement service life.

The personnel conducting the soils survey should have preliminary street plans and profiles so that the actual frequency of spacing and depths of soils borings can be determined in the field. The boring locations are discretionary and are to be adjusted to the size of the project and field observations of change in the soil types.

The number of tests to be conducted on the soil samples depends on the level of history and documentation of soil classifications in the project area. A particle size analysis ASTM D-422-63, liquid limit ASTM D-423-66, and plastic limit ASTM D-424-59, is to be run to determine the general classification of each soil expected to be found in the subgrade.

For CBR value greater than 10, similar samples as determined by the above analysis should be combined and tests run to determine maximum dry density in accordance with ASTM D-1557-70 and CBR values as provided in ASTM D-1883-73 (96-hour soaked sample) for each soil type. Obvious clay soils shall be tested to establish the required lime content and the parent soil treated accordingly prior to conducting the density and CBR tests.

A summary or report of the soil survey shall be submitted to the design engineer so that a final determination can be made on the pavement thickness and subgrade stabilization required for the project. CBR values can be converted to approximate plate bearing values or modulus of subgrade reaction "k" by use of Table 1-1. However, verification of this table could be accomplished by conducting plate bearing tests on the final subgrade.



Although it is possible these values are on the high side as an average for each category of residential street, some compensation for loss of serviceability due to weathering is provided in the thickness design. The formulas as provided in the AASHO Interim Guide and utilized in the design graphs are based on straight line dynamic loading repetitions for loss in serviceability without regard to losses for weathering of the pavement structure.

C. Pavement Type and Thickness Selection

1. Flexible Pavement -

From review of the design graphs for flexible and rigid pavement (Fig. 2-1 & 2-4), it is apparent that the flexible pavement thickness is much more susceptible to subgrade support than is the rigid pavement. This is to be expected since flexible pavement thickness is based on a component layer concept while rigid pavement is based on a concept of development of internal bending stresses within the pavement slab. Therefore, the design engineer is cautioned that variations in subgrade support for flexible pavement cannot be tolerated to the extent permitted for rigid pavement. Thus the preliminary soils investigation and job-site quality control should

both be more detailed where flexible pavements are proposed.

After receipt of the soils survey, the minimum CBR value to be used for pavement thickness is established. Utilizing the "Design Graph for Flexible Pavement" (Fig. 2-1), proceed vertically up the lines labeled for either Local or Collector residential street to the point of intercept with the given CBR value of subgrade support; then horizontally to the required thickness of asphalt pavement as shown in Figure 2-1. It is intended for the indicated thickness of flexible pavement to contain a two-inch surface course with the remainder as base course(s). Both surface and base course shall have the specified minimum Marshall stabilities noted in Figure 2-1.

For a Local residential street, a subgrade having a CBR of 10 requires 7 inches of asphalt pavement and a subgrade with a CBR of 20 requires 5-1/2 inches of asphalt pavement or a difference of 1-1/2 inches. It should normally be more feasible to modify the subgrade by stabilization or treatment to attain a CBR in the 10 to 20 range for residential streets as discussed previously in Paragraph A.1 of Section I than to use the considerably greater pavement thicknesses required for low CBR values.

DESIGN GRAPH FOR FLEXIBLE PAVEMENT ( $P_t = 2.0$ )

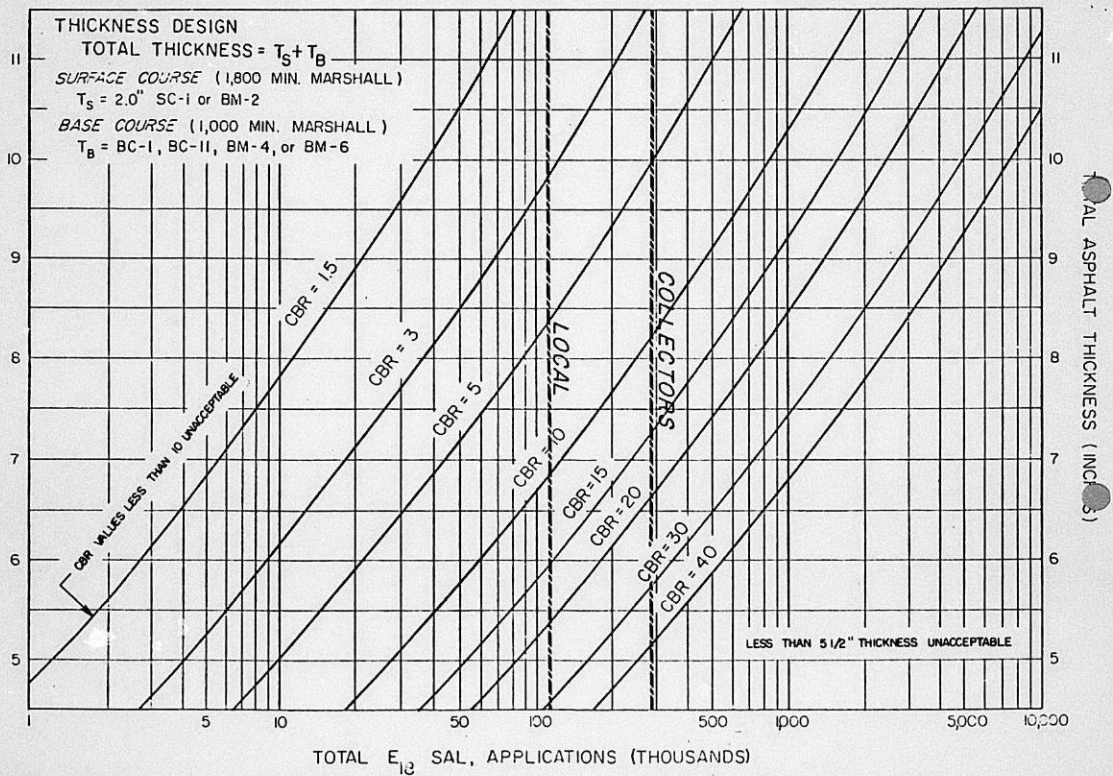
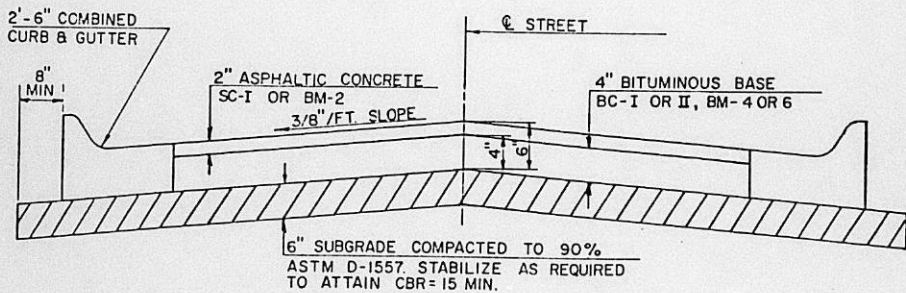
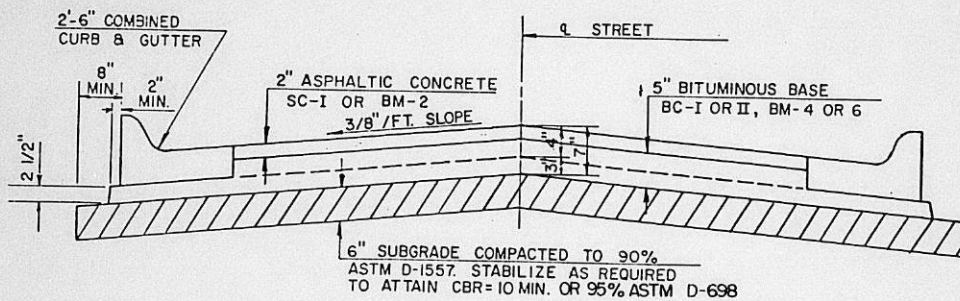


FIG 2-1

-9-

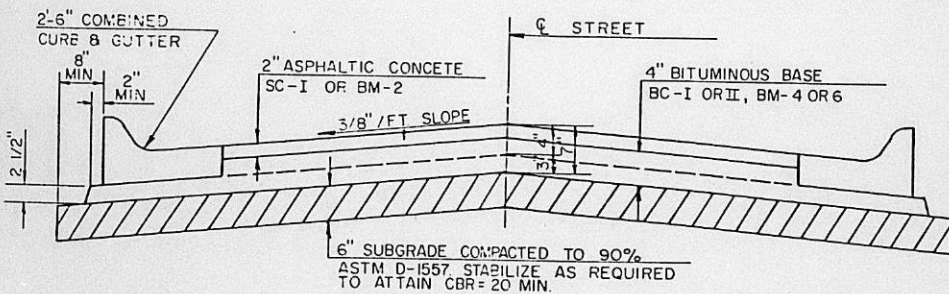
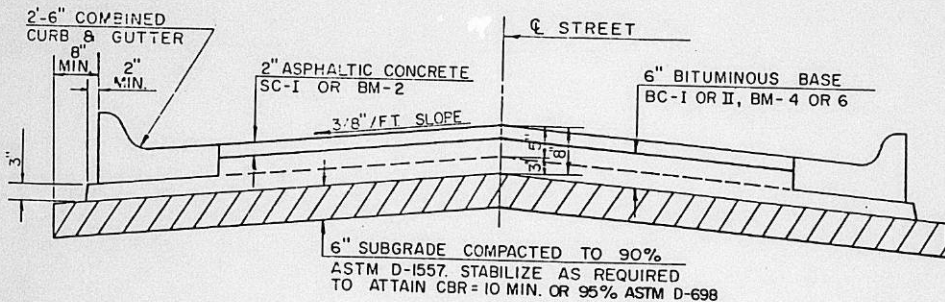
LOCAL RESIDENTIAL STREETS  
RECOMMENDED SECTIONS



FLEXIBLE PAVEMENT

FIG 2-2

COLLECTOR RESIDENTIAL STREETS  
RECOMMENDED SECTIONS



FLEXIBLE PAVEMENT

FIG 2-3

Typical sections for Local and Collector residential streets are shown in Figures 2-2 and 2-3 respectively for flexible pavement. It should be noted that when the thickness of asphalt pavement drops below 7' the possibility of having a portion of bituminous base below the curb and gutter section ceases. It is acknowledged that placing the curb and gutter over bituminous base has many advantages; however, it should not be a condition for determining the pavement thickness.

2. Rigid Pavement -

From a review of the "Design Graph For Rigid Pavement" (Fig. 2-4), it can be seen that for a given application of equivalent 18-kip single axle loads the difference in pavement thickness amounts to approximately one inch over the whole range of subgrade support values; whereas for flexible pavement (Fig. 2-1), the difference in thickness is approximately five and one-half inches. This illustrates that rigid pavement is not as sensitive to subgrade support variations as is flexible pavement. However, rigid pavement is more prone to problems from shrink-swell conditions and frost heaving conditions within the subgrade.

After the minimum "k" value of subgrade support for the project is established, the concrete thickness can be determined by use of Design Graph for Rigid Pavement (Fig. 2-4). This is accomplished by proceeding up the vertical lines labeled either Local or Collector residential street to the point of intercept with the given "k" value of subgrade support; then horizontally to the required thickness of concrete pavement. The thickness should be rounded off to the nearest one-half inch increment.

As discussed in Paragraph A.1., it is normally more feasible or desirable to modify the subgrade by stabilization or treatment to attain a "k" value of 200 minimum. Typical sections for Local and Collector residential streets are shown in Figures 2-5 and 2-6 respectively, for rigid pavement.

DESIGN GRAPH FOR RIGID PAVEMENT ( $P_t = 2.0$ )  
NO LOAD TRANSFER

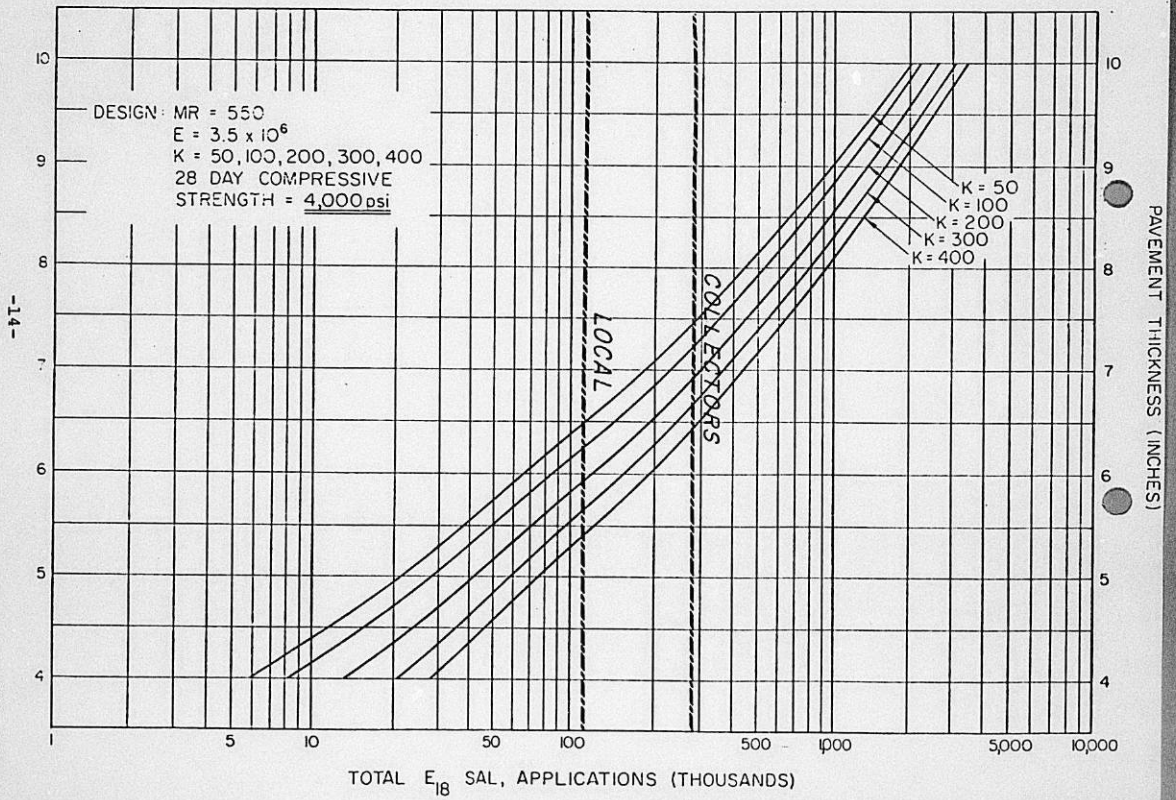
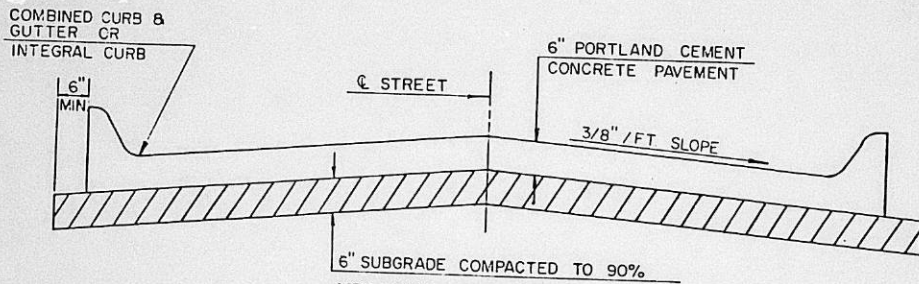


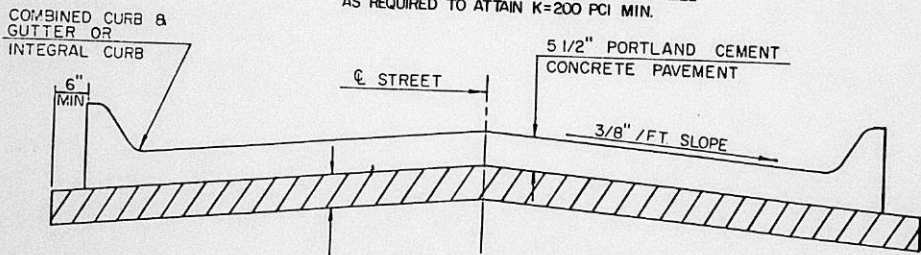
FIG 2-4

-14-

LOCAL RESIDENTIAL STREETS  
RECOMMENDED SECTIONS



ASTM D-1557 OR 95% ASTM D-698 STABILIZE  
AS REQUIRED TO ATTAIN K=200 PCI MIN.

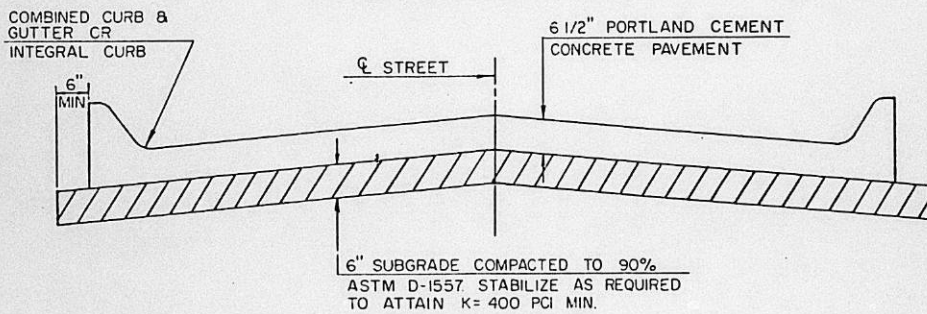
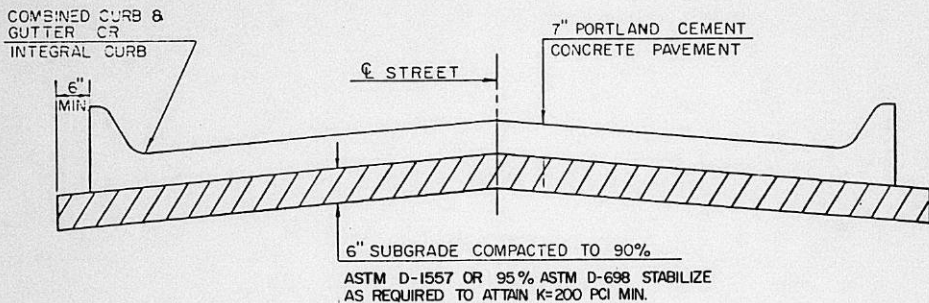


ASTM D-1557, STABILIZE AS REQUIRED  
TO ATTAIN K= 400 PCI MIN.

RIGID PAVEMENT

FIG. 2-5

COLLECTOR RESIDENTIAL STREETS  
RECOMMENDED SECTIONS



RIGID PAVEMENT

FIG 2-6

SECTION II  
QUALITY CONTROL

A. Pavement Subgrade

The project field representative shall be given a copy of the project Soils Report along with a set of plans and specifications. This should enable him to anticipate some problems that may be peculiar to the project site for obtaining specific densities and subgrade support values.

For a given soil or treated material, the CBR value or Modulus of Subgrade Reaction (k) is primarily a function of the degree of compaction. Soft areas or areas of undesirable subgrade soils, if present in the project site, will normally become apparent during the rolling or compaction process. It is therefore imperative for the project representative (inspector) to be present for full time observation of the compaction process. Unsuitable subgrade material shall be removed and replaced with suitable material as directed by the project representative. Density tests shall be conducted as determined necessary by the field engineer.

If lime treatment of the subgrade is required for the project, plasticity index tests shall be run on samples

taken from treated subgrade material on intervals selected by the field engineer.

B. Pavement Materials and Construction

1. General

Section I, Pavement Design, includes the standards for thicknesses for both rigid and flexible pavements to be used on Residential "Local" and "Collector" streets. These standards were based on the assumption that materials and construction details for the pavements will meet certain minimum requirements.

Utilization of materials and construction details contained herein should prevent sacrifice of quality and performance of the pavement regardless of the pavement type selected. The proper requirements are to be provided for in the specifications to assure control of all materials and construction methods incorporated in the work. Strict attention shall be given to laboratory and field testing of materials and to providing adequate inspection of the construction to assure compliance with the specifications in regard to quality of the work.

2. Rigid Pavement

a. Portland Cement - Cements complying with the requirements of ASTM C-150 shall be used. Type II cement is preferred for street construction due to its greater uniformity but Type I cement can be used satisfactorily. Alkali content of the cements should be limited.

Type II cement shall be used, however when unavailable Type I cement may be used with the Engineer's written approval. Type III cement may be permitted with the Engineer's written approval.

b. Fine Aggregate - Fine aggregates used in the mix shall comply with ASTM C-33.

c. Coarse Aggregate - Coarse aggregates, 3/4 inch maximum size (ASTM Size No. 67) may be used in the mix to comply with ASTM C-33 with the following additional requirement: Absorption - Maximum of 3.5 percent.

d. Admixtures - This group of materials is defined as any ingredient other than portland cement, aggregate and water that is introduced into the concrete mixture to modify its properties and make the concrete more suitable for the work at

hand. Several of these materials can provide significant benefits and should be considered for street pavement construction.

Air entrainment is the formation of millions of very small, finely dispersed air bubbles within the fresh concrete. The presence of these bubbles, with proper size and spacing, provides the hardened concrete with greatly increased resistance to freeze-thaw action. Also the concrete is less susceptible to the corrosive attack by deicing chemicals. Air entrainment is provided by introducing into the mix an approved material complying with ASTM C-233. Neutralized vinsol-resin is widely used as an air-entraining agent.

Water Reducing Agents (WRA) are materials which, when introduced into the concrete mixture, reduce the amount of mixing water required to produce a given workability (slump). WRA may be of three types: (1) Water-Reducing; (2) Water-Reducing and Set-Retarding; and (3) Water-Reducing and Set-Accelerating. All types are covered by ASTM C-494 and materials may be used. Accelerators are materials which increase the rate of hardening and strength gain of the concrete. By far the most prevalently used accelerator is calcium chloride.

This material is normally added to the concrete mixture in solution with a portion of the mixing water. For concrete placement during periods of cold weather (temperatures below 45°F) the use of an accelerator can be beneficial. The hydration of portland cement is affected by temperature and does not occur at normal rates with temperatures of the mix below 50°F. Calcium chloride appears to act as a catalyst when added to the concrete under such conditions and in many cases allows the hydration of the cement to proceed at normal rates with lower air temperatures.

Retarders are materials which inhibit the initial hardening of the plastic concrete by slowing down the initial rate of hydration of the portland cement. Widely used retarders are sulfonated lignins, hydroxylated carboxylic acids, and hydroxylated polymers. The latter two types of retarders generally do not contain any calcium chloride. Use of retarders can be of significant benefit for street pavement construction during hot weather. Their use can frequently provide the time needed to properly finish the pavement surface before initial set of the concrete occurs.

e. Proportioning - The design standard assumed a Modulus of Rupture (MR) at 28 days of 550 psi. This will normally equate to a 28 day compressive strength of about 4000 psi. Minimum cement factor would be 6.5 bags per cubic yard and maximum water cement ratio of 5.5 gallons per bag. Maximum slump would be 3 inches. Concrete would be air-entrained with air content of 5 to 8 percent. Total aggregate in the concrete mixture to contain 30 to 60 percent material retained on the No. 4 screen.

f. Construction Details - The recommended design standard is based on plain or reinforced concrete without load-transfer dowels at transverse joints. If reinforcing steel is used it should be uniformly distributed across the pavement section. Spacing of transverse contraction joints should be based on the slab thickness and the amount (if any) of reinforcing provided. Expansion joints would be placed at intersections, structures, and significant changes in horizontal alignment. Joints would be sealed with Hot-Pour joint sealant. Curing of the finished slab for a minimum of 3 days by approved methods would be required.

3. Flexible Pavement

a. Asphalt Cement. For Flexible pavement Penetration Grades asphalt cement complying with AASHTO M 20 shall be used. A penetration grade of 60-70 is suggested; however, the penetration grades of 40-50 and 85-100 can be used successfully. Use of viscosity graded asphalt AC-10 or as determined by ASTM D-3381 shall be used when viscosity graded asphalt is preferred in lieu of penetration graded asphalt.

b. Asphaltic Mixtures. Aggregates and mixtures complying with the requirements of ASTM D 3515, Hot-Mixed, HotLaid Bituminous Paving Mixtures, with modifications for use of local materials to the extent feasible shall be used. This includes limitations on absorption and deleterious substances in the aggregates and the provision for Marshall stability requirements.

c. Construction Methods. The mixing, spreading and compaction of bituminous mixtures shall require a compaction of 95 percent of a voidless mixture of Marshall test densities.

It is necessary to have the course aggregate hard enough to minimize fracturing or breakdown under compaction or traffic. Therefore desirable the Los Angeles Abrasion Test Method for maximum wear of 40 percent and a sodium sulfate weighted loss of not more than 15 percent shall be specified.

Bituminous mixtures for base courses being designed by Marshall tests are to be used. The recommended Marshall requirements tested in accordance with ASTM D 1559 are:

Stability (Minimum)	1000 lbs.
Flow	0.08 to 0.16 inch
Percent voids in compacted sample	3 to 7
Percent voids filled with asphalt	70 minimum

With regard to surface course bituminous mixture, the BM-2 gradation provides better control for stability than does the SCI master gradation limits.

It is recommended that the specifications for the surface course include the Marshall requirements as follows:

Stability (Minimum)	1600 lbs
Flow	0.08 to 0.16 inch
Percent voids in Compacted Sample	3 to 5
Percent voids filled with asphalt	70 minimum

ORDINANCE NO. \_\_\_\_\_

AN ORDINANCE INCORPORATING BY REFERENCE THE REVISED EDITION OF THE DESIGN MANUAL FOR PAVEMENT THICKNESS FOR RESIDENTIAL STREETS WITHIN THE WICHITA METROPOLITAN AREA; AMENDING SECTION 1 OF ORDINANCE NO. 36-572 OF THE CITY OF WICHITA, KANSAS; AND REPEALING THE ORIGINAL OF SAID SECTION.

BE IT ORDAINED BY THE GOVERNING BODY OF THE CITY OF WICHITA, KANSAS.

SECTION 1. The revised Edition of the "Pavement Thickness Design Manual for Residential Streets Within the Wichita Metropolitan Area" August 1980 Edition, including appendices and design graphs attached thereto, and designated as the "Design Manual for Pavement Thickness for Residential Streets Within the Wichita Metropolitan Area", is by reference incorporated in and by this publication made a part of this ordinance as fully as though set forth at length herein, and is hereby adopted as the design, material and construction manual for residential streets of the City of Wichita, Kansas.

SECTION 2. The original of Section 1 of Ordinance No. 36-572 of the City of Wichita, Kansas be and the same is hereby repealed.

SECTION 3. That this ordinance shall take effect and be in force from and after its adoption and publication in the official City paper.

ADOPTED AT WICHITA, KANSAS, \_\_\_\_\_

ATTEST:

\_\_\_\_\_  
Mayor

\_\_\_\_\_  
City Clerk

(SEAL)

\_\_\_\_\_  
Approved as to form City Attorney

R E S O L U T I O N

A RESOLUTION ESTABLISHING DESIGN CRITERIA  
FOR URBAN RESIDENTIAL STREETS AND INSPECTION  
PROCEDURES THEREFOR.

NOW BE IT ORDAINED BY THE BOARD OF COMMISSIONERS OF SEDGWICK COUNTY, KANSAS, THAT:

SECTION 1. The revised addition of pavement thickness manual for residential streets within the Wichita metropolitan area on December 1980. Addition including appendices and design grafts attached thereto and designated as a "Design Manual for Pavement Thickness for Residential Streets Within the Wichita Metropolitan Area" is by reference incorporated in and by this publication made a part of this resolution as fully as those set forth at length herein, and is hereby adopted as the design material and construction manual for all urban residential streets in the unincorporated area of Sedgwick County, Kansas.

SECTION 2. That the original Section 1 of the above cited resolution be the same as hereby repealed.

SECTION 3. That this resolution shall take effect and be enforced from and after its adoption and publication in the official County paper.

PASSED AND ADOPTED by the Board of County Commissioners at Wichita, Kansas, this \_\_\_\_\_ day of \_\_\_\_\_, 19\_\_\_\_.

\_\_\_\_\_, Chairman  
Everett Patrick

\_\_\_\_\_, Commissioner  
Tom Scott

\_\_\_\_\_, Commissioner  
Donald E. Gragg

ATTEST:

\_\_\_\_\_  
Dorothy K. White, County Clerk

(SEAL)

Approved as to form by County Counselor

\_\_\_\_\_  
Theodore H. Hill, County Counselor

METROPOLITAN AREA PLANNING COMMISSION

AND

BOARD OF LAND USE ECONOMICS

Committee on  
Drainage and Streets

Monday, November 3, 1980  
MAPC Conference Room - 10th Floor  
City Hall - 455 North Main  
4:00 p.m.

AGENDA

1. Review of Revised Street Design Manual.
2. Status of Drainage Standard Draft.



SEDGWICK COUNTY COURTHOUSE

**COUNTY OF SEDGWICK**  
**DEPARTMENT OF PUBLIC WORKS**

1015 STILLWELL  
WICHITA, KANSAS 67213

PHONE 268-7901

JOE D. FREEMAN, P.E.  
ACTING COUNTY ENGINEER

DATE: October 30, 1980  
TO: Robert Lakin  
FROM: Joe D. Freeman *JDF*  
RE: Revisions to Paving Manual

**RECEIVED**

**OCT 31 1980**

**METROPOLITAN PLANNING**

ROUTE

Due to a previous commitment I will be unable to attend the Streets and Drainage Committee Meeting on November 3.

I have reviewed the proposed modifications to the paving manual and have the following comments:

1. The use of 95% ASTM D-698 as a alternative compaction criteria is a good idea. This will allow a greater flexibility on the part of the designer, the agency responsible for quality control as well as the contractor without lowering the quality or durability of the finished pavement.
2. I have a very serious objection to the lowering of the Marshall Stability requirements for asphalt surface course from 1800 lbs to 1600 lbs. As was addressed in L. E. Mullins Memo of August 11, 1980 the design curves for pavement thickness in the manual are based on a given stability of the base and surface courses. If that stability requirement is changed then the design curves are not correct. Lower stability requirement for either one or both courses would require an increased thickness in the paving section to maintain a given pavement strength. Increased rutting and shoving will occur when a lower stability for the surface course is used. This will increase future maintenance problems and costs. I fully agree with L. E. Mullins statement that it is not prudent to modify the stability requirements.
3. I have no objections or comments about the other proposed changes.

I would greatly appreciate the Committee being made aware of this Departments positions as I will be unable to attend and present our views.

WICHITA-SEDGWICK COUNTY

DATE

METROPOLITAN AREA PLANNING DEPARTMENT

October 28, 1980

TO Streets and Drainage Committee  
FROM Robert A. Lakin, Director of Planning  
SUBJECT Paving Manual

Sometime ago, we talked about revision necessary for the paving design manual. The City Director of Law was also concerned about the use of many "shoulds" used in the original design manuals as opposed to specific standards. I have revised the original manual and supplement to a single manual. It has been sent to Freund, Ritchie, Lackey and Mullins to comment on. Their comments are attached for your review. I have incorporated Lackey's and Freund's comments in the current draft.

Essentially the only changes I made were the ones on number of "marshalls" and the compaction curves. Other issues (sulfur, etc.) were to be studied by a subcommittee yet to be appointed.

Please review the revised manual and adopting regulations. After your review, they will be sent to the MAPC and governing bodies.



Robert A. Lakin  
Director of Planning

RAL:rme  
Attachments

DESIGN MANUAL  
FOR  
PAVEMENT THICKNESS  
FOR  
RESIDENTIAL STREETS  
WITHIN THE  
WICHITA METROPOLITAN AREA

August 1980

November

Draft 7/15/80

" 10/27/80

CONTENTS

	<u>Page</u>
FOREWORD	1
SECTION I PAVEMENT DESIGN PROCEDURES	
A. Soils Investigation	
1. General	3
2. Preliminary Soils Survey, Tests and Report	4
B. Traffic Consideration	6
C. Pavement Type and Thickness Selection	
1. Flexible Pavement	7
2. Rigid Pavement	12
SECTION II QUALITY CONTROL	
A. Pavement Subgrade	17
B. Pavement Materials and Construction Control	18
1. <i>General</i>	18
2. <i>Rigid Pavement</i>	19
3. <i>Flexible Pavement</i>	23
<u>Table Of Figures</u>	
<u>Fig.</u>	
1-1 Approximate Relationship of Soil Bearing Value	6
2-1 Design for Flexible Pavement	9
2-2 Local Residential Streets-Recommended Sections	10
2-3 Collector Residential Streets Recommended Sections	11
2-4 Design Graph for Rigid Pavement	14
2-5 Local Residential Streets-Recommended Sections	15
2-6 Collector Residential Streets-Recommended Sections	16

#### FOREWORD

The purpose of this Pavement Thickness Design Manual is to provide design criteria based on the findings and the recommendations of the report "Pavement Design and Feasibility Study for Residential Streets Within the Wichita Metropolitan Area", dated April 1979 (hereinafter referred to as the Paving Report) prepared by Professional Engineering Consultants Inc., Wichita, Ks.

During the preparation of the Paving Report, meetings were held with the City and County Departments of Public Works and it was determined that the criteria and methodology utilized in establishing pavement thicknesses was acceptable to both agencies. The report was accepted as meeting the requirements of the Consultant's engineering agreement, however the consultant was instructed to and did prepare a supplementary design manual based on the following conditions:

1. The 40-year pavement design life (minimum) as recommended by the Consultant in the Paving Report was satisfactory.
2. Additional preliminary testing of subgrade soils and additional project site inspection and testing above the present levels could be utilized for pavement design and control of construction materials.

3. More than a single pavement thickness standard was acceptable, but some limitation was preferred. This would permit the engineer greater latitude in the design process, which hopefully will provide the most economical section for a given location within the Study Area.

In this era of spiraling construction costs resulting in very high special assessments in newly developed areas, it is apparent that more engineering is necessary to conserve materials and energy, reduce construction costs, and to improve quality control. It is the engineer's responsibility to keep abreast of new techniques, products and equipment which will provide a cost effective facility for any required service and to provide proposals to the governing bodies for change to these criteria as good engineering practice dictate.

Therefore, the design engineer should be cautioned that the design and recommendations presented in this Manual are valid only for the local area residential streets and are not to be considered as permanent in regard to time.

SECTION I  
PAVEMENT DESIGN PROCEDURES

A. Soils Investigation

1. General -

It is determined that a subgrade support value having a CBR of 10 for design purposes could be attained without changing specifications or design procedures for residential streets of the City of Wichita existing prior to 3-11-80. This includes using 95% ASTM D-698 as the standard for compaction. A CBR of 20 can be expected if the compaction effort was increased in the specification to 90 percent of maximum dry density as determined by ASTM D-1557-70. To obtain CBR value greater than 10, 90% max dry density ASTM D-1557-70 shall be used.

It is recommended that CBR values of subgrade support greater than 20 should not be utilized for residential street design purposes. Therefore thickness less than five and one-half inches in thickness shall not be permitted. As higher CBR values are used, the possibilities

of having localized areas of deficient subgrade support increases and can result in not obtaining the design or service life of the pavement. The formulas do not take into consideration any loss of pavement strength due to weathering over the 40-year design life and the problems of frost penetration into the subgrade. For these reasons, the five and one-half inch thickness is considered as the minimum or bottom for 40-year design life.

2. Preliminary Soils Survey, Tests and Report -  
Field sampling and laboratory testing of soils for pavement subgrade shall be conducted by experienced personnel familiar with standard test procedures. Slight variations in testing procedures can have significant effect on the reliability of test results which could affect the pavement service life.

The personnel conducting the soils survey should have preliminary street plans and profiles so that the actual frequency of spacing and depths of soils borings can be determined in the field. The boring locations are discretionary and are to be adjusted to the size of the project and field observations of change in the soil types.

The number of tests to be conducted on the soil samples depends on the level of history and

documentation of soil classifications in the project area. A particle size analysis ASTM D-422-63, liquid limit ASTM D-423-66, and plastic limit ASTM D-424-59, is to be run to determine the general classification of each soil expected to be found in the subgrade.

For CBR value greater than 10, similar samples as determined by the above analysis should be combined and tests run to determine maximum dry density in accordance with ASTM D-1557-70 and CBR values as provided in ASTM D-1883-73 (96-hour soaked sample) for each soil type. Obvious clay soils shall be tested to establish the required lime content and the parent soil treated accordingly prior to conducting the density and CBR tests.

A summary or report of the soil survey shall be submitted to the design engineer so that a final determination can be made on the pavement thickness and subgrade stabilization required for the project. CBR values can be converted to approximate plate bearing values or modulus of subgrade reaction "k" by use of Table 1-1. However, verification of this table should be accomplished by conducting plate bearing tests on the final subgrade.

TABLE 1-1  
 APPROXIMATE RELATIONSHIP OF SOIL BEARING VALUES

RESISTANCE VALUE - R																				
	20		30		40		50		55		60									
MODULUS OF SUBGRADE REACTION - k psi per in.																				
	100		150		200		250		300		400		500	600	700	800				
CALIFORNIA BEARING RATIO - CBR																				
2	3	4	5	6	7	8	9	10		15	20	25	30	40	50	60	70	80	90	100

B. Traffic Consideration

A review of Section IV.A.2.c. and d. in the Pavement Design and Feasibility Study For Residential Streets April 1979, prepared by Professional Engineering Consultants, P.A. Engineer, is necessary for establishing the number of applications of equivalent 18-kip single axle loads for Local and Collector residential streets over the 40-year design life is established as 117,000 and 290,000 respectively for the two categories of residential streets. A line has been added and labeled at these points on the design graphs for rigid and flexible pavement as presented in this manual (Fig. 2-1 & 2-4).

Although it is possible these values are on the high side as an average for each category of residential street, some compensation for loss of serviceability due to weathering is provided in the thickness design. The formulas as provided in the AASHO Interim Guide and utilized in the design graphs are based on straight line dynamic loading repetitions for loss in serviceability without regard to losses for weathering of the pavement structure.

C. Pavement Type and Thickness Selection

1. Flexible Pavement -

From review of the design graphs for flexible and rigid pavement (Fig. 2-1 & 2-4), it is apparent that the flexible pavement thickness is much more susceptible to subgrade support than is the rigid pavement. This is to be expected since flexible pavement thickness is based on a component layer concept while rigid pavement is based on a concept of development of internal bending stresses within the pavement slab. Therefore, the design engineer is cautioned that variations in subgrade support for flexible pavement cannot be tolerated to the extent permitted for rigid pavement. Thus the preliminary soils investigation and job-site quality control should

both be more detailed where flexible pavements are proposed.

After receipt of the soils survey, the minimum CBR value to be used for pavement thickness is established. Utilizing the "Design Graph for Flexible Pavement" (Fig. 2-1), proceed vertically up the lines labeled for either Local or Collector residential street to the point of intercept with the given CBR value of subgrade support; then horizontally to the required thickness of asphalt pavement as shown in Figure 2-1. It is intended for the indicated thickness of flexible pavement to contain a two-inch surface course with the remainder as base course(s). Both surface and base course shall have the specified minimum Marshall stabilities noted in Figure 2-1.

For a Local residential street, a subgrade having a CBR of 10 requires 7 inches of asphalt pavement and a subgrade with a CBR of 20 requires 5-1/2 inches of asphalt pavement or a difference of 1-1/2 inches. It should normally be more feasible to modify the subgrade by stabilization or treatment to attain a CBR in the 10 to 20 range for residential streets as discussed previously in Paragraph A.1 of Section I than to use the considerably greater pavement thicknesses required for low CBR values.

DESIGN GRAPH FOR FLEXIBLE PAVEMENT ( $P_t = 2.0$ )

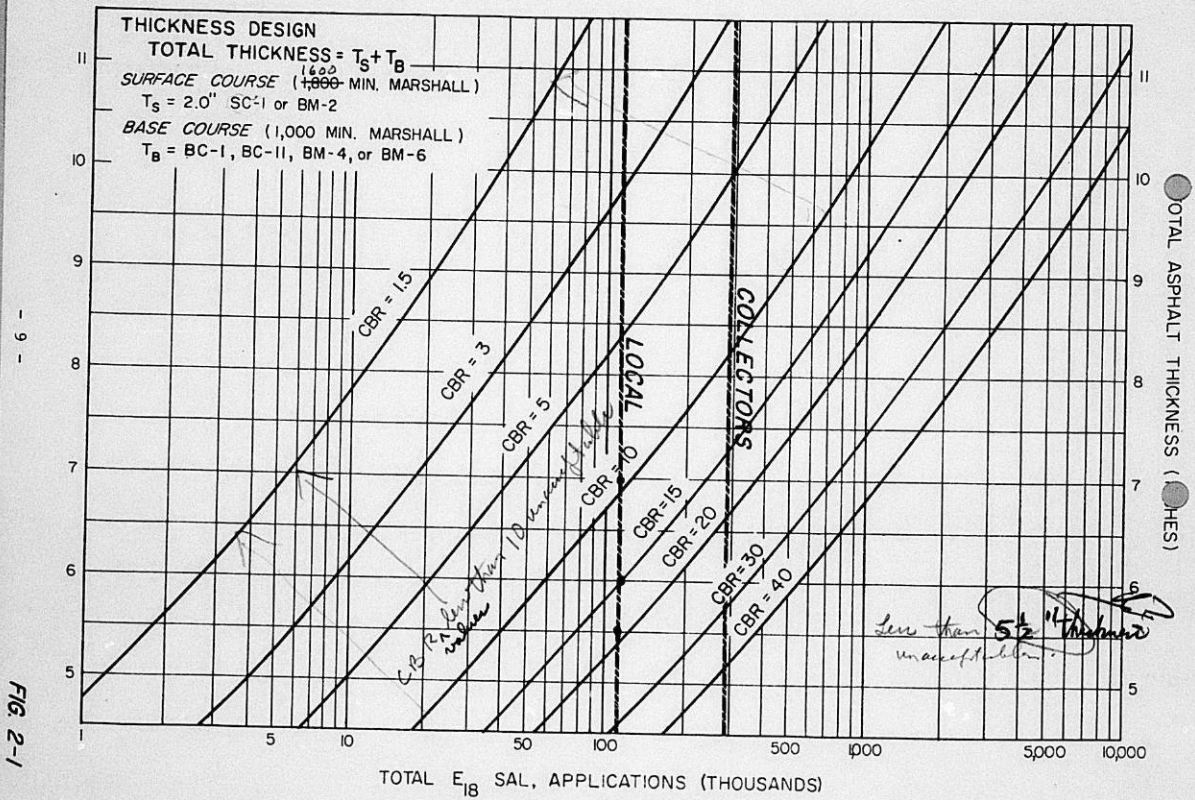
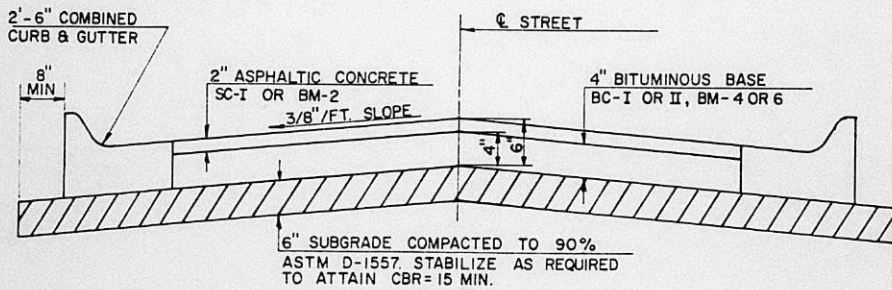
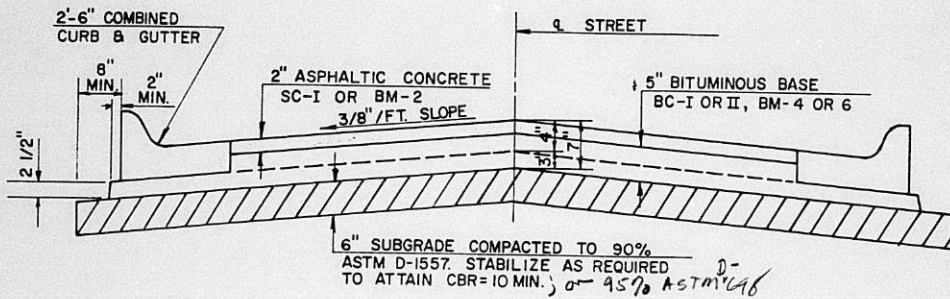


FIG. 2-1

LOCAL RESIDENTIAL STREETS  
RECOMMENDED SECTIONS

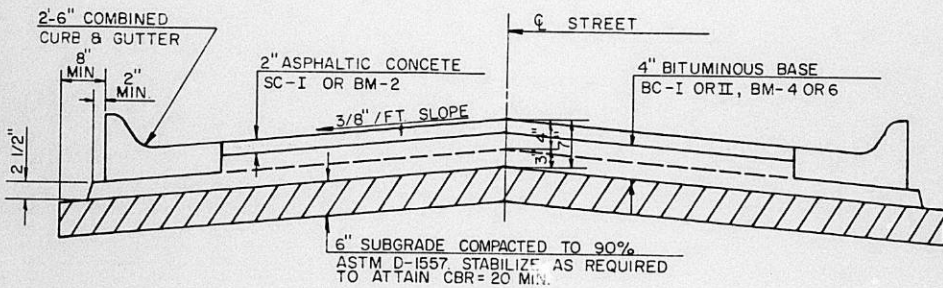
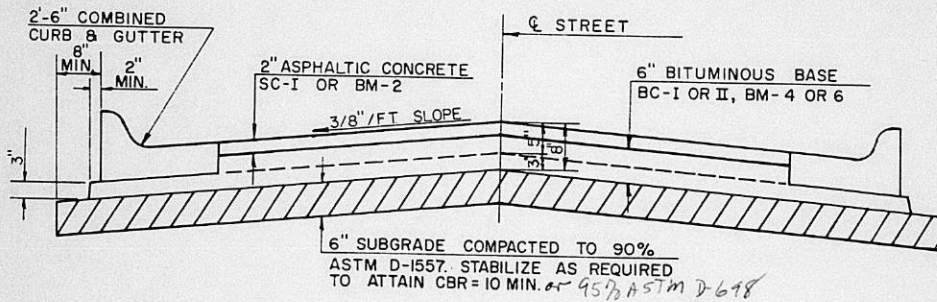


FLEXIBLE PAVEMENT

*Fig 2-2*

*FIG 2-2*

COLLECTOR RESIDENTIAL STREETS  
RECOMMENDED SECTIONS



FLEXIBLE PAVEMENT

Typical sections for Local and Collector residential streets are shown in Figures 2-2 and 2-3 respectively for flexible pavement. It should be noted that when the thickness of asphalt pavement drops below 7' the possibility of having a portion of bituminous base below the curb and gutter section ceases. It is acknowledged that placing the curb and gutter over bituminous base has many advantages; however, it should not be a condition for determining the pavement thickness.

2. Rigid Pavement -

From a review of the "Design Graph For Rigid Pavement" (Fig. 2-4), it can be seen that for a given application of equivalent 18-kip single axle loads the difference in pavement thickness amounts to approximately one inch over the whole range of subgrade support values; whereas for flexible pavement (Fig. 2-1), the difference in thickness is approximately five and one-half inches. This illustrates that rigid pavement is not as sensitive to subgrade support variations as is flexible pavement. However, rigid pavement is more prone to problems from shrink-swell conditions and frost heaving conditions within the subgrade.

After the minimum "k" value of subgrade support for the project is established, the concrete thickness can be determined by use of Design Graph for Rigid Pavement (Fig. 2-4). This is accomplished by proceeding up the vertical lines labeled either Local or Collector residential street to the point of intercept with the given "k" value of subgrade support; then horizontally to the required thickness of concrete pavement. The thickness should be rounded off to the nearest one-half inch increment.

As discussed in Paragraph A.1., it is normally more feasible or desirable to modify the subgrade by stabilization or treatment to attain a "k" value of 200 minimum. Typical sections for Local and Collector residential streets are shown in Figures 2-5 and 2-6 respectively, for rigid pavement.

DESIGN GRAPH FOR RIGID PAVEMENT ( $P_t = 2.0$ )  
NO LOAD TRANSFER

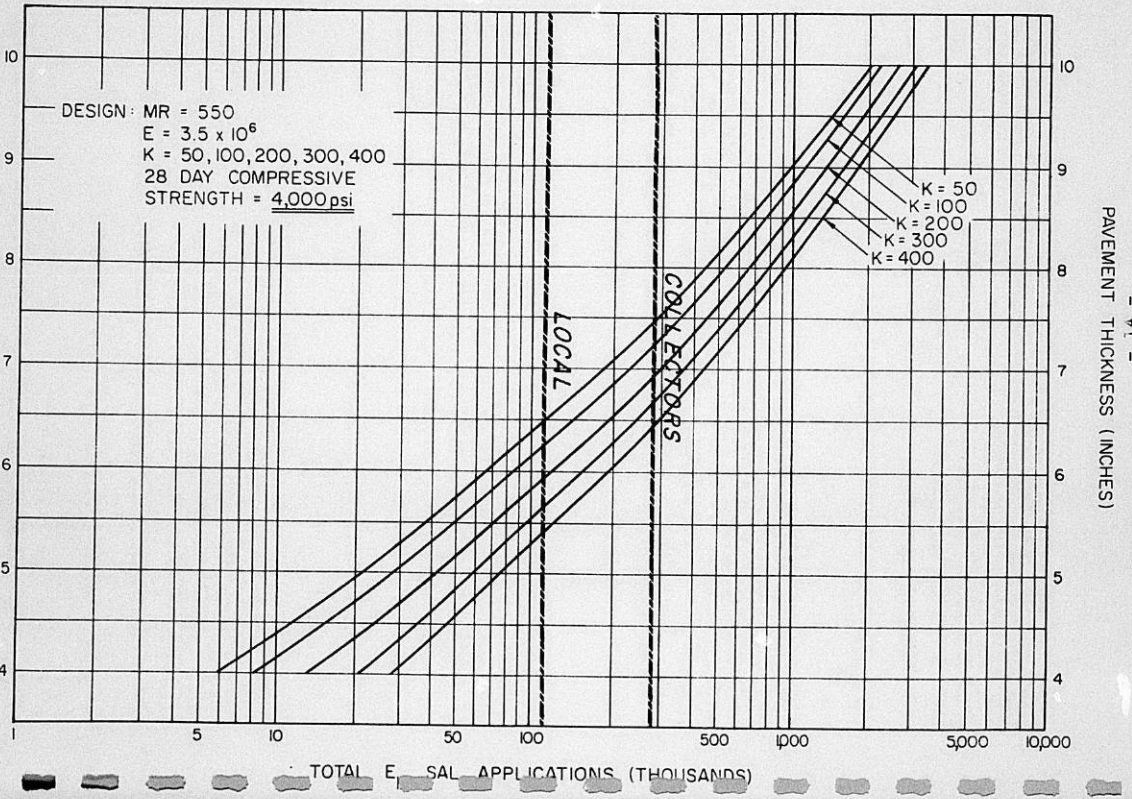


FIG. 2-4

LOCAL RESIDENTIAL STREETS  
RECOMMENDED SECTIONS

COMBINED CURB &  
GUTTER OR  
INTEGRAL CURB

6"  
MIN

CL STREET

6" PORTLAND CEMENT  
CONCRETE PAVEMENT

3/8" / FT. SLOPE



6" SUBGRADE COMPACTED TO 90%  
ASTM D-1557, STABILIZE AS REQUIRED  
TO ATTAIN K=200 PCI MIN.

or 4.5% ASTM D-698

COMBINED CURB &  
GUTTER OR  
INTEGRAL CURB

6"  
MIN

CL STREET

5 1/2" PORTLAND CEMENT  
CONCRETE PAVEMENT

3/8" / FT. SLOPE



6" SUBGRADE COMPACTED TO 90%  
ASTM D-1557, STABILIZE AS REQUIRED  
TO ATTAIN K=400 PCI MIN.

RIGID PAVEMENT

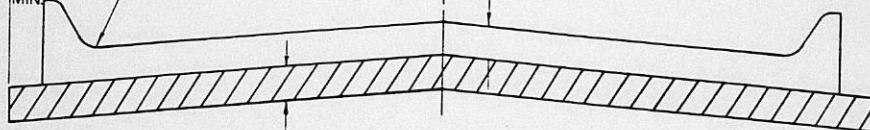
COLLECTOR RESIDENTIAL STREETS  
RECOMMENDED SECTIONS

COMBINED CURB &  
GUTTER OR  
INTEGRAL CURB

6"  
MIN.

CL STREET

7" PORTLAND CEMENT  
CONCRETE PAVEMENT



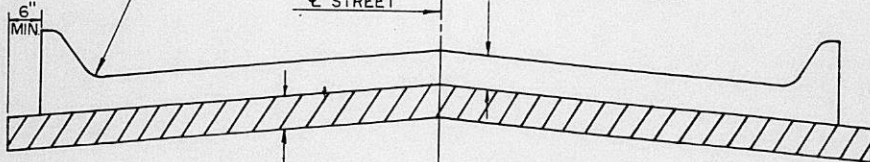
6" SUBGRADE COMPACTED TO 90%  
ASTM D-1557. STABILIZE AS REQUIRED  
TO ATTAIN  $K=200$  PCI MIN.  
or 95% ASTM D-68

COMBINED CURB &  
GUTTER OR  
INTEGRAL CURB

6"  
MIN.

CL STREET

6 1/2" PORTLAND CEMENT  
CONCRETE PAVEMENT



6" SUBGRADE COMPACTED TO 90%  
ASTM D-1557. STABILIZE AS REQUIRED  
TO ATTAIN  $K=400$  PCI MIN.

RIGID PAVEMENT

SECTION II  
QUALITY CONTROL

A. Pavement Subgrade

The project field representative shall be given a copy of the project Soils Report along with a set of plans and specifications. This should enable him to anticipate some problems that may be peculiar to the project site for obtaining specific densities and subgrade support values.

For a given soil or treated material, the CBR value or Modulus of Subgrade Reaction (k) is primarily a function of the degree of compaction. Soft areas or areas of undesirable subgrade soils, if present in the project site, will normally become apparent during the rolling or compaction process. It is therefore imperative for the project representative (inspector) to be present for full time observation of the compaction process. Unsuitable subgrade material shall be removed and replaced with suitable material as directed by the project representative. Density tests shall be conducted as determined necessary by the field engineer.

If lime treatment of the subgrade is required for the project, plasticity index tests shall be run on samples

taken from treated subgrade material on intervals selected by the field engineer.

B. Pavement Materials and Construction

1. General

Section I, Pavement Design, includes the standards for thicknesses for both rigid and flexible pavements to be used on Residential "Local" and "Collector" streets. These standards were based on the assumption that materials and construction details for the pavements will meet certain minimum requirements.

Utilization of materials and construction details contained herein should prevent sacrifice of quality and performance of the pavement regardless of the pavement type selected. The proper requirements are to be provided for in the specifications to assure control of all materials and construction methods incorporated in the work. Strict attention shall be given to laboratory and field testing of materials and to providing adequate inspection of the construction to assure compliance with the specifications in regard to quality of the work.

2. Rigid Pavement

a. Portland Cement - Cements complying with the requirements of ASTM C-150 shall be used. Type II cement is preferred for street construction due to its greater uniformity but Type I cement can be used satisfactorily. Alkali content of the cements should be limited.

Type II cement shall be used except ~~with~~ the use of Type I or Type III may be permitted with the Engineer's written approval.

b. Fine Aggregate - Fine aggregates used in the mix shall comply with ASTM C-33.

c. Coarse Aggregate - Coarse aggregates, 3/4 inch maximum size (ASTM Size No. 67) may be used in the mix to comply with ASTM C-33 with the following additional requirement: Absorption - Maximum of 3.5 percent.

d. Admixtures - This group of materials is defined as any ingredient other than portland cement, aggregate and water that is introduced into the concrete mixture to modify its properties and make the concrete more suitable for the work at

hand. Several of these materials can provide significant benefits and should be considered for street pavement construction.

Air entrainment is the formation of millions of very small, finely dispersed air bubbles within the fresh concrete. The presence of these bubbles, with proper size and spacing, provides the hardened concrete with greatly increased resistance to freeze-thaw action. Also the concrete is less susceptible to the corrosive attack by deicing chemicals. Air entrainment is provided by introducing into the mix an approved material complying with ASTM C-233. Neutralized vinsol-resin is widely used as an air-entraining agent.

Water Reducing Agents (WRA) are materials which, when introduced into the concrete mixture, reduce the amount of mixing water required to produce a given workability (slump). WRA may be of three types: (1) Water-Reducing; (2) Water-Reducing and Set-Retarding; and (3) Water-Reducing and Set-Accelerating. All types are covered by ASTM C-494 and materials may be used. Accelerators are materials which increase the rate of hardening and strength gain of the concrete. By far the most prevalently used accelerator is calcium chloride. This material is normally added to the concrete mixture in solution with a portion of the mixing

water. For concrete placement during periods of cold weather (temperatures below 45°F) the use of an accelerator can be beneficial. The hydration of portland cement is affected by temperature and does not occur at normal rates with temperatures of the mix below 50°F. Calcium chloride appears to act as a catalyst when added to the concrete under such conditions and in many cases allows the hydration of the cement to proceed at normal rates with lower air temperatures.

Retarders are materials which inhibit the initial hardening of the plastic concrete by slowing down the initial rate of hydration of the portland cement. Widely used retarders are sulfonated lignins, hydroxylated carboxylic acids, and hydroxylated polymers. The latter two types of retarders generally do not contain any calcium chloride. Use of retarders can be of significant benefit for street pavement construction during hot weather. Their use can frequently provide the time needed to properly finish the pavement surface before initial set of the concrete occurs.

e. Proportioning - The design standard assumed a Modulus of Rupture (MR) at 28 days of 550 psi. This will normally equate to a 28 day compressive strength of about 4000 psi. Minimum cement factor would be 6.5 bags per cubic yard and maximum water cement ratio of 5.5 gallons per bag. Maximum slump would be 3 inches. Concrete would be air-entrained with air content of 5 to 8 percent. Total aggregate in the concrete mixture to contain 30 to 60 percent material retained on the No. 4 screen.

f. Construction Details - The recommended design standard is based on plain or reinforced concrete without load-transfer dowels at transverse joints. If reinforcing steel is used it should be uniformly distributed across the pavement section. Spacing of transverse contraction joints should be based on the slab thickness and the amount (if any) of reinforcing provided. Expansion joints would be placed at intersections, structures, and significant changes in horizontal alignment. Joints would be sealed with Hot-Pour joint sealant. Curing of the finished slab for a minimum of 3 days by approved methods would be required.

3. Flexible Pavement

a. Asphalt Cement. For Flexible pavement Penetration Grades asphalt cement complying with AASHTO M 20 shall be used. A penetration grade of 60-70 is suggested; however, the penetration grades of 40-50 and 85-100 can be used successfully. *Use of viscosity graded asphalt AC-10 or 20 as determined by ASTM D-3381 shall be used when viscosity graded asphalt is ~~performed~~ prepared in lieu of penetration graded asphalt.*

b. Asphaltic Mixtures. Aggregates and mixtures complying with the requirements of ASTM D 3515, Hot-Mixed, HotLaid Bituminous Paving Mixtures, with modifications for use of local materials to the extent feasible shall be used. This includes limitations on absorption and deleterious substances in the aggregates and the provision for Marshall stability requirements.

c. Construction Methods. The mixing, spreading and compaction of bituminous mixtures shall require a compaction of 95 percent of a voidless mixture of Marshall test densities.

d. General. ~~Viscosity graded asphalt cement AC-10 or 20 as determined by ASTM D-3381 shall be used. However, it is recognized~~

that it would be difficult to administer this test or requirement without implementation of this requirement by the Kansas Department of Transportation. It is understood that KDOT now intends to conduct a small scale testing program in District No. 1 for utilization of viscosity graded asphalt cements.

<sup>COURSE</sup>  
It is necessary to have the aggregate hard enough to minimize fracturing or breakdown under compaction or traffic. Therefore desirable the Los Angeles Abrasion Test Method for maximum wear of 40 percent ~~including~~ <sup>AND</sup> a sodium sulfate weighted loss of not more than 15 percent ~~as is specified in ASTM D-1073 for fine aggregates~~ shall be specified.

An absorption limit of 4 percent on aggregates shall be specified. The use of fly ash as a mineral filler supplement may be permitted since in some cases it appears to be superior to both lime or stone quarry dust with regard to creep of flexible pavement.

Bituminous mixtures for base courses being designed by Marshall tests are to be used. The recommended Marshall requirements tested in accordance with ASTM D 1559 are:

Stability (Minimum)	1000 lbs.
Flow	0.08 to 0.16 inch
Percent voids in compacted sample	3 to 7
Percent voids filled with asphalt	70 minimum

With regard to surface course bituminous mixture, the BM-2 gradation provides better control for stability than does the SCI master gradation limits.

It is recommended that the specifications for the surface course include the Marshall requirements as follows:

Stability (Minimum)	1600 lbs
Flow	0.08 to 0.16 inch
Percent voids in Compacted Sample	3 to 5
Percent voids filled with asphalt	70 minimum

~~The master gradation limits for SC-I shall be changed so that the gradation median when plotted on the Federal Highway Administration 0.45 Power Gradation Chart approaches a straight line. This chart was developed from a modified Fuller equation for maximum density curves and is as follows:~~

$$p = 100 \left( \frac{d}{D} \right)^{.45}$$

in which

p = total percentage passing a given sieve

d = size of sieve opening

D = largest sieve size in gradation

A change in the gradation limits will permit the Engineer to design the job mix to more readily achieve the above Marshall limitations. This is desirable since the stability curve generally follows the density curve which reduces air voids in the surface course. However, a minimum of 3 percent voids is desirable due to flushing of asphalt under traffic. It is also necessary to maintain the minimum Flow so that the mix is not designed too dry to achieve stability.



SEDGWICK COUNTY COURTHOUSE

**COUNTY OF SEDGWICK**  
**DEPARTMENT OF PUBLIC WORKS**

1250 S. SENECA  
WICHITA, KANSAS 67213

PHONE 268-7901

LAWRENCE E. MULLINS  
DIRECTOR OF PUBLIC WORKS

TO: Robert A. Lakin, Director of Planning  
FROM: L. E. Mullins, Director of Public Works *LEM*  
DATE: August 11, 1980  
RE: Paving Design Manual

I have reviewed the proposed modifications to the paving design manual you forwarded to me on July 21, 1980. Two major modifications are proposed.

The first is to use either ASTM D-1557-70 or ASIM D-698 tests for determining the required soil compaction. We have no serious objections to this modification.

The second major change is to decrease the required Marshall stability of the asphalt surface course from 1800 lb. to 1600 lb. I strongly disagree with this proposition. A decrease in the Marshall stability will decrease the strength of the paving layer. We would emphasize that the pavement thickness curves are based on a given pavement strength and if a lower strength material is used, the curves contained in the report are no longer valid. I would also point out that a lower strength surface course will increase future maintenance problems due to shoving and rutting.

One asphalt plant operator had requested the lowering of the strength requirements as he stated he could not produce that material with his present set up. However, the other two asphalt plant operators stated they could meet the 1800 lb. requirement. I do not feel it is prudent to modify an accepted report to accommodate the wishes of one contractor.

**RECEIVED**

AUG 13 1980

METROPOLITAN PLANNING

ROUTE



RECEIVED

AUG 12 1980

METROPOLITAN PLANNING  
ROUTE

August 11, 1980

Mr. Robert A. Lakin  
Director of Planning  
Wichita-Sedgwick County  
Metropolitan Planning Department  
455 North Main  
Wichita, Kansas 67202

Re: The Paving Manual for Pavement Thickness  
for Residential Streets Within the Wichita  
Metropolitan Area - dated August, 1980.

Dear Mr. Lakin:

I have carefully reviewed the draft paving manual which was sent to me on July 21, 1980. There are three relatively minor concerns which I would like to bring to your attention. The first concern refers to the last sentence on page 5 which states "verification of the K-Value table should be accomplished by conducting plate bearing tests on the final subgrade". My concern is that this particular test and its result could inadvertently cause substantial delay and expense to a contractor should the results of the plate bearing test not be consistent with the initial design value. Hopefully a better approach would be to accomplish the plate bearing tests while the project was in the preliminary design stage. By accomplishing this test at the preliminary design stage, there should be substantially reduced risk of a project ever needing to be redesigned while it is under construction due to the K-Value selected for designing the pavement thickness being incorrect. The second concern has to do with the minimum pavement thickness. The last paragraph on page 3 and continued on page 4, indicates that the minimum thickness should be five and one-half inches. It is my feelings that the minimum thickness for asphalt streets should be 6". The reasoning is that which is listed in the paragraph concerning the possibility of having localized areas of deficient subgrade. In addition, we have reduced the required Marshal stability on the surface from 1800 lbs minimum to 1600 lbs minimum. I believe that the selection of a 6" thick minimum asphalt pavement thickness, in conjunction with these specifications, would reduce the risk of future pavement failures which are more likely to occur in a highly stressed design. In other words, I would feel substantially more comfortable guaranteeing the results with a 6" asphalt pavement than a 5½" pavement. The third area has to do with paragraph 2-A on page 19 - Portland Cement. I would like to point out that Type II cement, while it is superior to Type I, is both more expensive and often times more difficult to obtain. Generally Type I cement can be used, as the paragraph

Cont'd . . .

1900 AMIDON/P.O. BOX 4048/WICHITA, KANSAS 67204/(316) 838-9301

Mr. Robert A. Lakin

August 11, 1980

indicates, very satisfactorily. By specifying Type II cement with the option to get permission to use Type I cement, I think we are automatically building in some increase in cost. It would possibly be better to allow the use of Type II cement or Type I cement provided the Type I cement meets some additional specifications to guarantee it's quality and uniformity. I realize that this is a relatively minor consideration. However, it's quite possible that some savings could be incorporated by allowing use of either type of cement while at the same time not sacrificing any substantial quality.

I have no additional comments concerning the balance of the report and believe that we can successfully build projects using this design. I am perfectly willing to participate in additional discussions on this matter in the future if necessary.

Very truly yours,

*Tom Ritchie*

Tom Ritchie

TR:lb  
copy: Charles Freund  
Professional Engineering  
Consultants  
1440 E. English St.  
Wichita, Kansas

**THE CITY OF WICHITA**

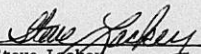
OFFICE OF PUBLIC WORKS ENGINEERING      DATE August 1, 1980

TO Robert A. Lakin, Director of Planning

FROM Steve Lackey, Design Chief Engineer

SUBJECT Paving Manual Specifications

I've reviewed Charlie's comments, and I basically agree; however, I believe paragraph "C" should remain, the second paragraph on page 24 should include "shall be specified", and the third paragraph on page 24 should be eliminated as per Charlie Freund's remarks. My reasoning for eliminating said paragraph is the uncertainty of using fly ash as a mineral filler. I wouldn't want to imply we would use fly ash and then find out later that it would be unworkable. Through further discussions and analysis this might become an option, but I don't feel we, as the City of Wichita, are prepared for its implementation.

  
Steve Lackey  
Design Chief Engineer

SL:md

Attachment

**RECEIVED**

AUG 1 1980

METROPOLITAN PLANNING

ROUTE  \_\_\_\_\_  
 \_\_\_\_\_

C. Frounc

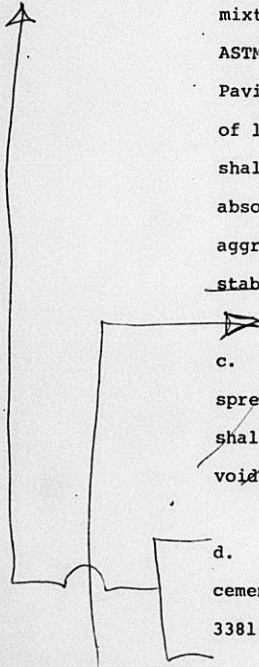
3. Flexible Pavement

*Use of viscosity graded asphalt cement AC-10 or 20 as determined by ASTM D-3381 shall be used when viscosity graded asphalt is preferred in lieu of penetration graded asphalt.*

a. Asphalt Cement. For Flexible pavement Penetration Grades asphalt cement complying with AASHTO M 20 shall be used. A penetration grade of 60-70 is suggested; however, the penetration grades of 40-50 and 85-100 can be

used successfully.

b. Asphaltic Mixtures. Aggregates and mixtures complying with the requirements of ASTM D 3515, Hot-Mixed, HotLaid Bituminous Paving Mixtures, with modifications for use of local materials to the extent feasible shall be used. This includes limitations on absorption <sup>of 4 percent or less</sup> and deleterious substances in the aggregates, ~~and the provision for Marshall stability requirements as follows:~~



~~c. Construction Methods. The mixing, spreading and compaction of bituminous mixtures shall require a compaction of 95 percent of a voidless mixture of Marshall test densities.~~

~~d. General. Viscosity graded asphalt cement AC-10 or 20 as determined by ASTM D-3381 shall be used. However, it is recognized~~

that it would be difficult to administer this test or requirement without implementation of this requirement by the Kansas Department of Transportation. It is understood that KDOT now intends to conduct a small scale testing program in District No. 1 for utilization of viscosity graded asphalt cements.

Move to b.

It is necessary to have the <sup>course</sup> aggregate hard enough to minimize fracturing or breakdown under compaction or traffic. Therefore, ~~desirable~~ the Los Angeles Abrasion Test Method for maximum wear of 40 percent <sup>and</sup> including a sodium sulfate weighted loss of not more than 15 percent ~~as specified in ASTM D-1073 for fine aggregates shall be specified.~~ shall be specified.

An absorption limit of 4 percent on aggregates shall be specified. The use of fly ash as a mineral filler supplement may be permitted since in some cases it appears to be superior to both lime or stone quarry dust with regard to creep of flexible pavement. — P

Bituminous mixtures for base courses being designed by Marshall tests are to be used. The recommended Marshall requirements tested in accordance with ASTM D 1559 are:

Stability (Minimum) 1000 lbs.  
Flow 0.08 to 0.16 inch  
Percent voids in compacted sample 3 to 7  
Percent voids filled with asphalt 70 minimum

With regard to surface course bituminous mixture, the BM-2 gradation provides better control for stability than does the SCI master gradation limits.

It is recommended that the specifications for the surface course include the Marshall requirements as follows:

Stability (Minimum) 1600 lbs  
Flow 0.08 to 0.16 inch  
Percent voids in Compacted Sample 3 to 5  
Percent voids filled with asphalt 70 minimum

~~The master gradation limits for SC-I shall be changed so that the gradation median when plotted on the Federal Highway Administration 0.45 Power Gradation Chart approaches a straight line. This chart was developed from a modified Fuller equation for maximum density curves and is as follows:~~

$$p = 100 \left( \frac{d}{D} \right)^{.45}$$

in which

p = total percentage passing a given sieve

d = size of sieve opening

D = largest sieve size in gradation

A change in the gradation limits will permit the Engineer to design the job mix to more readily achieve the above Marshall limitations. This is desirable since the stability curve generally follows the density curve which reduces air voids in the surface course. However, a minimum of 3 percent voids is desirable due to flushing of asphalt under traffic. It is also necessary to maintain the minimum flow so that the mix is not designed too dry to achieve stability.

THE CITY OF WICHITA

OFFICE OF DEPARTMENT OF LAW

DATE July 31, 1980

TO ROBERT LAKIN, DIRECTOR OF PLANNING

FROM H. R. KUHN, ASSISTANT CITY ATTORNEY

SUBJECT Paving Manual

I am enclosing herewith the proposed Amendatory ordinance relating to the paving manual -- both in delineated form as well as in the proposed final form.

I do not think what you included in your "Section 2" of your proposed ordinance would be properly included in the proposed ordinance. Any amendments subsequently made to the design manual would have to be incorporated by reference in a new ordinance such as we are doing with Section 1.

If I can be of further assistance, please advise.

Respectfully submitted,



H. R. KUHN  
ASSISTANT CITY ATTORNEY

HRK:mb  
Enclosure  
cc: John Dekker

**RECEIVED**

AUG 1 1980

METROPOLITAN PLANNING

ROUTE

ORDINANCE NO. \_\_\_\_\_

AN ORDINANCE INCORPORATING BY REFERENCE THE REVISED EDITION OF THE DESIGN MANUAL FOR PAVEMENT THICKNESS FOR RESIDENTIAL STREETS WITHIN THE WICHITA METROPOLITAN AREA; AMENDING SECTION 1 OF ORDINANCE NO. 36-572 OF THE CITY OF WICHITA, KANSAS; AND REPEALING THE ORIGINAL OF SAID SECTION.

BE IT ORDAINED BY THE GOVERNING BODY OF THE CITY OF WICHITA, KANSAS.

SECTION 1. That Section 1 of Ordinance No. 36-572 of the City of Wichita, Kansas, be and hereby is amended to read as follows:

~~SECTION 1. The "Supplementary Pavement Thickness Design Manual for Residential Streets Within the Wichita Metropolitan Area", published by Professional Engineering Consultants, P.A., October 1979 Edition, including the appendices and design graphs attached thereto, is by reference incorporated in and by this publication made a part of this ordinance as fully as though set forth at length herein, and is hereby adopted as the design, material and construction manual for residential streets of the City of Wichita, Kansas.~~

SECTION 1. The revised Edition of the "Pavement Thickness Design Manual for Residential Streets Within the Wichita Metropolitan Area" August 1980 Edition, including appendices and design graphs attached thereto, and designated as the "Design Manual for Pavement Thickness for Residential Streets Within the Wichita Metropolitan Area", is by reference incorporated in and by this publication made a part of this ordinance as fully as though set forth at length herein, and is hereby adopted as the design, material and construction manual for residential streets of the City of Wichita, Kansas.

SECTION 2. The original of Section 1 of Ordinance No. 36-572 of the City of Wichita, Kansas be and the same is hereby repealed.

SECTION 3. That this ordinance shall take effect and be in force from and after its adoption and publication in the official City paper.

ADOPTED AT WICHITA, KANSAS, \_\_\_\_\_

ATTEST:

\_\_\_\_\_  
Mayor

\_\_\_\_\_  
City Clerk

(SEAL)

\_\_\_\_\_  
Approved as to form City Attorney

ORDINANCE NO. \_\_\_\_\_

AN ORDINANCE INCORPORATING BY REFERENCE THE REVISED EDITION OF THE DESIGN MANUAL FOR PAVEMENT THICKNESS FOR RESIDENTIAL STREETS WITHIN THE WICHITA METROPOLITAN AREA; AMENDING SECTION 1 OF ORDINANCE NO. 36-572 OF THE CITY OF WICHITA, KANSAS; AND REPEALING THE ORIGINAL OF SAID SECTION.

BE IT ORDAINED BY THE GOVERNING BODY OF THE CITY OF WICHITA, KANSAS.

SECTION 1. The revised Edition of the "Pavement Thickness Design Manual for Residential Streets Within the Wichita Metropolitan Area" August 1980 Edition, including appendices and design graphs attached thereto, and designated as the "Design Manual for Pavement Thickness for Residential Streets Within the Wichita Metropolitan Area", is by reference incorporated in and by this publication made a part of this ordinance as fully as though set forth at length herein, and is hereby adopted as the design, material and construction manual for residential streets of the City of Wichita, Kansas.

SECTION 2. The original of Section 1 of Ordinance No. 36-572 of the City of Wichita, Kansas be and the same is hereby repealed.

SECTION 3. That this ordinance shall take effect and be in force from and after its adoption and publication in the official City paper.

ADOPTED AT WICHITA, KANSAS, \_\_\_\_\_

ATTEST:

\_\_\_\_\_  
Mayor

\_\_\_\_\_  
City Clerk

(SEAL)

\_\_\_\_\_  
Approved as to form City Attorney

ORDINANCE No. \_\_\_\_\_

AN ORDINANCE AMENDING SECTION 1 OF ORDINANCE NO. 36-572 REGULATING THE CONSTRUCTION OF RESIDENTIAL STREETS WITHIN THE CITY OF WICHITA, KANSAS; ESTABLISHING CRITERIA AS TO PAVEMENT THICKNESS AND DESIGN, MATERIAL AND CONSTRUCTION AND REPEALING SAID SECTION 1 OF ORDINANCE NO. 36-572.

BE IS ORDAINED BY THE GOVERNING BODY OF THE CITY OF WICHITA, KANSAS:

SECTION 1. Amend Section 1 of Ordinance No. 36-572 to read as follows:

"The Design Manual for Pavement Thickness for Residential <sup>Within the Wichita Metropolitan Area</sup> Streets for Residential Areas, August 1980, is by reference incorporated in and by this publication made a part of this ordinance as fully as though set forth at length herein, and is hereby adopted as the design and material manual for all urban residential streets of the City of Wichita, Kansas".

SECTION 2. In order to provide for new developments in regard to materials and construction practices, provision is hereby made to supplement and add to the material standards contained in Section II B of the design manual. Any changes certified by the City Engineer shall be submitted to the City Commission to be approved and filed as a City Clerk agenda item and shall be filed with the City Clerk in the same manner as the original design manual.

SECTION 3. Section 1 of Ordinance No. 36-572 is hereby repealed.

SECTION 4. That this ordinance shall take effect and be in force from and after its adoption and publication in the official City paper.

ADOPTED at Wichita, Kansas, this \_\_\_\_\_ day of \_\_\_\_\_, 1980.

\_\_\_\_\_  
Mayor

ATTEST:

\_\_\_\_\_  
Donald Giswick, City Clerk

Approved as to form:

\_\_\_\_\_  
John Dekker, Director of Law

**THE CITY OF WICHITA**

OFFICE OF Public Works Engineering

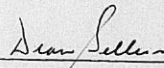
DATE July 29, 1980

**TO** Robert A. Lakin, Director of Planning

**FROM** Dean Sellers, Acting City Engineer

**SUBJECT** Paving Manual

Steve Lackey reviewed the revised design manual you prepared. It is okay.

  
\_\_\_\_\_  
Dean Sellers  
Acting City Engineer

DS:ck

**RECEIVED**

JUL 30 1980

METROPOLITAN PLANNING

ROUTE  \_\_\_\_\_  
 \_\_\_\_\_

DESIGN MANUAL  
 FOR  
 PAVEMENT THICKNESS  
 FOR  
 RESIDENTIAL STREETS  
 WITHIN THE  
 WICHITA METROPOLITAN AREA

*prepared by MAPD*

August 1980

*Draft 7/15/80*

WICHITA-SEDGWICK COUNTY  
METROPOLITAN AREA PLANNING DEPARTMENT

MAPC HEARING DATE: 7-3-80

Case No. Z-2258

Request: "AA" to "R-6"

Location: Northwest corner of Elm and Hoover

Reason: The property is approximately 250' deep which would waste a lot of ground with single-family houses facing Hoover. Multiple-family development would act as an excellent buffer against I-235 in that apartments would face Hoover with parking being next to I-235.

Acres: 2.86

Size: 232' x 462' (irregular shape)

	<u>Land Use</u>	<u>Zoning</u>
Existing	Single-family & undeveloped	"AA"
North	Single-family	"AA"
East	Single-family	"AA"
South	Single-family	"AA"
West	I-235 Highway	----

Necessary street right-of-way to be acquired at the time of platting.

Platted: No

History: None

COMMENTS:

1. The following items should be considered by the Planning Commission in making findings of fact:

The applicant is requesting a change of zoning from the "AA" Single-family District to the "R-6" General Residence District for an unplatted tract of land containing approximately 2.86 acres and occupied in part by a single-family residence.

Subject property is on an unimproved collector street (Hoover) and lies one block north of a major street (Central). Properties to the north, south and east are developed with single-family residences, west is I-235 Highway.

The requested "R-6" district permits 29 dwelling units per acre which would allow the construction of approximately

27

CONTENTS

	<u>Page</u>
FOREWORD	1
SECTION I <i>Q</i> PAVEMENT DESIGN PROCEDURES	
A. Soils Investigation	
1. General	3
2. Preliminary Soils Survey, Tests and Report	4
B. Traffic Consideration	6
C. Pavement Type and Thickness Selection	
1. Flexible Pavement	7
2. Rigid Pavement	12
SECTION II <i>Q</i> QUALITY CONTROL	
A. Pavement Subgrade	17
B. Pavement Materials and Construction	18
<i>Control</i>	
1. General	
2. Rigid Pavement	
3. <i>asphalt</i> Flexible Pavement	
<u>Table Of Figures</u>	
<u>Fig.</u>	
1-1 Approximate Relationship of Soil Bearing Value	6
2-1 Design <i>Graph</i> for Flexible Pavement	9
2-2 Local Residential Streets-Recommended Sections	10
2-3 Collector Residential Streets Recommended Sections	11
2-4 Design Graph for Rigid Pavement	14
2-5 Local Residential Streets-Recommended Sections	15
2-6 Collector Residential Streets-Recommended Sections	16

*Graph*

Page 2  
Z-2253  
MAPC AGENDA  
7-3-90

72 dwelling units to be constructed on the site. The "R-5" district permits 17.4 dwelling units per acre which would permit approximately 49 dwelling units to be constructed.

A recommendation of approval of a change of zoning should be subject to platting within one year from the date of approval by the Board of City Commissioners or the case be considered denied and closed; and that the ordinance establishing the zone change not be published until the plat has been recorded with the Register of Deeds.

52

FOREWORD

The purpose of this Pavement Thickness Design Manual is to provide design criteria based on the findings and the recommendations of the report "Pavement Design and Feasibility Study for Residential Streets Within the Wichita Metropolitan Area", dated April 1979 (hereinafter referred to as the Paving Report) prepared by Professional Engineering Consultants Inc., Wichita, Ks.

During the preparation of the Paving Report, meetings were held with the City and County Departments of Public Works and it was determined that the criteria and methodology utilized in establishing pavement thicknesses was acceptable to both agencies. The report was accepted as meeting the requirements of the Consultant's engineering agreement, however the consultant was instructed to <sup>and did</sup> prepare a supplementary design manual based on the following conditions:

1. The 40-year pavement design life (minimum) as recommended by the Consultant in the Paving Report was satisfactory.
2. Additional preliminary testing of subgrade soils and additional project site inspection and testing above the present levels could be utilized for pavement design and control of construction materials.

Page 2  
Z-2253  
MAPC AGENDA  
7-3-90

72 dwelling units to be constructed on the site. The "R-5" district permits 17.4 dwelling units per acre which would permit approximately 49 dwelling units to be constructed.

A recommendation of approval of a change of zoning should be subject to platting within one year from the date of approval by the Board of City Commissioners or the case be considered denied and closed; and that the ordinance establishing the zone change not be published until the plat has been recorded with the Register of Deeds.

- 3. More than a single pavement thickness standard was acceptable, but some limitation was preferred. This would permit the engineer greater latitude in the design process, which hopefully will provide the most economical section for a given location within the Study Area.

In this era of spiraling construction costs resulting in very high special assessments in newly developed areas, it is apparent that more engineering is necessary to conserve materials and energy, reduce construction costs, and to improve quality control. It is the engineer's responsibility to keep abreast of new techniques, products and equipment which will provide a cost effective facility for any required service and to provide proposals to the governing bodies for change to these criteria as good engineering practice dictate.

Therefore, the design engineer should be cautioned that the design and recommendations presented in this Manual are valid only for the local area residential streets and are not to be considered as permanent in regard to time.

Page 2  
Z-2253  
MAPC AGENDA  
7-3-30

72 dwelling units to be constructed on the site. The "R-5" district permits 17.4 dwelling units per acre which would permit approximately 49 dwelling units to be constructed.

A recommendation of approval of a change of zoning should be subject to platting within one year from the date of approval by the Board of City Commissioners or the case be considered denied and closed; and that the ordinance establishing the zone change not be published until the plat has been recorded with the Register of Deeds.

SECTION I  
PAVEMENT DESIGN PROCEDURES

A. Soils Investigation

1. General -

It is determined that a subgrade support value having a CBR of 10 for design purposes could be attained without changing specifications or design procedures for residential streets of the City of Wichita existing prior to 3-11-80. This includes using 95% ~~testing~~ <sup>ASTM D-698</sup> as the standard for compaction. A CBR <sup>R</sup> of 20 can be expected if the compaction effort was increased in the specification to 90 percent of maximum dry density as determined by ASTM D-1557-70, ~~which is proposed herein~~. To obtain CBR value greater than 10, 90% <sup>dry</sup> ~~max~~ density ASTM D-1557-70 shall be used.

It is recommended that CBR values of subgrade support greater than 20 should not be utilized for residential street design purposes. Therefore <sup>minimum</sup> thickness less than five and one-half inches in thickness shall not be permitted. As higher CBR values are used, the possibilities

Page 2  
Z-2253  
MAPC AGENDA  
7-3-90

72 dwelling units to be constructed on the site. The "R-5" district permits 17.4 dwelling units per acre which would permit approximately 49 dwelling units to be constructed.

A recommendation of approval of a change of zoning should be subject to platting within one year from the date of approval by the Board of City Commissioners or the case be considered denied and closed; and that the ordinance establishing the zone change not be published until the plat has been recorded with the Register of Deeds.

15

of having localized areas of deficient subgrade support increases and can result in not obtaining the design or service life of the pavement. The formulas do not take into consideration any loss of pavement strength due to weathering over the 40-year design life and the problems of frost penetration into the subgrade. For these reasons, the five and one-half inch thickness is considered as the minimum or bottom for 40-year design life.

2. Preliminary Soils Survey, Tests and Report -  
Field sampling and laboratory testing of soils for pavement subgrade shall be conducted by experienced personnel familiar with standard test procedures. Slight variations in testing procedures can have significant effect on the reliability of test results which could affect the pavement service life.

The personnel conducting the soils survey should have preliminary street plans and profiles so that the actual frequency of spacing and depths of soils borings can be determined in the field. The boring locations are discretionary and are to be adjusted to the size of the project and field observations of change in the soil types.

The number of tests to be conducted on the soil samples depends on the level of history and

4

Page 6  
MPC AGENDA  
7-17-80

15. Case No. DR 80-12

Request: Special permit to establish a non-discharging  
facultative wastewater treatment lagoon

Location: 1/2 mile south of 53rd Street North and lying west  
of I-135 Highway.

-----

16. DR 80-14 - Request by City Commission to consider changes to  
the zoning ordinance regarding taverns.

-----

17. Other Matters

Robert A. Lakin  
Secretary

41

documentation of soil classifications in the project area. A particle size analysis ASTM D-422-63, liquid limit ASTM D-423-66, and plastic limit ASTM D-424-59, is to be run to determine the general classification of each soil expected to be found in the subgrade.

For CBR value greater than 10, similar samples as determined by the above analysis should be combined and tests run to determine maximum dry density in accordance with ASTM D-1557-70 and CBR values as provided in ASTM D-1883-73 (96-hour soaked sample) for each soil type. Obvious clay soils shall be tested to establish the required lime content and the parent soil treated accordingly prior to conducting the density and CBR tests.

A summary or report of the soil survey shall be submitted to the design engineer so that a final determination can be made on the pavement thickness and subgrade stabilization required for the project. CBR values can be converted to approximate plate bearing values or modulus of subgrade reaction "k" by use of Table 1-1. However, verification of this table should be accomplished by conducting plate bearing tests on the final subgrade.

5

Page 6  
MAPC AGENDA  
7-17-80

15. Case No. DR 80-12

Request: Special permit to establish a non-discharging  
facultative wastewater treatment lagoon

Location: 1/2 mile south of 53rd Street North and lying west  
of I-135 Highway.

-----

16. DR 80-14 - Request by City Commission to consider changes to  
the zoning ordinance regarding taverns.

-----

17. Other Matters

Robert A. Lakin  
Secretary

TABLE 1-1

APPROXIMATE RELATIONSHIP OF SOIL BEARING VALUES

B. Traffic Consideration

A review of Section IV.A.2.c. and d. in the Pavement Design and Feasibility Study For Residential Streets April 1979, prepared by Professional Engineering Consultants, P.A. Engineer, is necessary for establishing the number of applications of equivalent 18-kip single axle loads for Local and Collector residential streets over the 40-year design life is established as 117,000 and 290,000 respectively for the two categories of residential streets. A line has been added and labeled at these points on the design graphs for rigid and flexible pavement as presented in this manual (Fig. 2-1 & 2-4).

*Should this be 2 sentences?*

- C. The final plat tracing shall indicate a 20-foot building setback from the east line of the contingent street dedication. The applicant is hereby advised that no expansion of the existing structure within this setback will be allowed.
  - D. The applicant or his engineer shall meet with City Engineering regarding the possible need to establish an access easement for the shared opening to the north.
  - E. Recording of the plat within 30 days after approval by the Board of City Commissioners.
- 

ZONING:

- 11. Case No. Z-2261  
Request: "R-5" to "BB"  
Location: East side of Tyler Road, in an area north of Bekemeyer.  
-----
- 12. Case No. Z-2262  
Request: "R-5" to "BB"  
Location: East side of Tyler Road, in an area between Bekemeyer and Ninth.  
-----
- 13. Case No. Z-2263  
Request: "AA" to "A"  
Location: North side of Pawnee, in an area between Rock and Webb Roads.  
-----
- 14. Case No. Z-2264  
Request: "BB" to "LC"  
Location: Northwest corner of Meridian and Esthner.  
-----

Although it is possible these values are on the high side as an average for each category of residential street, some compensation for loss of serviceability due to weathering is provided in the thickness design. The formulas as provided in the AASHO Interim Guide and utilized in the design graphs are based on straight line dynamic loading repetitions for loss in serviceability without regard to losses for weathering of the pavement structure.

C. Pavement Type and Thickness Selection

1. Flexible Pavement -

From review of the design graphs for flexible and rigid pavement (Fig. 2-1 & 2-4), it is apparent that the flexible pavement thickness is much more susceptible to subgrade support than is the rigid pavement. This is to be expected since flexible pavement thickness is based on a component layer concept while rigid pavement is based on a concept of development of internal bending stresses within the pavement slab. Therefore, the design engineer is cautioned that variations in subgrade support for flexible pavement cannot be tolerated to the extent permitted for rigid pavement. Thus the preliminary soils investigation and job-site quality control should

- C. The final plat tracing shall indicate a 20-foot building setback from the east line of the contingent street dedication. The applicant is hereby advised that no expansion of the existing structure within this setback will be allowed.
- D. The applicant or his engineer shall meet with City Engineering regarding the possible need to establish an access easement for the shared opening to the north.
- E. Recording of the plat within 30 days after approval by the Board of City Commissioners.

-----  
ZONING:

- 11. Case No. Z-2261  
Request: "R-5" to "BB"  
Location: East side of Tyler Road, in an area north of Bekemeyer.  
-----
- 12. Case No. Z-2262  
Request: "R-5" to "BB"  
Location: East side of Tyler Road, in an area between Bekemeyer and Ninth.  
-----
- 13. Case No. Z-2263  
Request: "AA" to "A"  
Location: North side of Pawnee, in an area between Rock and Webb Roads.  
-----
- 14. Case No. Z-2264  
Request: "BB" to "LC"  
Location: Northwest corner of Meridian and Esthner.  
-----

both be more detailed where flexible pavements are proposed.

After receipt of the soils survey, the minimum CBR value to be used for pavement thickness is established. Utilizing the "Design Graph for Flexible Pavement" (Fig. 2-1), proceed vertically up the lines labeled for either Local or Collector residential street to the point of intercept with the given CBR value of subgrade support; then horizontally to the required thickness of asphalt pavement as shown in Figure 2-1. It is intended for the indicated thickness of flexible pavement to contain a two-inch surface course with the remainder as base course(s). Both surface and base course shall have the specified minimum Marshall stabilities noted in Figure 2-1.

For a Local residential street, a subgrade having a CBR of 10 requires 7 inches of asphalt pavement and a subgrade with a CBR of 20 requires 5-1/2 inches of asphalt pavement or a difference of 1-1/2 inches. It should normally be more feasible to modify the subgrade by stabilization or treatment to attain a CBR in the 10 to 20 range for residential streets as discussed previously in Paragraph A.1 of Section I than to use the considerably greater pavement thicknesses required for low CBR values.

- 
8. S/D 90-45 - Final plat of Caliendo 5th Addition, generally located on the east side of Hillside in an area south of Gilbert Street.

Engineer: Baughman Company  
Acreage: 0.30  
Number of lots: 1

SUBDIVISION COMMITTEE RECOMMENDATION: JULY 10, 1980:

That this plat be approved subject to:

- A. The final plat tracing shall indicate a 20-foot building setback from the new property line adjacent to Hillside. The applicant is hereby advised that no expansion of the existing structure within this setback will be allowed.
- B. The access control on the final plat tracing shall be revised to indicate "access control except for one opening".
- C. Recording of the plat within 30 days after approval by the Board of City Commissioners.

- 
9. S/D 80-28 Final plat of the Second Addition to Cedar Ridge, (formerly named 6th Addition to Cherry Creek Hills), generally located at the northwest corner of Mt. Vernon and Webb Road.

Engineer: Baughman Company  
Acreage: 32.7+  
Number of lots: 128

SUBDIVISION COMMITTEE RECOMMENDATION: JULY 10, 1980:

That this plat be approved subject to:

- A. The applicant shall obtain from the adjacent property owner to the south the dedication of the balance of right-of-way for Mt. Vernon.
- B. The applicant shall guarantee the paving of all streets being platted, including Mt. Vernon but excluding Webb Road.
- C. The applicant shall guarantee construction of sidewalks along both sides of the collector streets (Cypress and Mt. Vernon/Longford).
- D. The applicant shall guarantee construction of storm sewers to drain all streets.

taken from treated subgrade material on intervals selected by the field engineer.

~~SECTION III~~

~~B~~ PAVEMENT MATERIALS AND CONSTRUCTION ~~CONTROL~~

A 1. General

Section I, Pavement Design, includes the standards for thicknesses for both rigid and flexible pavements to be used on Residential "Local" and "Collector" streets. These standards were based on the assumption that materials and construction details for the pavements will meet certain minimum requirements.

Utilization of materials and construction details contained herein should prevent sacrifice of quality and performance of the pavement regardless of the pavement type selected. The proper requirements are to be provided for in the specifications to assure control of all materials and construction methods incorporated in the work. Strict attention shall be given to laboratory and field testing of materials and to providing adequate inspection of the construction to assure compliance with the specifications in regard to quality of the work.

2. Rigid Pavement

2. Portland Cement - Cements complying with the requirements of ASTM C-150 shall be used. Type II cement is preferred for street construction due to its greater uniformity but Type I cement can be used satisfactorily. Alkali content of the cements should be limited.

~~Current City specifications specify Type I portland cement with the use of Type II permitted when authorized in writing by the Engineer. The Specifications also limit the "Total Alkali" content of the cement. Type II cement shall be used except with the use of Type I or Type III may be permitted with the Engineer's written approval.~~

b. Fine Aggregate - Fine aggregates used in the mix shall comply with ASTM C-33.

c. Coarse Aggregate - Coarse aggregates, 3/4 inch maximum size (ASTM Size No. 67), may be used in the mix to comply with ASTM C-33 with the following additional requirement: Absorption - Maximum of 3.5 percent.

d. Admixtures - This group of materials is defined as any ingredient other than portland cement, aggregate and water that is introduced into the concrete mixture to modify its properties and make the concrete more suitable

94

for the work at hand. Several of these materials can provide significant benefits and should be considered for street pavement construction.

Air entrainment is the formation of millions of very small, finely dispersed air bubbles within the fresh concrete. The presence of these bubbles, with proper size and spacing, provides the hardened concrete with greatly increased resistance to freeze-thaw action. Also the concrete is less susceptible to the corrosive attack by de-icing chemicals. Air entrainment is provided by introducing into the mix an approved material complying with ASTM C-233. Neutralized vinsol-resin is widely used as an air-entraining agent.

Water Reducing Agents (WRA) are materials which, when introduced into the concrete mixture, reduce the amount of mixing water required to produce a given workability (slump). WRA may be of three types: (1) Water-Reducing; (2) Water-Reducing and Set-Retarding; and (3) Water-Reducing and Set-Accelerating. All types are covered by ASTM C-494 and materials may be used. Accelerators are materials which increase the rate of hardening and strength gain of the concrete. By far the most prevalent used accelerator is calcium chloride. This material is normally added to the concrete mixture in

//

solution with a portion of the mixing water. For concrete placement during periods of cold weather (temperatures below 45°F) the use of an accelerator can be beneficial. The hydration of portland cement is affected by temperature and does not occur at normal rates with temperatures of the mix below 50°F. Calcium chloride appears to act as a catalyst when added to the concrete under such conditions and in many cases allows the hydration of the cement to proceed at normal rates with lower air temperatures.

Retarders are materials which inhibit the initial hardening of the plastic concrete by slowing down the initial rate of hydration of the portland cement. Widely used retarders are sulfonated lignins, hydroxylated <sup>carboxylic</sup> carboxylic acids, and hydroxylated polymers. The latter two types of retarders generally do not contain any calcium chloride. Use of retarders can be of significant benefit for street pavement construction during hot weather. Their use can frequently provide the time needed to properly finish the pavement surface before initial set of the concrete occurs.

Proportioning - The design standard assumed a Modulus of Rupture ( $M_R$ ) at 28 days of 550 psi. This will normally equate to a 28 day compressive strength of about 4000 psi. Minimum cement factor would be 6.5

bags per cubic yard and maximum water cement ratio of 5.5 gallons per bag. Maximum slump would be 3 inches. Concrete would be air-entrained with air content of 5 to 8 percent. Total aggregate in the concrete mixture to contain 30 to 60 percent material retained on the No. 4 screen.

f. Construction Details - The recommended design standard is based on plain or reinforced concrete without load-transfer dowels at transverse joints. If reinforcing steel is used it should be uniformly distributed across the pavement section. Spacing of transverse contraction joints should be based on the slab thickness and the amount (if any) of reinforcing provided. Expansion joints would be placed at intersections, structures, and significant changes in horizontal alignment. Joints would be sealed with Hot-Pour joint sealant. Curing of the finished slab for a minimum of 3 days by approved methods would be required.

g. Flexible Pavement

g. Asphalt Cement. For Flexible pavement Penetration Graded asphalt cement complying with AASHTO M 20 shall be used. A penetration grade of 60-70 is suggested; however, the penetration grades of 40-50 and 85-100 can be used successfully.

b 2. Asphaltic Mixtures. Aggregates and mixtures complying with the requirements of ASTM D 3515, Hot-Mixed, Hot-Laid Bituminous Paving Mixtures, with modifications for use of local materials to the extent feasible shall be used. This includes limitations on absorption and deleterious substances in the aggregates and the provision for Marshall stability requirements.

c 3. Construction Methods. The mixing, spreading and compaction of bituminous mixtures shall require a compaction of 95 percent of a voidless mixture of Marshall test densities.

d 4. General. ~~It appears desirable to have better control of asphalt cement grades being used in bituminous mixtures than the present penetration grade of 60-70 (AC-3), as established in ASTM D 946. It is recommended that consideration be given to using the Viscosity graded asphalt cement AC-10 or 20 as determined by ASTM D-3381 shall be~~  
<sup>used.</sup> However, it is recognized that it would be difficult to administer this test or requirement without implementation of this requirement by the Kansas Department of Transportation. It is understood that KDOT now intends to conduct a small scale testing program in District No. 1 for utilization of viscosity graded asphalt cements.

It is necessary to have the aggregate hard enough to minimize fracturing or breakdown under compaction or traffic. Therefore desirable the Los Angeles Abrasion Text Method for maximum wear of 40 percent including a sodium sulfate weighted loss of not more than 15 percent as is specified in ASTM D-1073 for fine aggregates shall be specified.

An absorption limit of 4 percent on aggregates shall be specified. The use of fly ash as a mineral filler supplement may be permitted since in some cases it appears to be superior to both lime or stone quarry dust with regard to creep of flexible pavement.

Bituminous mixtures for base courses being designed by Marshall tests are to be used. The recommended Marshall requirements tested in accordance with ASTM D 1559 are:

Stability (Minimum)	1000 lbs.
Flow	0.08 to 0.16 inch
Percent voids in compacted sample	3 to 7
Percent voids filled with asphalt	70 minimum

With regard to surface course bituminous mixture, the BM-2 gradation provides better control for stability than does the SC-I master gradation limits.

It is recommended that the specifications for the surface course include the Marshall requirements as follows:

Stability (Minimum)	1600 lbs
Flow	0.08 to 0.16 inch
Percent voids in Compacted Sample	3 to 5
Percent voids filled with asphalt	70 minimum

The master gradation limits for SC-I shall be changed so that the gradation median when plotted on the Federal Highway Administration 0.45 Power Gradation Chart approaches a straight line. This chart was developed from a modified Fuller equation for maximum density curves and is as follows:

$$p = 100 \left( \frac{d}{D} \right)^{.45}$$

in which

- p = total percentage passing a given sieve
- d = size of sieve opening
- D = largest sieve size in gradation

A change in the gradation limits will permit the Engineer to design the job mix to more readily achieve the above Marshall limitations. This is desirable since the stability curve generally follows the density curve which reduces air voids in the surface course. However, a minimum of 3 percent voids is desirable due to flushing

of asphalt under traffic. It is also necessary to  
maintain the minimum flow so that the mix is not designed  
too dry to achieve stability.

SUPPLEMENTARY PAVEMENT THICKNESS  
DESIGN MANUAL  
FOR  
RESIDENTIAL STREETS  
WITHIN THE  
WICHITA METROPOLITAN AREA

~~Prepared for the  
CITY OF WICHITA, KANSAS  
and  
SEDGWICK COUNTY, KANSAS~~

~~Prepared By  
PROFESSIONAL ENGINEERING CONSULTANTS, P. A.  
ENGINEERS~~

~~October 1979~~

~~August 1980~~



*Draft  
2 up  
Set up for final  
w/1 upline.  
Draft 5 copies*

CONTENTS

	<u>Page</u>
FOREWORD	i
SECTION I - PAVEMENT DESIGN PROCEDURES	1
A.    Soils Investigation	1
1.    General	1
2.    Preliminary Soils Survey, Tests and Report	2
B.    Traffic Consideration	3
C.    Pavement Type and Thickness Selection	4
1.    Flexible Pavement	4
2.    Rigid Pavement	6
SECTION II - QUALITY CONTROL	8
A.    Pavement Subgrade	8
B.    Pavement Materials and Construction Control	9

*Rec'd  
numbers  
on general draft*

Table Of Figures

<u>Fig.</u>	
1-1	<i>Approximate Relation of Soil Bearing Values</i>
2-1	Design Graph for Flexible Pavement
2-2	Local Residential Streets-Recommended Sections
2-3	Collector Residential Streets Recommended Sections
2-4	Design Graph for Rigid Pavement
2-5	Local Residential Streets-Recommended Sections
2-6	Collector Residential Streets- Recommended Sections

## FOREWORD

The purpose of this Supplementary Pavement Thickness Design Manual is to *provide design criteria based on summarize* the findings and the recommendations of the report "Pavement Design and Feasibility Study for Residential Streets Within the Wichita Metropolitan Area", dated April 1979 (hereinafter referred to as the Paving Report) *Proposed by*

*Profession of Engineering Consultants Inc., Wichita Ks.*

During the preparation of the Paving Report, meetings were held with the City and County Departments of Public Works and it was determined that the criteria and methodology utilized in establishing pavement thicknesses was acceptable to both agencies. The report was accepted as meeting the requirements of the Consultant's engineering agreement, *however* but the recommended pavement section or standard for each type of pavement and category of residential street was not formally adopted.

This status quo remained until a joint meeting between the City, the County and the Consultant was held on September 19, 1979. At this meeting, areas of agreement or compromise were explored in order to reach a solution acceptable to both parties. The Consultant was instructed to prepare a supplementary design manual based on the following conditions:

1. The 40-year pavement design life (minimum) as recommended by the Consultant in the Paving Report was satisfactory.

2. Additional preliminary testing of subgrade soils and additional project site inspection and testing above the present levels could be utilized for pavement design and control of construction materials.
3. More than a single pavement thickness standard was acceptable, but some limitation was preferred. This would permit the engineer greater latitude in the design process, which hopefully will provide the most economical section for a given location within the Study Area.

In this era of spiraling construction costs resulting in very high special assessments in newly developed areas, it is apparent that more engineering is necessary to conserve materials and energy, reduce construction costs, and to improve quality control. It is the engineer's responsibility to keep abreast of new techniques, products and equipment which will provide a cost effective facility for any required service *and to provide proposals to the governing bodies to these criteria as good engineering practice dictate.*

Therefore, the design engineer should be cautioned that the design and recommendations presented in ~~the Paving Report~~ and this Manual are valid only for the local area residential streets and are not to be considered as permanent in regard to time.

SECTION I  
PAVEMENT DESIGN PROCEDURES

A. Soils Investigation

1. General -

Review of Section III - Soils and Section IV.A.1. in the Paving Report is recommended to obtain suggested subgrade support values within the Study Area. It was <sup>is</sup> determined that a subgrade support value having a CBR of 10 for design purposes could be attained without changing current specifications or design procedures for residential streets. It was also established that a CBR of 20 <sup>can</sup> be expected if the compaction effort was increased in the specification to 90 percent of maximum dry density as determined by ASTM

D-1557-70, which is proposed herein. *To obtain CBR values greater than 10, 90% max dry density ASTM D-1557-70 shall be used.*

It is recommended that CBR values of subgrade support greater than 20 should not be utilized for residential street design purposes. <sup>Therefore</sup> ~~This is especially critical as the pavement thickness approaches a five and one-half inch minimum.~~ <sup>As higher CBR values are used, the possibilities of having localized areas of deficient subgrade support increases and can result in not obtaining the design or service life of the pavement.</sup> ~~As higher CBR values are used, the possibilities of having localized areas of deficient subgrade support increases and can result in not obtaining the design or service life of the pavement.~~ In addition, as discussed in the Paving Report, ~~the~~ formulas

*\* prior to 3-11-80, This includes using 98% ASTM 648 as the standard for compaction.*

do not take into consideration any loss of pavement strength due to weathering over the 40-year design life and the problems of frost penetration into the subgrade. For these reasons, the five and one-half inch thickness ~~should~~<sup>is</sup> be considered as the minimum or bottom for 40-year design life, ~~until more experience~~  
~~in performance of these thinner sections is obtained.~~

2. Preliminary Soils Survey, Tests and Report -

Field sampling and laboratory testing of soils for pavement subgrade ~~should~~<sup>shall</sup> be conducted by experienced personnel familiar with standard test procedures. Slight variations in testing procedures can have significant effect on the reliability of test results which could affect the pavement service life.

The personnel conducting the soils survey should have preliminary street plans and profiles so that the actual frequency of spacing and depths of soils borings can be determined in the field. The boring locations ~~should~~<sup>are</sup> be discretionary and ~~can~~<sup>are to</sup> be adjusted to the size of the project and field observations of change in the soil types.

The number of tests to be conducted on the soil samples depends on the level of history and documentation of soil classifications in the project area. A particle size analysis ASTM D-422-63, liquid limit ASTM D-423-66, and plastic limit ASTM D-424-59,

*into*

should be run to determine the general classification of each soil expected to be found in the subgrade.

*For CBR values greater than 10,*

Similar samples as determined by the above analysis should be combined and tests run to determine maximum dry density in accordance with ASTM D-1557-70 and CBR values <sup>greater than 10</sup> as provided in ASTM D-1883-73 (96-hour soaked sample) for each soil type. ~~ASTM D-1557-70~~ <sup>shall</sup> Obvious clay soils should be tested to establish the required lime content and the parent soil treated accordingly prior to conducting the density and CBR tests.

A summary or report of the soil survey <sup>shall</sup> should be submitted to the design engineer so that a final determination can be made on the pavement thickness and subgrade stabilization required for the project. CBR values can be converted to approximate plate bearing values or modulus of subgrade reaction "k" by use of Table ~~4-1~~ <sup>1-1</sup> in the Paving Report. However, verification of this table should be accomplished by conducting plate bearing tests on the final subgrade.

TABLE 1-1

APPROXIMATE RELATIONSHIP OF SOIL BEARING VALUES

*add:*

*Table*

B. Traffic Consideration

A review of Section IV.A.2.c. and d. in the <sup>Prepared by</sup> Paving Report is necessary for establishing the number of applications of equivalent 18-kip single axle loads for Local and Collector residential streets

\* *Pavement Design & Feasibility Study for Residential Streets*  
*April 1974, Prepared by Professional Engineering Consultants P.A. Engineers*

*is established*  
over the 40-year design life. This number was determined as 117,000 and 290,000 respectively for the two categories of residential streets. A line has been added and labeled at these points on the design graphs for rigid and flexible pavement as presented in this manual (Fig. 2-1 & 2-4).

*Although*  
✓ It is possible these values are on the high side as an average for each category of residential street, but as noted in the Paving Report, some compensation for loss of serviceability due to weathering should be provided in the thickness design. The formulas as provided in the AASHO Interim Guide and utilized in the design graphs are based on straight line dynamic loading repetitions for loss in serviceability without regard to losses for weathering of the pavement structure.

C. Pavement Type and Thickness Selection

1. Flexible Pavement -

From review of the design graphs for flexible and rigid pavement (Fig. 2-1 & 2-4), it is apparent that the flexible pavement thickness is much more susceptible to subgrade support than is the rigid pavement. This is to be expected since flexible pavement thickness is based on a component layer concept while rigid pavement is based on a concept of development of internal bending stresses within the pavement slab. Therefore, the

design engineer is cautioned that variations in subgrade support for flexible pavement cannot be tolerated to the extent permitted for rigid pavement. Thus the preliminary soils investigation and job-site quality control should both be more detailed where flexible pavements are proposed.

After receipt of the soils survey, the minimum CBR value to be used for pavement thickness is established. Utilizing the "Design Graph for Flexible Pavement" (Fig. 2-1), proceed vertically up the lines labeled for either Local or Collector residential street to the point of intercept with the given CBR value of subgrade support; then horizontally to the required thickness of asphalt pavement as shown in Figure 2-1. It is intended for the indicated thickness of flexible pavement to contain a two-inch surface course with the remainder as base course(s). Both surface and base course shall have the specified minimum Marshall stabilities noted in Figure 2-1.

For a Local residential street, a subgrade having a CBR of 10 requires 7 inches of asphalt pavement and a subgrade with a CBR of 20 requires 5-1/2 inches of asphalt pavement or a difference of 1-1/2 inches. It should normally be more feasible to modify the subgrade by stabilization or treatment to attain a CBR in the 10 to 20 range for residential streets as discussed previously in Paragraph A.1. <sup>Section I</sup> than to use the considerably greater pavement thicknesses required for low CBR values.

Typical sections for Local and Collector residential streets are shown in Figures 2-2 and 2-3 respectively for flexible pavement. It should be noted that when the thickness of asphalt pavement drops below 7" the possibility of having a portion of bituminous base below the curb and gutter section ceases. It is acknowledged that placing the curb and gutter over bituminous base has many advantages; however, it should not be a condition for determining the pavement thickness.

2. Rigid Pavement -

From a review of the "Design Graph For Rigid Pavement" (Fig. 2-4), it can be seen that for a given application of equivalent 18-kip single axle loads the difference in pavement thickness amounts to approximately one inch over the whole range of subgrade support values; whereas for flexible pavement (Fig. 2-1), the difference in thickness is approximately five and one-half inches. This illustrates that rigid pavement is not as sensitive to subgrade support variations as is flexible pavement. However, rigid pavement is more prone to problems from shrink-swell conditions and frost heaving conditions within the subgrade.

After the minimum "k" value of subgrade support for the project is established, the concrete thickness can be determined by use of Design Graph for Rigid Pavement (Fig. 2-4). This is accomplished by proceeding up the vertical lines labeled either

Local or Collector residential street to the point of intercept with the given "k" value of subgrade support; then horizontally to the required thickness of concrete pavement. The thickness should be rounded off to the nearest one-half inch increment.

As discussed in Paragraph A.1., it is normally more feasible or desirable to modify the subgrade by stabilization or treatment to attain a "k" value of 200 minimum. Typical sections for Local and Collector residential streets are shown in Figures 2-5 and 2-6 respectively, for rigid pavement.

SECTION II  
QUALITY CONTROL

A. Pavement Subgrade

The project field representative <sup>shall</sup> be given a copy of the project Soils Report along with a set of plans and specifications. This should enable him to anticipate some problems that may be peculiar to the project site for obtaining specific densities and subgrade support values.

For a given soil or treated material, the CBR value or Modulus of Subgrade Reaction (k) is primarily a function of the degree of compaction. Soft areas or areas of undesirable subgrade soils, if present in the project site, will normally become apparent during the rolling or compaction process. It is therefore imperative for the project representative (inspector) to be present for full time observation of the compaction process. Unsuitable subgrade material <sup>shall</sup> be removed and replaced with suitable material as directed by the project representative. Density tests <sup>shall be conducted as determined</sup> ~~should be conducted every station (100 feet)~~ along the roadway in addition to every suspected problem area and where ~~trenching for utilities was accomplished~~. For flexible pavement, the spacing for density tests should be decreased to fifty feet or less for reasons previously discussed.

*necessary by the field engineer.*

If lime treatment of the subgrade is required for the project, plasticity index tests <sup>shall</sup> be run on samples taken from treated subgrade material on intervals of 250 to 300 feet.

SECTION ~~VII~~<sup>B</sup> - PAVEMENT MATERIALS AND CONSTRUCTION

A. GENERAL

Section ~~IV~~<sup>II</sup>, Pavement Design Procedures, <sup>includes</sup> presented the ~~recommended~~<sup>range of permitted</sup> thicknesses <sup>standards for</sup> for both rigid and flexible pavements to be used on Residential "Local" and "Collector" streets. These ~~recommendations~~<sup>standards</sup> were based on the assumption that materials and construction details for the pavements <sup>would</sup> meet certain minimum requirements.

Utilization of materials and construction details <sup>contained herein</sup> as ~~discussed in~~ Section ~~VII~~ should prevent sacrifice of quality and performance of the pavement regardless of the pavement type selected. The proper requirements <sup>can</sup> be provided for in the specifications to assure control of all materials and construction methods incorporated in the work.

It is therefore ~~highly recommended that~~ <sup>shall</sup> strict attention be given to laboratory and field testing of materials and to providing adequate inspection of the construction to assure compliance with the specifications in regard to quality of the work.

B. RIGID PAVEMENT

1. Portland Cement - The recommended design assumed that <sup>shall</sup> Cements complying with the requirements of ASTM C-150 ~~would~~ be used. Type II cement is preferred for street construction due to its greater uniformity but Type I cement can be used satisfactorily. Alkali content of the cements should be limited.

Current City specifications specify Type I portland cement with the use of Type II permitted when authorized in writing by the Engineer. The Specifications also limit the "Total Alkali" content of the cement.

*shall be used except*  
Current County specifications call for Type II cement with the  
*the* use of Type I or Type III, *maybe* permitted with the Engineer's written approval.

Both agencies require cement to meet ASTM C-150.

2. Fine Aggregate - The recommended design assumed Fine  
aggregates used in the mix *shall* would comply with ASTM C-33.

Current City and County specifications both comply with ASTM C-33. City gradation requirements however do not require the same amounts of material passing the No. 50 and No. 100 screens as recommended by ASTM.

3. Coarse Aggregate - The recommended design assumed 3/4 inch  
maximum size (ASTM Size No. 67) *max size* coarse aggregates *used* in the  
mix *will* comply with ASTM C33 and *with* the following additional requirements:

Absorption - Maximum of 3.5 percent ,

Current City specifications call for 1 1/2 inch maximum size (ASTM Size No. 467) coarse aggregate complying with ASTM C33 except as follows.

Abrasion - Maximum loss of 40 percent

Absorption - Maximum of 5.0 percent

Soundness - Maximum loss 15 percent with magnesium sulphate

Current County specifications call for 3/4 inch maximum size material complying with ASTM C-33 except as follows.

Abrasion - Maximum loss of 40 percent

Absorption - Maximum of 4 percent

4. Admixtures - This group of materials is defined as any ingredient other than portland cement, aggregate and water that is introduced into the concrete mixture to modify its properties and make the concrete more suitable for the work at hand. Several of these materials can provide significant benefits and should be considered for street pavement construction.

Air entrainment is the formation of millions of very small, finely dispersed air bubbles within the fresh concrete. The presence of these bubbles, with proper size and spacing, provides the hardened concrete with greatly increased resistance to freeze-thaw action. Also the concrete is less susceptible to the corrosive attack by de-icing chemicals. Air entrainment is provided by introducing into the mix an approved material complying with ASTM C-233. Neutralized vinsol-resin is widely used as an air-entraining agent.

Water Reducing Agents (WRA) are materials which, when introduced into the concrete mixture, reduce the amount of mixing water required to produce a given workability (slump). WRA may be of three types: (1) Water-Reducing; (2) Water-Reducing and Set-Retarding; and (3) Water-Reducing and Set-Accelerating. All types are covered by ASTM C-494 and materials <sup>may be</sup> used should comply with those requirements.

Accelerators are materials which increase the rate of hardening and strength gain of the concrete. By far the most prevalent used accelerator is calcium chloride. This material is normally added to the concrete mixture in solution with a portion of the mixing water. For concrete placement during periods of cold weather (temperatures below 45°F) the use of an accelerator can be beneficial. The hydration of portland cement is affected by temperature and does not occur at normal rates with temperatures of the mix below 50°F. Calcium chloride appears to act as a catalyst when added to the concrete under such conditions and in many cases allows the hydration of the cement to proceed at normal rates with lower air temperatures.

Retarders are materials which inhibit the initial hardening of the plastic concrete by slowing down the initial rate of hydration of the portland cement. Widely used retarders are sulfonated lignins, hydroxylated carboxylic acids, and hydroxylated polymers. The latter two types of retarders generally do not contain any calcium chloride. Use of retarders can be of significant benefit for street pavement construction during hot weather. Their use can frequently provide the time needed to properly finish the pavement surface before initial set of the concrete occurs.

5. Proportioning - The recommended design assumed a Modulus of Rupture ( $M_R$ ) at 28 days of 550 psi. <sup>standard</sup> Minimum cement factor would be 6.5 bags per cubic yard and maximum water cement ratio of

\* This will normally equate to a 28 day compressive strength of about 4000 PSI

5.5 gallons per bag. Maximum slump would be 3 inches. Concrete would be air-entrained with air content of 5 to 8 percent. Total aggregate in the concrete mixture to contain 30 to 60 percent material retained on the No. 4 screen.

Current City specifications require compressive strength at 28 days of 3500 psi. Minimum cement factor is 6.0 bags per cubic yard and maximum water cement ratio of 5.5 gallons per bag. Air content is specified at 4 to 6 percent and maximum slump at 3 inches. No specific limits are set for aggregate content.

Current County specifications require  $M_R$  of 500 psi at 28 days and compressive strength of 4000 psi at 28 days. Minimum cement factor is 6.5 bags per cubic yard and maximum water-cement ratio of 6.0 gallons per bag. Maximum slump is 3 inches with air content of 5 to 8 percent. Total aggregate is required to contain 30 to 60 percent material retained on the No. 4 screen.

6. Construction Details - <sup>standard</sup> The recommended design is based on plain or reinforced concrete without load-transfer dowels at transverse joints. If reinforcing steel is used it should be uniformly distributed across the pavement section. Spacing of transverse contraction joints should be based on the slab thickness and the amount (if any) of reinforcing provided. Expansion joints would be placed at intersections, structures, and significant changes

in horizontal alignment. Joints would be sealed with Hot-Pour joint sealant. Curing of the finished slab for a minimum of 3 days by approved methods would be required.

Current City specifications use perimeter reinforcing steel in their concrete pavement following a pattern originated in the 1930's. Transverse contraction joints are spaced at 30 feet center-to-center. Expansion joints are placed at intersections, structures and at intervals not exceeding 120 feet. Cold-pour joint sealant is specified to fill joints. Curing of finished pavement is by emulsified asphalt spray, liquid curing compounds or other approved methods.

Current County specifications follow the procedures proposed for the recommended design.

7. Discussion - The specifications proposed by the study do not differ significantly from the current City and County Standard Specifications.

Type II portland cement is preferred for use in pavements within the Study Area since it is felt to be a more uniform product. However, acceptable concrete for pavements can be produced with Type I portland cement and its use should be permissive with the Engineer.

Some cement suppliers have indicated that Type II cement may not be generally available in the future due to greater problems in its production. KDOT now specifies Type II cement for all pavements and bridge decks and has advised that they intend to continue this practice in the future. It is our opinion that Type II cement would be generally available in the Wichita Area should the City and County elect to specify its use on paving projects.

Concrete aggregates present a different problem within the Study Area. Fine Aggregate (sand) is available in adequate quantities at numerous locations in and around Wichita. The quality of the local sands is suitable but subject to considerable variations in its gradation. It is our opinion that the gradation of the fine aggregate has a significant effect on the uniformity of the concrete of which it becomes a part. This factor becomes more critical when local custom dictates the use of "over-sanded" mixes due to economic considerations (i.e. lack of good coarse aggregate). It is recommended that close control of the fine aggregate gradation should be emphasized for street pavement construction.

Coarse aggregate used in the Wichita area is primarily crushed limestone. Unfortunately, Kansas' limestones are of marginal quality for use in concrete pavement. They exhibit high loss to abrasion, are soft and tend to pulverize under handling in stockpiles and have high absorption. Of particular concern are the second and third items noted.

Coarse aggregates which are soft and tend to pulverize or "dust" during handling can be detrimental in concrete pavements. The presence of excessive "dust" on the aggregate, as measured by amount of material passing the No. 200 screen, can materially reduce the flexural strength which the concrete will produce. Compressive strength is also adversely affected. Cause of the lower concrete strengths is the decreased bond between cement paste and coarse aggregate due to the "dust" on aggregate particles. Both ASTM (C-33) and AASHTO (M-80) recognize this characteristic and place specific limitations on the amount of minus No. 200 material which the coarse aggregate may contain.

Absorption of the aggregate is a measure of the material's porosity. This characteristic is of importance in materials used for concrete pavements which will be subjected to repeated freeze-thaw cycles while the concrete is saturated. Kansas limestones used for concrete aggregate normally have absorptions in the range of 3 to 6 percent with only the better stone sources able to show absorption below 4 percent. D-Cracking is the term used to describe the concrete deterioration which occurs when saturated coarse aggregate is frozen repeatedly, thus causing "cracking" of the individual aggregate particle. Most authorities recommend aggregates have a maximum porosity (absorption) of 1 1/2 percent to insure they are not susceptible to D-Cracking. Within the State of Kansas there are no major sources of such material. In Kansas and the Study Area, it has been found that acceptable concrete pavements can be built using smaller size coarse aggregate (i.e. 3/4 maximum

size in lieu of 1 1/2 inch); using high quality cement paste (i.e. 5.5 gallons of water per bag of cement, maximum); a low slump concrete mixture; (i.e. 2 inches or less) providing adequate entrained air (i.e. 5 to 8 percent); and providing adequate drainage to prevent water accumulation on or under the pavement. Absorption should be specified as low as is feasible for local (Kansas) aggregates and 3.5 percent is suggested as an acceptable maximum.

In proportioning the concrete mixture, some constraints should be placed on the total aggregate composition. The amount of coarse aggregate used can affect the economy of the mix since crushed rock is relatively expensive compared with locally produced fine aggregate. Also the coarse aggregate, as noted above, is suspect from the durability standpoint. ~~We would prefer to see~~ not less than 30 percent of the total aggregate retained on the No. 4 screen ~~and not more than 50 percent.~~ <sup>50 percent</sup> Between these limits the Contractor should be permitted to vary the proportions of coarse and fine material to produce optimum economy and workability.

Concrete strength is an important factor since the pavement acts as a beam to carry the applied wheel loads. The flexural strength is most significant as the pavement will be an unreinforced section. A 28-day strength ( $M_R$ ) of 550 psi minimum <sup>shall</sup> be provided. This would normally equate to a 28-day compressive strength of about 4000 psi. We would suggest that the mix design for concrete pavement <sup>shall</sup> be prepared utilizing the strength evaluation procedures outlined

in ACI Standard 214-77. Suggested criteria for use in determining required average strength ( $f'_{cr}$ ) would be that one test in ten could fall below the design strength ( $f'_c$ ); and the average coefficient of variation (V) for transit-mix concrete <sup>shall</sup> be assumed at 12 percent unless otherwise documented by the supplier. ~~With these criteria mix designs can be prepared which will provide acceptable concrete for street pavement.~~

~~The question of using plain or reinforced concrete for the pavement has been debated over many years. For light traffic such as residential streets it is generally felt unnecessary to provide reinforcing steel.~~

This position is taken by PCA and many municipalities. In the Study Area however all existing concrete pavements have utilized a reinforced section. Consequently there is no local performance history for plain pavement. If it is desired to use unreinforced pavement we would suggest a "trial project" initially to provide information on performance characteristics of the system.

C. FLEXIBLE PAVEMENT

1. Asphalt Cement. The recommended design <sup>F</sup> for flexible pavement utilized Penetration Graded asphalt cement complying with AASHTO M 20<sub>v</sub> <sup>shall be used</sup> A penetration grade of 60-70 is suggested; however, the penetration grades of 40-50 and 85-100 can be used successfully.

Current City specifications call for 60 to 70 penetration grade asphalt cement with 85 to 100 optional with the Contractor during cold weather.

Current County specifications call for 60-70 penetration-grade asphalt cement.

2. Asphaltic Mixtures. ~~The proposed design anticipates use of aggregates and mixtures complying with the requirements of ASTM D 3515, Hot-Mixed, Hot-Laid Bituminous Paving Mixtures, with modifications for use of local materials to the extent feasible.~~ <sup>shall be used</sup> ~~The recommendations also includes limitations on absorption and deleterious substances in the aggregates and the provision for Marshall stability requirements.~~ <sup>This</sup>

a. Bituminous Bases. Present City and County specifications are similar to the extent that both meet the requirements specified by the Kansas Department of Transportation for BM-4 or BM-6 with the following exceptions.

Present City specifications require a maximum wear of 40 percent in lieu of 45 percent wear permitted by the County in the L.A. Abrasion Test Method. The City specifications has no limit on absorption in aggregates whereas the County has a maximum of 4 percent. The City is more restrictive in the use of silt for mineral filler and does not permit the use of volcanic ash or fly ash as mineral filler. The City is not too specific on requirements

for soundness of aggregates whereas the County has freeze-thaw cycle test requirements. The City permits 1.0 percent moisture in the mixtures while a maximum of 0.5 percent is allowed in BM-4.

Sedgwick County specifies the use of BM-4 or BM-6 with a provision for the mix to be designed by Marshall tests meeting certain criteria and limits in addition to the comparisons noted above.

b. Surface Courses. Current City specifications call for a mixture gradation somewhere between 3/8 inch (6A) and No. 4 (7A) (Sand Asphalt) as shown in Table 3 of ASTM D 3515. The City permits 1.0 percent moisture in the mixture and the use of portland cement, crushed limestone or chat sludge for mineral filler supplement. There appear to be no requirements regarding absorption and soundness of aggregate other than a L.A. Abrasion maximum of 40 percent.

The County specifies a bituminous mixture meeting the requirements of BM-2 which approximates asphaltic concrete mixture (5A) or 1/2 inch size in ASTM D 3515. The County permits a maximum moisture content of 0.35 percent and mineral filler supplements of portland

cement, crushed stone, volcanic ash, fly ash and chat sludge. Maximum absorption is 4 percent, maximum wear for L.A. abrasion is 40 percent, and soundness is 0.9 minimum for course aggregates.

The County also requires the bituminous mixture to be designed to meet certain Marshall test criteria and limits.

3. Construction Methods. The mixing, spreading and compaction of bituminous mixtures for both the <sup>Marshall</sup> City and the County are ~~comparable except that the City's compaction requirements are more stringent.~~ The City requires a compaction of 95 percent of a voidless mixture, whereas the County requires 96 percent of field Marshall <sup>As per the Marshall test densities for</sup> densities for surface courses and 94 percent for base courses.

4. <sup>General</sup> Discussion. Due to a greater influx of foreign crude oil imports in recent years, ~~it~~ appears desirable to have better control of asphalt cement grades being used in bituminous mixtures than the present penetration grade of 60 - 70 (AC-3), as established in ASTM D 946. It is recommended that consideration be given to using the viscosity graded asphalt cement AC-10 or 20 as determined by ASTM D-3381. However, it is recognized that it would be difficult to administer this test or requirement without

implementation of this requirement by the Kansas Department of Transportation. It is understood that KDOT now intends to conduct a small scale testing program in District No. 1 for utilization of viscosity graded asphalt cements.

It is believed that better control of asphalt mix designs within the Study Area would be obtained for both "tender mixes" and thermal cracking (cold temperature) of asphalt pavements if viscosity graded asphalt is required.

Although coarse aggregates in bituminous mixtures are not subject to the high compressive stresses of rigid pavement, it is necessary to have the aggregate hard enough to minimize fracturing or breakdown under compaction or traffic. It is therefore desirable to keep the Los Angeles Abrasion Test Method maximum wear of 40 percent as specified by the City and include a sodium sulfate weighted loss of not more than 15 percent as is specified in ASTM D 1073 for fine aggregates. *shall be considered standard as specified*

It is also recommended to specify an absorption limit of 4 percent on aggregates, *shall be specified* particularly for surface course mixes, since high absorption aggregates tend to dry up the pavement as the asphalt is absorbed into the pores through time. This is undesirable as it causes the asphalt pavement to undergo extensive shrinkage with subsequent cracking.

The use of fly ash as a mineral filler supplement <sup>may</sup> be permitted since in some cases it appears to be superior to both lime or stone quarry dust with regard to creep of flexible pavement.

~~The present bituminous mixtures for base courses appear to perform quite satisfactorily using local materials, primarily sand. These mixtures are presently being designed by Marshall tests by the Kansas State Department of Transportation, the City of Wichita, and Sedgwick County. It is therefore recommended that the Marshall requirements be set forth in the specifications in order to give the Engineer more control of the mix design. The recommended Marshall requirements tested in accordance with ASTM D 1559 are:~~

Stability (Minimum)	1000 lbs.
Flow	0.08 to 0.16 inch
Percent voids in compacted sample	3 to 7
Percent voids filled with asphalt	70 minimum

With regard to surface course bituminous mixture, ~~our review indicates that the BM-2 gradation provides better control for stability than does the SC-I master gradation limits, presently specified by the City.~~ From review of data furnished by the City, it appears that the gradation was used for the wearing surface on the first full depth asphalt street constructed on

18th Street discussed in Section VI. The changes in SC-I since that project include requirements that the combined aggregates shall contain a minimum of 47 percent crushed material, the addition of mix tolerances, a maximum P.I. of 4, and limitation of 1 percent moisture in the mixture. The current SC-I mixture provides a finer surface texture and workability than BM-2 which may not be too desirable with regard to skid resistance. Also it is suggested that the moisture content in the mix be reduced to a maximum of 0.5 percent or less.

It is recommended that the specifications for the surface course include the Marshall requirements as follows:

Stability (Minimum)	<del>1500</del> 1600 lbs
Flow	0.08 to 0.16 inch
Percent voids in Compacted Sample	3 to 5
Percent voids filled with asphalt	70 minimum

*shall*  
It is further recommended that the master gradation limits for SC-I be changed so that the gradation median when plotted on the Federal Highway Administration 0.45 Power Gradation Chart approaches a straight line. This chart was developed from a modified Fuller equation for maximum density curves and is as follows.

$$p = 100 \left( \frac{d}{D} \right)^{.45}$$

in which

p = total percentage passing a given sieve

d = size of sieve opening

D = largest sieve size in gradation

A change in the gradation limits <sup>will</sup> should permit the Engineer to design the job mix to more readily achieve the above Marshall limitations. This is desirable since the stability curve generally follows the density curve which reduces air voids in the surface course. However, a minimum of 3 percent voids is desirable due to flushing of asphalt under traffic. It is also necessary to maintain the minimum flow so that the mix is not designed too dry to achieve stability.

## ATTENDANCE RECORD

Date: 6-11-80  
 Time: 4 PM  
 Place: \_\_\_\_\_ MAPD  
 Meeting Arranged By: \_\_\_\_\_  
 Purpose: PAVING

Name	Organization	Address
<u>Robt Lakin</u> Phone: <u>4351</u>	<u>MAPD</u>	
<u>Carl O. Knop</u> Phone: _____	<u>PEC</u>	<u>Wichita</u>
<u>L. F. MULLINS</u> Phone: <u>268-7901</u>	<u>SEDGWICK CO</u>	<u>Wichita</u>
<u>JOE FREEMAN</u> Phone: <u>7901</u>	<u>SEDGWICK CO.</u>	
<u>GEO TOMLIN</u> Phone: <u>943 2256</u>	<u>MAJOR INC</u>	<u>WICHITA</u>
<u>STEVE LUCKEY</u> Phone: <u>268-4450</u>	<u>CITY</u>	"
<u>John Kraus</u> Phone: <u>264-2831</u>	<u>City</u>	"
<u>Larry Martin</u> Phone: _____	<u>mid-Hansas coast</u>	✓
<u>Jon Ritchie</u> Phone: <u>838-9301</u>	<u>Ritchie Paving</u>	<u>Wichita, Kans.</u>
<u>Charles Freund</u> Phone: <u>262 2691</u>	<u>PEC</u>	" "
<u>JAMES L. GARDNER, Jr</u> Phone: <u>264-9181</u>	<u>MAPC</u>	



#### LEGAL PUBLICATION

Published in the Wichita Beacon March 31, 1980

#### RESOLUTION

A RESOLUTION ESTABLISHING DESIGN CRITERIA FOR URBAN TYPE RESIDENTIAL STREETS AND INSPECTION PROCEDURES THEREOF.

NOW BE IT RESOLVED BY THE BOARD OF COMMISSIONERS OF SEDGWICK COUNTY, KANSAS, THAT:

SECTION 1. The "Supplementary Pavement Thickness Design Manual for Residential Streets Within the Wichita Metropolitan Area", published by Professional Engineering Consultants, P.A., October 1979 Edition, including the appendices and design graphs attached thereto, is by reference incorporated in and by this publication made a part of this resolution as fully as though set forth at length herein. The County Engineer, in accordance with the duties as outlined by K.S.A. 46-302, has previously adopted the "manual" as the paving design criteria for urban residential streets. This "manual" is hereby adopted as the design, material and construction manual for all urban residential streets in the unincorporated area of Sedgewick County, Kansas.

SECTION 2. All urban residential streets, as defined in the "Subdivision Regulations of the Wichita-Sedgewick County Metropolitan Area Planning Commission", hereinafter designated and constructed within the unincorporated area of Sedgewick County shall conform to the requirements set forth in the "manual" identified in Section 1 of this resolution. Said regulations, to the extent necessary to give full effect to the provisions of this resolution, are by reference incorporated in and by this publication made a part of this resolution as fully as though set forth at length herein; and, to such extent, are hereby adopted as part of this resolution.

SECTION 3. The "manual" referred to in Section 1 and the "regulations" referred to in Section 2 of this resolution, having been published as by law required, are on file in the offices of the County Clerk and the County Engineer of Sedgewick County, Kansas and are open to inspection and available to the public at all reasonable hours. The provisions of this resolution shall be cumulative and are not intended to supersede other County code provisions relating to street construction, licensing, traffic or use regulation.

SECTION 4. Plans for all streets covered by the provisions of this resolution shall indicate that the design and proposed material conform to the criteria set forth in the "manual" identified in Section 1 of this resolution and shall be signed with the name and seal of the Engineer responsible for their preparation.

SECTION 5. Before any such street improvement shall be accepted by Sedgewick County, a certificate signed by the contractor and the licensed professional engineer responsible for project resident engineering shall be submitted to the County Commission stating that the construction is in compliance with the plans and specifications authorized under Section 1 hereof. In the event said construction fails to meet the above approved specifications, the matter shall be placed before the Board of Commissioners for determination of appropriate action. If during construction, the inspecting engineer determines there is a failure to meet specification, said inspecting engineer shall report the facts to the County Engineer who is hereby empowered to issue a stop work order until the job is brought back to specification. Final acceptance shall not free the Contractor from contractual agreements such as warranty or maintenance clauses provided in the contract documents.

A contractor's permit for future street construction in the unincorporated area of Sedgewick County shall not be issued to any contractor who fails or refuses to fully comply with all rules and regulations necessary in the enforcement of this Resolution.

SECTION 6. That this Resolution shall take effect and be in force from and after its adoption and publication in the official County newspaper.

PASSED AND ADOPTED by the Board of County Commissioners at Wichita, Kansas, this 19th day of March, 1980.

Everett Patrick, Chairman

Tom Scott, Commissioner

Donald E. Grapp, Commissioner

Dorothy K. White, County Clerk

Approved as to form by County Counselor

Theodore H. Hill, County Counselor

(SEAL)

*Atkins*  
*Bas*

R E S O L U T I O N

A RESOLUTION ESTABLISHING DESIGN CRITERIA  
FOR URBAN TYPE RESIDENTIAL STREETS AND  
INSPECTION PROCEDURES THEREFOR.

NOW BE IT RESOLVED BY THE BOARD OF COMMISSIONERS OF SEDGWICK COUNTY, KANSAS, THAT:

SECTION 1. The "Supplementary Pavement Thickness Design Manual for Residential Streets Within the Wichita Metropolitan Area", published by Professional Engineering Consultants, P.A., October 1979 Edition, including the appendices and design graphs attached thereto, is by reference incorporated in and by this publication made a part of this resolution as fully as though set forth at length herein. The County Engineer, in accordance with the duties as outlined by K.S.A. 68-502, has previously adopted the "manual" as the paving design criteria for urban residential streets. This "manual" is hereby adopted as the design, material and construction manual for all urban residential streets in the unincorporated area of Sedgwick County, Kansas.

SECTION 2. All urban residential streets, as defined in the "Subdivision Regulations of the Wichita-Sedgwick County Metropolitan Area Planning Commission", hereinafter designed and constructed within the unincorporated area of Sedgwick County shall conform to the requirements set forth in the "manual" identified in Section 1 of this resolution. Said regulations, to the extent necessary to give full effect to the provisions of this resolution, are by reference incorporated in and by this publication made a part of this resolution as fully as though set forth at length herein, and, to such extent, are hereby adopted as part of this resolution.

SECTION 3. The "manual" referred to in Section 1 and the "regulations" referred to in Section 2 of this resolution, having been published as by law required, are on file in the offices of the County Clerk and the County Engineer of Sedgwick County, Kansas and are open to inspection and available to the public at all reasonable hours. The provisions of this resolution shall be cumulative and are not intended to supersede other County code provisions relating to street construction, licensing, traffic or use regulation.

SECTION 4. Plans for all streets covered by the provisions of this resolution shall indicate that the design and proposed material conform to the criteria set forth in the "manual" identified in Section 1 of this resolution and shall be signed with the name and seal of the Engineer responsible for their preparation.

SECTION 5. Before any such street improvement shall be accepted by Sedgwick County, a certificate signed by the contractor and the licensed professional engineer responsible for project resident engineering shall be submitted to the County Commission stating that the construction is in compliance with the plans and specifications authorized under Section 1 hereof. In the event said construction fails to meet the above approved specifications, the matter shall be placed before the Board of Commissioners for determination of appropriate action. If during construction, the inspecting engineer determines there is a failure to meet specification, said inspecting engineer shall report the facts to the County Engineer, who is hereby empowered to issue a stop work order until the job is brought back to specification. Final acceptance shall not free the Contractor from contractual agreements such as warranty or maintenance clauses provided in the contract documents.

A contractor's permit for future street construction in the unincorporated area of Sedgwick County shall not be issued to any contractor who fails or refuses to fully comply with all rules and regulations necessary in the enforcement of this Resolution.

SECTION 6. That this Resolution shall take effect and be in force from and after its adoption and publication in the official County paper.

PASSED AND ADOPTED by the Board of County Commissioners at Wichita, Kansas, this 19<sup>th</sup> day of March, 1980.

\_\_\_\_\_, Chairman  
Everett Patrick

\_\_\_\_\_, Commissioner  
Donald Gragg

\_\_\_\_\_, Commissioner  
Tom Scott

ATTEST:

\_\_\_\_\_  
Dorothy K. White, County Clerk

(SEAL)

Approved as to form by County Counselor

\_\_\_\_\_  
Theodore H. Hill, County Counselor

1. Louise

©1454 Published in The Daily Record, March 26, 1980(1)  
ORDINANCE NO. 38-572

**AN ORDINANCE REGULATING THE CONSTRUCTION OF RESIDENTIAL STREETS WITHIN THE CITY OF WICHITA, KANSAS; ESTABLISHING CRITERIA AS TO PAVEMENT DESIGN, MATERIAL AND CONSTRUCTION; AND PROVIDING FOR QUALITY CONTROL AND INSPECTION PROCEDURES THEREFOR. BE IT ORDAINED BY THE GOVERNING BODY OF THE CITY OF WICHITA, KANSAS:**

**SECTION 1. The "Supplementary Pavement Thickness**

**Design Manual for Residential Streets Within the Wichita Metropolitan Area"** published by Professional Engineering Consultants, P.A., October 1979 Edition, including the appendices and design graphs attached thereto, is by reference incorporated in and by this publication made a part of this ordinance as fully as though set forth at length herein, and is hereby adopted as the design, material and construction manual for all urban residential streets of the City of Wichita, Kansas.

**SECTION 2. All urban residential streets, as defined in the "Subdivision Regulations of the Wichita-Sedwick County Metropolitan Area Planning Commission", hereinafter designed and constructed within the City of Wichita shall conform to the requirements set forth in the "manual" identified in Section 1 of this ordinance. Said regulations, to the extent necessary to give full effect to the provisions of this ordinance, are by reference incorporated in and by this publication made a part of this ordinance as fully as though set forth at length herein, and, to such extent, are hereby adopted as part of this ordinance.**

**SECTION 3. The "manual" referred to in Section 1 and the "regulations" referred to in Section 2 of this ordinance, having been published as by law required, are on file in the offices of the City Clerk and the City Engineer of the City of Wichita, Kansas and are open to inspection and available to the public at all reasonable hours. The provisions of this ordinance shall be cumulative and are not intended to supersede other City of Wichita code provisions relating to street construction, licensing, traffic or use regulation.**

**SECTION 4. Plans for all streets covered by the provisions of this ordinance shall indicate that the design and proposed material conform to the criteria set forth in the "manual" identified in Section 1 of this ordinance and shall be signed with the name and seal of the Engineer responsible for their preparation.**

**SECTION 5. Before any such street improvement shall be accepted by the City of Wichita, a certificate signed by the contractor and the licensed professional engineer responsible for project resident engineering shall be submitted to the City Commission stating that construction is in compliance with the plans and specifications authorized under Section 1 hereof. In the event said construction fails to meet the above approved specifications, the matter shall be placed before the Board of Commissioners for determination of appropriate action. If during construction, the inspecting engineer determines there is a failure to meet specification, said inspecting engineer shall report the facts to the City Engineer who is hereby empowered to issue a stop work order until the job is brought back to specification. Final acceptance shall not free the Contractor from contractual agreements such as warranty or maintenance clauses provided in the contract documents.**

**A contractor's permit for future street construction in the City of Wichita shall not be issued to any contractor who fails or refuses to fully comply with all rules and regulations necessary in the enforcement of this ordinance.**

**SECTION 6. That this ordinance shall take effect and be in force from and after its adoption and publication in the official City paper.**

**ADOPTED AT WICHITA, KANSAS, March 18, 1980.**

**TONY CASADO, Mayor**

**ATTEST: (SEAL)**

**DONALD C. GISICK, City Clerk**

ORDINANCE NO. 36-572

AN ORDINANCE REGULATING THE CONSTRUCTION OF RESIDENTIAL STREETS WITHIN THE CITY OF WICHITA, KANSAS; ESTABLISHING CRITERIA AS TO PAVEMENT DESIGN, MATERIAL AND CONSTRUCTION; AND PROVIDING FOR QUALITY CONTROL AND INSPECTION PROCEDURES THEREFOR.

BE IT ORDAINED BY THE GOVERNING BODY OF THE CITY OF WICHITA, KANSAS.

SECTION 1. The "Supplementary Pavement Thickness Design Manual for Residential Streets Within the Wichita Metropolitan Area", published by Professional Engineering Consultants, P.A., October 1979 Edition, including the appendices and design graphs attached thereto, is by reference incorporated in and by this publication made a part of this ordinance as fully as though set forth at length herein, and is hereby adopted as the design, material and construction manual for all urban residential streets of the City of Wichita, Kansas.

SECTION 2. All urban residential streets, as defined in the "Subdivision Regulations of the Wichita-Sedgwick County Metropolitan Area Planning Commission", hereinafter designed and constructed within the City of Wichita shall conform to the requirements set forth in the "manual" identified in Section 1 of this ordinance. Said regulations, to the extent necessary to give full effect to the provisions of this ordinance, are by reference incorporated in and by this publication made a part of this ordinance as fully as though set forth at length herein, and, to such extent, are hereby adopted as part of this ordinance.

SECTION 3. The "manual" referred to in Section 1 and the "regulations" referred to in Section 2 of this ordinance, having been published as by law required, are on file in the offices of the City Clerk and the City Engineer of the City of Wichita, Kansas and are open to inspection and available to the public at all reasonable hours. The provisions of this ordinance shall be cumulative and are not intended to supersede other City of Wichita code provisions relating to street construction, licensing, traffic or use regulation.

SECTION 4. Plans for all streets covered by the provisions of this ordinance shall indicate that the design and proposed material conform to the criteria set forth in the "manual" identified in Section 1 of this ordinance and shall be signed with the name and seal of the Engineer responsible for their preparation.

SECTION 5. Before any such street improvement shall be accepted by the City of Wichita, a certificate signed by the contractor and the licensed professional engineer responsible for project resident engineering shall be submitted to the City Commission stating that construction is in compliance with the plans and specifications authorized under Section 1 hereof. In the event said construction fails to meet the above approved specifications, the matter shall be placed before the Board of Commissioners for determination of appropriate action. If during construction, the inspecting engineer determines there is a failure to meet specification, said inspecting engineer shall report the facts to the City Engineer who is hereby empowered to issue a stop work order until the job is brought back to specification. Final acceptance shall not free the Contractor from contractual agreements such as warranty or maintenance clauses provided in the contract documents.

A contractor's permit for future street construction in the City of Wichita shall not be issued to any contractor who fails or refuses to fully comply with all rules and regulations necessary in the enforcement of this ordinance.

SECTION 6. That this ordinance shall take effect and be in force from and after its adoption and publication in the official City paper.

ADOPTED AT WICHITA, KANSAS, March 18, 1980.

ATTEST:

\_\_\_\_\_  
Mayor

\_\_\_\_\_  
City Clerk

(SEAL)

\_\_\_\_\_  
Approved as to form City Attorney

March 24, 1980

Dorothy Peil, Deputy County Clerk

Louise Olivarez, Senior Planner

Pavement thickness Design Manual

Bob Lakin asked me to send you several additional copies of the Pavement Thickness Design Manual which the Board of County Commissioners adopted by reference in a resolution passed March 19, 1980. Enclosed are five xerox copies of this manual. If a second printing of the manual is made, we will send you five printed copies.

Louise Olivarez  
Senior Planner

LO:bh

Encl.

177HPD

R#56-1980

RESOLUTION

*Signed copy  
of County  
Resolution*

A RESOLUTION ESTABLISHING DESIGN CRITERIA FOR URBAN TYPE RESIDENTIAL STREETS AND INSPECTION PROCEDURES THEREFOR.

NOW BE IT RESOLVED BY THE BOARD OF COMMISSIONERS OF SEDGWICK COUNTY, KANSAS, THAT:

SECTION 1. The "Supplementary Pavement Thickness Design Manual for Residential Streets Within the Wichita Metropolitan Area", published by Professional Engineering Consultants, P.A., October 1979 Edition, including the appendices and design graphs attached thereto, is by reference incorporated in and by this publication made a part of this resolution as fully as though set forth at length herein. The County Engineer, in accordance with the duties as outlined by K.S.A. 68-502, has previously adopted the "manual" as the paving design criteria for urban residential streets. This "manual" is hereby adopted as the design, material and construction manual for all urban residential streets in the unincorporated area of Sedgwick County, Kansas.

SECTION 2. All urban residential streets, as defined in the "Subdivision Regulations of the Wichita-Sedgwick County Metropolitan Area Planning Commission", hereinafter designed and constructed within the unincorporated area of Sedgwick County shall conform to the requirements set forth in the "manual" identified in Section 1 of this resolution. Said regulations, to the extent necessary to give full effect to the provisions of this resolution, are by reference incorporated in and by this publication made a part of this resolution as fully as though set forth at length herein, and, to such extent, are hereby adopted as part of this resolution.

SECTION 3. The "manual" referred to in Section 1 and the "regulations" referred to in Section 2 of this resolution, having been published as by law required, are on file in the offices of the County Clerk and the County Engineer of Sedgwick County, Kansas and are open to inspection and available to the public at all reasonable hours. The provisions of this resolution shall be cumulative and are not intended to supersede other County code provisions relating to street construction, licensing, traffic or use regulation.

SECTION 4. Plans for all streets covered by the provisions of this resolution shall indicate that the design and proposed material conform to the criteria set forth in the "manual" identified in Section 1 of this resolution and shall be signed with the name and seal of the Engineer responsible for their preparation.

SECTION 5. Before any such street improvement shall be accepted by Sedgwick County, a certificate signed by the contractor and the licensed professional engineer responsible for project resident engineering shall be submitted to the County Commission stating that the construction is in compliance with the plans and specifications authorized under Section 1 hereof. In the event said construction fails to meet the above approved specifications, the matter shall be placed before the Board of Commissioners for determination of appropriate action. If during construction, the inspecting engineer determines there is a failure to meet specification, said inspecting engineer shall report the facts to the County Engineer, who is hereby empowered to issue a stop work order until the job is brought back to specification. Final acceptance shall not free the Contractor from contractual agreements such as warranty or maintenance clauses provided in the contract documents.

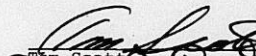
A contractor's permit for future street construction in the unincorporated area of Sedgwick County shall not be issued to any contractor who fails or refuses to fully comply with all rules and regulations necessary in the enforcement of this Resolution.

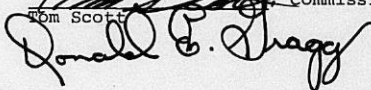
SECTION 6. That this Resolution shall take effect and be in force from and after its adoption and publication in the official County paper.

PASSED AND ADOPTED by the Board of County Commissioners at Wichita, Kansas, this 19<sup>th</sup> day of March, 19 20.

  
Everett Patrick, Chairman

  
\_\_\_\_\_, Commissioner

  
Tom Scott, Commissioner

  
Donald E. Tracy

TESTED: 0  
  
  
Wesley K. White, County Clerk

(SEAL)

Approved as to form by County Counselor

  
Theodore H. Hill, County Counselor

Set of materials as sent  
to County Commissioners  
for meeting of 3-19-80.  
Copy of feasibility study  
and design manual included.

(Also full set sent to Peil.  
Set minus study and manual sent  
to Freeman, Hill, Philbrick

WICHITA-SEDGWICK COUNTY

DATE

March 6, 1980

**METROPOLITAN AREA PLANNING DEPARTMENT**

TO Everett Patrick, Chairman, Board of County  
Commissioners  
FROM Robert A. Lakin, Director of Planning  
SUBJECT Paving Thickness Design Manual

The Board of City Commissioners and Board of County Commissioners jointly authorized a consultant to return to each of the governing bodies a report recommending the design thickness for residential streets within the Wichita metropolitan area. This report was necessitated by the different design approach used by the prior City Engineer and the prior County Engineer. Professional Engineering Consultants was selected to do this work, and the two Public Works Departments of the City and County jointly worked with the consultant in preparing the report. Two reports have been prepared, one entitled "Pavement Design and Feasibility Study for Residential Streets within the Wichita Metropolitan Area", April 1979, and a second document "Supplementary Pavement Thickness Design Manual for Residential Streets within the Wichita Metropolitan Area", October 1979.

The issue of 20 versus 40 year streets was discussed in the original report as well as the cost effectiveness of those street design alternates. Also discussed were the design criteria, including the soils, pavement design procedures, field evaluations of both rigid and flexible pavement, analysis of pavement materials and construction techniques, in arriving at the recommendations.

The results of the reports were submitted to City and County staffs who have reviewed the materials and are in agreement with the proposed design criteria. Those combined staffs asked that the supplementary design manual be created so that it could be used as a design basis and adopted by the governing bodies as a guide for both public and private engineers in designing streets in this area.

Subsequent to this action, the design manual supplement was submitted to the joint subcommittee of the Planning Commission and Land Use Economics Board, as well as to the Planning Commission, and to the Land Use Economics Board itself. Each of those groups in turn has recommended the adoption of the design manual as a basis for engineering design of residential streets in this area.

The intent of the design manual is to provide a range of design decisions which would be acceptable to local engineers, and provide a long-wearing and economical street. Essentially, depending on cost of materials and labor, the engineer would have the choice

Everett Patrick, Chairman  
Board of County Commissioners  
March 6, 1980  
Page 2

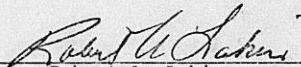
of more engineering work and soil preparation work with a thinner pavement, hence lesser and fewer materials, or in the event of high cost of labor and changing in materials pricing, of having a thicker pavement with lesser amount of soil preparation. It is critical, however, because of the approach to design which allows the development of a stronger subbase under which to support the pavement, that inspection and job site quality control be improved in order to insure the continuing long life of the project.

A resolution has been prepared which would allow for the adoption of the street standards report. Within the resolution it does speak to certification of the projects and acceptance by the governing bodies. A sample form used within the engineering profession is attached which could be used as an example of inspection and completion of the projects. The guarantees for a good design essentially would be: 1) the seal of the engineer in preparing the design plans; and 2) the seal of the engineer in submitting a certificate of substantial completion of the as-built job in the field based on approved plans.

As noted in the Planning Commission motion of approval of this design manual, it is anticipated there will be several addendums to the design manual, or separate design manuals to clarify elements related to street design including widths and drainage.

Recommendation

It is recommended that the Board of County Commissioners place the attached resolution on first reading.

  
Robert A. Lakin  
Director of Planning

RAL:rme  
Attachments

cc: Donald Gragg, County Commissioner  
Tom Scott, County Commissioner  
Joe Freeman, Acting County Engineer  
John Philbrick, County Administrator  
Theodore H. Hill, County Counselor  
Charles Freund, Professional Engineering Consultants  
Carl Knop, Professional Engineering Consultants  
Land Use Economics Board  
Metropolitan Area Planning Commission

R E S O L U T I O N

A RESOLUTION ESTABLISHING DESIGN CRITERIA  
FOR URBAN TYPE RESIDENTIAL STREETS AND  
INSPECTION PROCEDURES THEREFOR.

NOW BE IT RESOLVED BY THE BOARD OF COMMISSIONERS OF SEDGWICK COUNTY, KANSAS, THAT:

SECTION 1. The "Supplementary Pavement Thickness Design Manual for Residential Streets Within the Wichita Metropolitan Area", published by Professional Engineering Consultants, P.A., October 1979 Edition, including the appendices and design graphs attached thereto, is by reference incorporated in and by this publication made a part of this resolution as fully as though set forth at length herein. The County Engineer, in accordance with the duties as outlined by K.S.A. 68-502, has previously adopted the "manual" as the paving design criteria for urban residential streets. This "manual" is hereby adopted as the design, material and construction manual for all urban residential streets in the unincorporated area of Sedgwick County, Kansas.

SECTION 2. All urban residential streets, as defined in the "Subdivision Regulations of the Wichita-Sedgwick County Metropolitan Area Planning Commission", hereinafter designed and constructed within the unincorporated area of Sedgwick County shall conform to the requirements set forth in the "manual" identified in Section 1 of this resolution. Said regulations, to the extent necessary to give full effect to the provisions of this resolution, are by reference incorporated in and by this publication made a part of this resolution as fully as though set forth at length herein, and, to such extent, are hereby adopted as part of this resolution.

SECTION 3. The "manual" referred to in Section 1 and the "regulations" referred to in Section 2 of this resolution, having been published as by law required, are on file in the offices of the County Clerk and the County Engineer of Sedgwick County, Kansas and are open to inspection and available to the public at all reasonable hours. The provisions of this resolution shall be cumulative and are not intended to supersede other County code provisions relating to street construction, licensing, traffic or use regulation.

SECTION 4. Plans for all streets covered by the provisions of this resolution shall indicate that the design and proposed material conform to the criteria set forth in the "manual" identified in Section 1 of this resolution and shall be signed with the name and seal of the Engineer responsible for their preparation.

SECTION 5. Before any such street improvement shall be accepted by Sedgwick County, a certificate signed by the contractor and the licensed professional engineer responsible for project resident engineering shall be submitted to the County Commission stating that the construction is in compliance with the plans and specifications authorized under Section 1 hereof. In the event said construction fails to meet the above approved specifications, the matter shall be placed before the Board of Commissioners for determination of appropriate action. If during construction, the inspecting engineer determines there is a failure to meet specification, said inspecting engineer shall report the facts to the County Engineer who is hereby empowered to issue a stop work order until the job is brought back to specification. Final acceptance shall not free the Contractor from contractual agreements such as warranty or maintenance clauses provided in the contract documents.

A contractor's permit for future street construction in the unincorporated area of Sedgwick County shall not be issued to any contractor who fails or refuses to fully comply with all rules and regulations necessary in the enforcement of this Resolution.

SECTION 6. That this Resolution shall take effect and be in force from and after its adoption and publication in the official County paper.

PASSED AND ADOPTED by the Board of County Commissioners at Wichita, Kansas, this \_\_\_\_\_ day of \_\_\_\_\_, 19 \_\_\_\_.

\_\_\_\_\_, Chairman  
Everett Patrick

\_\_\_\_\_, Commissioner  
Donald Gragg

\_\_\_\_\_, Commissioner  
Tom Scott

ATTEST:

\_\_\_\_\_  
Dorothy K. White, County Clerk

(SEAL)

Approved as to form by County Counselor

\_\_\_\_\_  
Theodore H. Hill, County Counselor

CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner's Project No. .... Engineer's Project No. ....  
Project .....

Contractor ..... Contract Date .....  
Contract For .....

Project or Specified Part Shall Include .....  
.....  
.....

DEFINITION OF SUBSTANTIAL COMPLETION

The date of substantial completion of a project or specified part of a project is the date when the construction is sufficiently completed, in accordance with the contract documents, so that the project or specified part of the project can be utilized for the purpose for which it was intended.

To .....  
(Owner)  
And .....  
(Contractor)  
Date of Substantial Completion .....

The work performed under this contract has been inspected by authorized representatives of the Owner, Contractor, and Engineer and the above part of the Project is hereby declared to be substantially completed on the above date.

A tentative list of items to be completed or corrected is appended hereto. This list may not be exhaustive, and the failure to include an item on it does not alter the responsibility of the Contractor to complete all the work in accordance with the contract documents. These items shall be completed by the Contractor within ..... days of Substantial Completion.

NSPE 1910-8-D (1967 Edition) 7M

© 1967, National Society of Professional Engineers

The date of Substantial Completion is the date upon which all guarantees and warranties begin, except as noted below.

The responsibilities between the Owner and the Contractor for maintenance, heat, and utilities shall be as set forth below.

ENGINEER	AUTHORIZED REPRESENTATIVE	DATE
----------	---------------------------	------

The Contractor accepts the above Certificate of Substantial Completion and agrees to complete and correct the items on the tentative list within the time indicated.

CONTRACTOR	AUTHORIZED REPRESENTATIVE	DATE
------------	---------------------------	------

RESPONSIBILITIES: (For heat, maintenance, utilities, etc.)

OWNER:

CONTRACTOR:

EXCEPTIONS AS TO GUARANTEES AND WARRANTIES:

ENCLOSURES:

**THE CITY OF WICHITA**

**OFFICE OF** Industrial Development

**DATE** February 28, 1980

**TO** Robert A. Lakin, Director of Planning

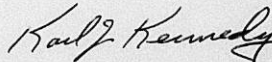
**FROM** Karl Kennedy, Industrial Analyst

**SUBJECT** Design Manual for  
Residential Streets

The Board of Land Use Economics, as a result of your presentation to the Board on February 6, 1980 regarding the Design Manual for Residential Streets within the Wichita Metropolitan Area, approved the following motion concerning the adoption of the Manual:

"The Board of Land Use Economics recommends that the Board of City Commissioners adopt the enabling ordinance to implement the Design Manual for Residential Streets. The Board also recommends that the City Commission instruct staff to conduct an annual review of the Manual for the purpose of updating it to reflect new developments in technology and to correct deficiencies of application in the field. The Board additionally recommends that clarification be made of the term 'licensed professional engineer' to mean an engineer from the private sector as well as a person on the City staff.

It is further recommended by the Board of Land Use Economics that the Board of County Commissioners also adopt the Manual on the same basis as stated above."



Karl J. Kennedy  
Industrial Analyst and  
Staff Ex officio member  
Board of Land Use Economics

KJK/st

cc: Board of Land Use Economics Members  
Louise Alvarez, Senior Planner

**RECEIVED**

FEB 29 1980

METROPOLITAN PLANNING

ROUTE  \_\_\_\_\_

\_\_\_\_\_

EXCERPT FROM PLANNING COMMISSION MINUTES OF JANUARY 31, 1980

15. Consideration of "Design Manual" for Street Thickness.

LAKIN gave some background on the Design Manual. He said that the full report was prepared by Professional Engineering Consultants, and completed. It was reviewed by staff and agreed upon. He said that the consultants were asked to prepare a shortened version of the manual which could be used as a basis for design and perhaps tied to the Subdivision Regulations. He said that the City and County engineers were in agreement as to the basic parameters that are set forth in the manual, and the staff proposes that this become an official design criteria.

LAKIN commented that Commissioner Gardner had a question on slip form pavement and re-bar. He said that the City would accept slip form pavement and concrete projects without re-bar.

MOTION: Accept the design criteria with the understanding that, because of ongoing committee work, they anticipate developing several addendums to the Drainage Manual to clarify other elements that do relate to design criteria of streets. Gardner moved, Savina seconded and it carried unanimously. Jones and Lofton were absent.

-----

**LEGAL PUBLICATION**

Published in the Wichita Beacon March 12, 1980  
IN THE MATTER OF THE ADOPTION OF A  
DESIGN MANUAL FOR URBAN TYPE RESI-  
DENTIAL STREETS IN THE UNINCORPORAT-  
ED AREAS OF SEDGWICK COUNTY  
Pursuant to K.S.A. 12-321 et seq.

**NOTICE OF HEARING**

To Whom It May Concern:

Take notice that the Board of County Commis-  
sioners of Sedgewick County, Kansas, will, on the  
15th day of March 1980 at 9:00 A.M., or as soon  
thereafter as the same can be heard at the meeting  
room of the Board of County Commissioners of  
Sedgewick County, Kansas, third floor of the Sedg-  
wick County Courthouse, 225 North Main, Wichita,  
Kansas hold a public hearing on the adoption of a  
street construction design manual entitled "Sup-  
plementary Pavement Thickness Design Manual  
For Residential Streets Within The Wichita Metro-  
politan Area" and on a Resolution establishing  
design criteria for urban type residential streets in  
the unincorporated areas of Sedgewick County,  
Kansas, by incorporating the above Manual by  
reference.

Dated this 15th day of March, 1980.

Dorothy K. White  
County Clerk  
Sedgewick County, Kansas

Seal

IN THE MATTER OF THE ADOPTION OF A DESIGN )  
MANUAL FOR URBAN TYPE RESIDENTIAL STREETS )  
IN THE UNINCORPORATED AREAS OF SEDGWICK )  
COUNTY )

Pursuant to KSA 12-3301 et seq.

NOTICE OF HEARING

To Whom It May Concern:

Take notice that the Board of County Commissioners of Sedgwick County, Kansas, will, on the 19th day of March, 1980 at 9:00 A.M., or as soon thereafter as the same can be heard at the meeting room of the Board of County Commissioners of Sedgwick County, Kansas, third floor of the Sedgwick County Courthouse, 525 North Main, Wichita, Kansas hold a public hearing on the adoption of a street construction design manual entitled "Supplementary Pavement Thickness Design Manual For Residential Streets Within The Wichita Metropolitan Area" and on a Resolution establishing design criteria for urban type residential streets in the unincorporated areas of Sedgwick County, Kansas, by incorporating the above Manual by reference.

Dated this \_\_\_\_ day of \_\_\_\_\_, 1980.

\_\_\_\_\_  
Dorothy K. White  
County Clerk  
Sedgwick County, Kansas



SEDGWICK COUNTY, KANSAS

**BOARD OF COUNTY COMMISSIONERS**

EVERETT PATRICK

CHAIRMAN

COMMISSIONER THIRD DISTRICT

TOM SCOTT

CHAIRMAN PRO-TEM

COMMISSIONER SECOND DISTRICT

DONALD E. GRAGG

COMMISSIONER

FIRST DISTRICT

COUNTY COURTHOUSE • SUITE 320 • WICHITA, KANSAS 67203 • TELEPHONE (316) 260-7411

DATE: March 6, 1980

TO: Bob Lakin, MAPD

FROM: G. Craig Robinson

RE: Pavement Thickness Manual; Resolution;  
Incorp. by Reference

Please find enclosed a sample Notice of Hearing for adopting the above manual. One question is the areas in question, the unincorporated areas or metropolitan? If metropolitan, please change Notice accordingly.

Through this hearing method, which could be had after one publication on any regular Wednesday meeting, the County should be able to adopt the manual and resolve to establish the design criteria. After acceptance by the board, and copies stamped "official copy as incorporated by resolution No. \_\_\_\_\_" shall be filed in County Clerks office. KSA 12-3301 et sey.

In my opinion there are no problems with the implementation of this design manual. The reference to paragraph 2 of Section 5 of the resolution is of no concern because the County has adequate home rule to cover such licensing. KSA 19-101. Likewise, I believe it could be implied from the statutes creating the County engineer. KSA 19-4501 et sey.

It is my unconfirmed belief that public works has no objection to this manual or resolution. If they do, this memo will serve notice that they need to respond.

Attachment

cc: Joe Freeman, DPW

\* Joe, attached is a copy of the final proposed resolution. I believe it addresses your concerns. See Section 5.

IN THE MATTER OF THE ADOPTION OF )  
A DESIGN MANUAL FOR RESIDENTIAL STREETS )  
PAVEMENT THICKNESS IN THE UNINCORPORATED )  
AREAS OF SEDGWICK COUNTY )

Pursuant to KSA 12-3301 et seq. *seq.*

NOTICE OF HEARING

To Whom It May Concern:

Take notice that the BOCC of Sedgwick County, Kansas, will, on the 19th day of March, 1980 at 9:00 A.M., or as soon thereafter as the same can be heard at the meeting room of the BOCC of Sedgwick County, Kansas, third floor of the Sedgwick County Courthouse, 525 North Main, Wichita, Kansas hold a public hearing upon the adoption of a Design Manual For Residential Streets Pavement Thickness Within The Unincorporated Areas Of Sedgwick County, Kansas, and upon a Resolution Establishing Design Criteria for Urban Type Streets incorporating the above Manual by reference.

Dated this \_\_\_\_ day of \_\_\_\_\_, 1980.

*a hearing upon*

\_\_\_\_\_  
Dorothy K. White  
County Clerk  
Sedgwick County, Kansas

*is something left out here*

~~Bob, you may change at will.~~

*and upon approval shall adopt a resolution establishing the design criteria ... by incorporating the above manual by reference*

from: Louise date: 3-7

*1/2*  
admin. adv. plans cur. plans social

- |                                    |                                    |  |                                   |                                   |
|------------------------------------|------------------------------------|--|-----------------------------------|-----------------------------------|
| <input type="checkbox"/> jakin     | <input type="checkbox"/> stockwell | <input type="checkbox"/> galbraith           | <input type="checkbox"/> mitchell |                                   |
| <input type="checkbox"/> walter    | <input type="checkbox"/> funk      | <input type="checkbox"/> lytle               | <input type="checkbox"/> lane     |                                   |
| <input type="checkbox"/> eubanks   | <input type="checkbox"/> shen      | <input type="checkbox"/> young               | <input type="checkbox"/> kohl     | <input type="checkbox"/> samsing  |
| <input type="checkbox"/> hanson    | <input type="checkbox"/> leaw      | <input type="checkbox"/> meek                | <input type="checkbox"/> hart     | <input type="checkbox"/> johns    |
| <input type="checkbox"/> nelson, v | <input type="checkbox"/> apodaca   | <input type="checkbox"/> shirkey             | <input type="checkbox"/> covert   | <input type="checkbox"/> miller   |
| <input type="checkbox"/> lakin, e  | <input type="checkbox"/> curfman   | <input type="checkbox"/> newby               | <input type="checkbox"/> coppel   | <input type="checkbox"/> patrick  |
| <input type="checkbox"/> henderson | <input type="checkbox"/> reed      | <input type="checkbox"/> dobson              | <input type="checkbox"/> beebe    | <input type="checkbox"/> watson   |
| <input type="checkbox"/> brothers  | <input type="checkbox"/> schaefer  | <input checked="" type="checkbox"/> olivarez | <input type="checkbox"/> syal     | <input type="checkbox"/> krenning |
| <input type="checkbox"/> peters    | <input type="checkbox"/> brown     | <input type="checkbox"/>                     | <input type="checkbox"/> davis    | <input type="checkbox"/> rojas    |
| <input type="checkbox"/> craig     | <input type="checkbox"/> buller    |  | <input type="checkbox"/> luettens | <input type="checkbox"/> whitlock |
| <input type="checkbox"/> barnes    | <input type="checkbox"/> huggins   |  | <input type="checkbox"/> sharpe   | <input type="checkbox"/> brown b. |
| <b>graphics</b>                    | <input type="checkbox"/> nagley    |  | <input type="checkbox"/> harvey   | <input type="checkbox"/> garmon   |
| <input type="checkbox"/> pierce    | <input type="checkbox"/> lickteig  |  | <input type="checkbox"/> smith    | <input type="checkbox"/> carlson  |
| <input type="checkbox"/> stafford  | <input type="checkbox"/> torinash  |  | <input type="checkbox"/> crawford | <input type="checkbox"/>          |
| <input type="checkbox"/> gariand   | <input type="checkbox"/> chambers  |  | <input type="checkbox"/> Phelps   |                                   |
| <input type="checkbox"/> pate      | <input type="checkbox"/> bechtel   |  | <input type="checkbox"/> jones    |                                   |
| <input type="checkbox"/>           | <input type="checkbox"/> mcfadden  |  | <input type="checkbox"/> martinez |                                   |
| <input type="checkbox"/>           | <input type="checkbox"/> swander   |  |                                   |                                   |
| <input type="checkbox"/> crook     | <input type="checkbox"/>           |  |                                   |                                   |
| <input type="checkbox"/> commer    |                                    |  |                                   |                                   |
| <input type="checkbox"/> vinson    |                                    |  |                                   |                                   |
| <input type="checkbox"/>           |                                    |  |                                   |                                   |

- |  |                                      |
|--|--------------------------------------|
| <input type="checkbox"/> note & return | <input type="checkbox"/> signature   |
| <input type="checkbox"/> handle        | <input type="checkbox"/> library     |
| <input type="checkbox"/> all staff     | <input type="checkbox"/> information |
| <input type="checkbox"/> comment       | <input type="checkbox"/> files       |

remarks: Joel Freeman brought  
this by today. It is a suggested  
change in Sec. 1 of the resolution  
on Street Design. Do you *MP* TS-105 →

the resolution retyped to  
include his extra sentence.  
All copies to MARC, Land Use  
Board, etc. have already  
been sent out. Copies to  
Commissioners & other County  
officials are ready for  
delivery Monday but can  
be changed.

SECTION 1. The "Supplementary Pavement Thickness Design Manual for Residential Streets Within the Wichita Metropolitan Area", published by Professional Engineering Consultants, P.A., October 1979 Edition, including the appendices and design graphs attached thereto, is by reference incorporated in and by this publication made a part of this resolution as fully as though set forth at length herein. The County Engineer, in accordance with the duties as outlined by K.S.A. 68-502, has previously adopted the "manual" as the paving design criteria for urban residential streets, and is hereby adopted as the design, material and construction manual for all urban residential streets in the unincorporated area of Sedgwick County, Kansas.

*The "manual"*

RESOLUTION

A RESOLUTION ESTABLISHING DESIGN CRITERIA FOR URBAN TYPE RESIDENTIAL STREETS AND INSPECTION PROCEDURES THEREFOR.

*Superseded  
(see Freeman's  
Section)*

NOW BE IT RESOLVED BY THE BOARD OF COMMISSIONERS OF SEDGWICK COUNTY, KANSAS, THAT:

SECTION 1. The "Supplementary Pavement Thickness Design Manual for Residential Streets Within the Wichita Metropolitan Area", published by Professional Engineering Consultants, P.A., October 1979 Edition, including the appendices and design graphs attached thereto, is by reference incorporated in and by this publication made a part of this resolution as fully as though set forth at length herein, and is hereby adopted as the design, material and construction manual for all urban residential streets in the unincorporated area of Sedgwick County, Kansas.

SECTION 2. All urban residential streets, as defined in the "Subdivision Regulations of the Wichita-Sedgwick County Metropolitan Area Planning Commission", hereinafter designed and constructed within the unincorporated area of Sedgwick County shall conform to the requirements set forth in the "manual" identified in Section 1 of this resolution. Said regulations, to the extent necessary to give full effect to the provisions of this resolution, are by reference incorporated in and by this publication made a part of this resolution as fully as though set forth at length herein, and, to such extent, are hereby adopted as part of this resolution.

SECTION 3. The "manual" referred to in Section 1 and the "regulations" referred to in Section 2 of this resolution, having been published as by law required, are on file in the offices of the County Clerk and the County Engineer of Sedgwick County, Kansas and are open to inspection and available to the public at all reasonable hours. The provisions of this resolution shall be cumulative and are not intended to supersede other County code provisions relating to street construction, licensing, traffic or use regulation.

SECTION 4. Plans for all streets covered by the provisions of this resolution shall indicate that the design and proposed material conform to the criteria set forth in the "manual" identified in Section 1 of this resolution and shall be signed with the name and seal of the Engineer responsible for their preparation.

SECTION 5. Before any such street improvement shall be accepted by Sedgwick County, a certificate signed by the contractor and the licensed professional engineer responsible for project resident engineering shall be submitted to the County Commission stating that the construction is in compliance with the plans and specifications authorized under Section 1 hereof. In the event said construction fails to meet the above approved specifications, the matter shall be placed before the Board of Commissioners for determination of appropriate action. If during construction, the inspecting engineer determines there is a failure to meet specification, said inspecting engineer shall report the facts to the County Engineer who is hereby empowered to issue a stop work order until the job is brought back to specification. Final acceptance shall not free the Contractor from contractual agreements such as warranty or maintenance clauses provided in the contract documents.

A contractor's permit for future street construction in the unincorporated area of Sedgwick County shall not be issued to any contractor who fails or refuses to fully comply with all rules and regulations necessary in the enforcement of this Resolution.

SECTION 6. That this Resolution shall take effect and be in force from and after its adoption and publication in the official County paper.

PASSED AND ADOPTED by the Board of County Commissioners at Wichita, Kansas, this \_\_\_\_\_ day of \_\_\_\_\_, 19 \_\_\_\_.

\_\_\_\_\_, Chairman  
Everett Patrick

\_\_\_\_\_, Commissioner  
Donald Gragg

\_\_\_\_\_, Commissioner  
Tom Scott

ATTEST:

Dorothy K. White, County Clerk

(SEAL)

Approved as to form by County Counselor

Theodore H. Hill, County Counselor

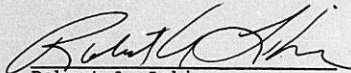
WICHITA-SEDGWICK COUNTY

DATE  
March 5, 1980

**METROPOLITAN AREA PLANNING DEPARTMENT**

TO Orval W. Daniels, Engineering Testing Company  
Richard L. Luke, Wichita Testing Laboratories  
Kent Schwieger, Wichita Testing Laboratories  
Mike Thompson, Poe and Associates  
FROM Fred Schoell, Soil Testing Services of Kansas  
Robert A. Lakin, Director of Planning  
SUBJECT Design Manual for Residential Streets within the  
Wichita Metropolitan Area

On March 11, 1980, the Board of City Commissioners will consider adopting an ordinance regulating the construction of residential streets within the City of Wichita. On March 19, 1980, the Board of County Commissioners will consider a resolution regulating the construction of urban residential streets within the unincorporated areas of Sedgwick County. Both the City Ordinance and the County Resolution will adopt by reference the "Supplementary Pavement Thickness Design Manual for Residential Streets Within The Wichita Metropolitan Area" published by Professional Engineering Consultants, P.A., October, 1979 Edition. The design supplement manual has been amended to require soaked samples in the testing for CBR Values (Page 3, line 6).



Robert A. Lakin  
Director of Planning

RAL:LO:bh

*5 copies marked 3-6*

Sample set as  
sent to City Commission  
for meeting 3-11-80.  
Copy of feasibility  
study and design manual  
included.

(Also full set sent to  
Manager. Set minus  
study & manual sent  
to Dekker  
Buggeman  
Sellers  
Gisick )

WICHITA-SEDGWICK COUNTY *Item 1*  
METROPOLITAN AREA PLANNING DEPARTMENT

DATE  
February 27, 1980

TO Board of City Commissioners  
(through E. H. Denton, City Manager)  
FROM Robert A. Lakin, Director of Planning

*H-0*

SUBJECT Paving Thickness Design Manual

The Board of City Commissioners and Board of County Commissioners jointly authorized a consultant to return to each of the governing bodies a report recommending the design thickness for residential streets within the Wichita metropolitan area. This report was necessitated by the different design approach used by the prior City Engineer and the prior County Engineer. Professional Engineering Consultants was selected to do this work, and the two Public Works Departments of the City and County jointly worked with the consultant in preparing the report. Two reports have been prepared, one entitled "Pavement Design and Feasibility Study for Residential Streets within the Wichita Metropolitan Area", April 1979, and a second document "Supplementary Pavement Thickness Design Manual for Residential Streets within the Wichita Metropolitan Area", October 1979.

The issue of 20 versus 40 year streets was discussed in the original report as well as the cost effectiveness of those street design alternates. Also discussed were the design criteria, including the soils, pavement design procedures, field evaluations of both rigid and flexible pavement, analysis of pavement materials and construction techniques, in arriving at the recommendations.

The results of the reports were submitted to City and County staffs who have reviewed the materials and are in agreement with the proposed design criteria. Those combined staffs asked that the supplementary design manual be created so that it could be used as a design basis and adopted by the governing bodies as a guide for both public and private engineers in designing streets in this area.

Subsequent to this action, the design manual supplement was submitted to the joint subcommittee of the Planning Commission and Land Use Economics Board, as well as to the Planning Commission, and to the Land Use Economics Board itself. Each of those groups in turn has recommended the adoption of the design manual as a basis for engineering design of residential streets in this area.

*MAPC  
Self-form  
widths*

The intent of the design manual is to provide a range of design decisions which would be acceptable to local engineers, and provide a long-wearing and economical street. Essentially, depending on cost of materials and labor, the engineer would have the choice

Board of City Commissioners  
February 27, 1980  
Page 2

of more engineering work and soil preparation work with a thinner pavement, hence lesser and fewer materials, or in the event of high cost of labor and changing in materials pricing, of having a thicker pavement with lesser amount of soil preparation. It is critical, however, because of the approach to design which allows the development of a stronger subbase under which to support the pavement, that inspection and job site quality control be improved in order to insure the continuing long life of the project.

An ordinance has been prepared which would allow for the adoption of the street standards report. Within the ordinance it does speak to certification of the projects and acceptance by the governing bodies. A sample form used within the engineering profession is attached which could be used as an example of inspection and completion of the projects. The guarantees for a good design essentially would be: 1) the seal of the engineer in preparing the design plans; and 2) the seal of the engineer in submitting a certificate of substantial completion of the as-built job in the field based on approved plans.

As noted in the Planning Commission motion of approval of this design manual, it is anticipated there will be several addendums to the design manual, or separate design manuals to clarify elements related to street design including widths and drainage.

Recommendation

It is recommended that the Board of City Commissioners place the attached ordinance on first reading.



Robert A. Lakin  
Director of Planning

RAL:rme  
Attachments

cc: Metropolitan Area Planning Commission  
Land Use Economics Board  
Carl Knop, Professional Engineering Consultants  
Charles Freund, Professional Engineering Consultants  
R. W. Bruggeman, Director of Public Works  
Dean Sellers, Acting City Engineer  
John Dekker, Director of Law

ORDINANCE NO. \_\_\_\_\_

AN ORDINANCE REGULATING THE CONSTRUCTION OF RESIDENTIAL STREETS WITHIN THE CITY OF WICHITA, KANSAS; ESTABLISHING CRITERIA AS TO PAVEMENT DESIGN, MATERIAL AND CONSTRUCTION; AND PROVIDING FOR QUALITY CONTROL AND INSPECTION PROCEDURES THEREFOR.

BE IT ORDAINED BY THE GOVERNING BODY OF THE CITY OF WICHITA, KANSAS.

SECTION 1. The "Supplementary Pavement Thickness Design Manual for Residential Streets Within the Wichita Metropolitan Area", published by Professional Engineering Consultants, P.A., October 1979 Edition, including the appendices and design graphs attached thereto, is by reference incorporated in and by this publication made a part of this ordinance as fully as though set forth at length herein, and is hereby adopted as the design, material and construction manual for all urban residential streets of the City of Wichita, Kansas.

SECTION 2. All urban residential streets, as defined in the "Subdivision Regulations of the Wichita-Sedgwick County Metropolitan Area Planning Commission", hereinafter designed and constructed within the City of Wichita shall conform to the requirements set forth in the "manual" identified in Section 1 of this ordinance. Said regulations, to the extent necessary to give full effect to the provisions of this ordinance, are by reference incorporated in and by this publication made a part of this ordinance as fully as though set forth at length herein, and, to such extent, are hereby adopted as part of this ordinance.

SECTION 3. The "manual" referred to in Section 1 and the "regulations" referred to in Section 2 of this ordinance, having been published as by law required, are on file in the offices of the City Clerk and the City Engineer of the City of Wichita, Kansas and are open to inspection and available to the public at all reasonable hours. The provisions of this ordinance shall be cumulative and are not intended to supersede other City of Wichita code provisions relating to street construction, licensing, traffic or use regulation.

SECTION 4. Plans for all streets covered by the provisions of this ordinance shall indicate that the design and proposed material conform to the criteria set forth in the "manual" identified in Section 1 of this ordinance and shall be signed with the name and seal of the Engineer responsible for their preparation.

SECTION 5. Before any such street improvement shall be accepted by the City of Wichita, a certificate signed by the contractor and the licensed professional engineer responsible for project resident engineering shall be submitted to the City Commission stating that construction is in compliance with the plans and specifications authorized under Section 1 hereof. In the event said construction fails to meet the above approved specifications, the matter shall be placed before the Board of Commissioners for determination of appropriate action. If during construction, the inspecting engineer determines there is a failure to meet specification, said inspecting engineer shall report the facts to the City Engineer who is hereby empowered to issue a stop work order until the job is brought back to specification. Final acceptance shall not free the Contractor from contractual agreements such as warranty or maintenance clauses provided in the contract documents.

A contractor's permit for future street construction in the City of Wichita shall not be issued to any contractor who fails or refuses to fully comply with all rules and regulations necessary in the enforcement of this ordinance.

SECTION 6. That this ordinance shall take effect and be in force from and after its adoption and publication in the official City paper.

ADOPTED AT WICHITA, KANSAS, \_\_\_\_\_.

ATTEST:

\_\_\_\_\_  
Mayor

\_\_\_\_\_  
City Clerk

(SEAL)

\_\_\_\_\_  
Approved as to form City Attorney

CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner's Project No. .... Engineer's Project No. ....

Project .....

Contractor ..... Contract Date .....

Contract For .....

Project or Specified Part Shall Include .....

.....

.....

**DEFINITION OF SUBSTANTIAL COMPLETION**

The date of substantial completion of a project or specified part of a project is the date when the construction is sufficiently completed, in accordance with the contract documents, so that the project or specified part of the project can be utilized for the purpose for which it was intended.

To .....  
(Owner)

And .....  
(Contractor)

Date of Substantial Completion .....

The work performed under this contract has been inspected by authorized representatives of the Owner, Contractor, and Engineer and the above part of the Project is hereby declared to be substantially completed on the above date.

A tentative list of items to be completed or corrected is appended hereto. This list may not be exhaustive, and the failure to include an item on it does not alter the responsibility of the Contractor to complete all the work in accordance with the contract documents. These items shall be completed by the Contractor within ..... days of Substantial Completion.

NSPE 1910-8-D (1967 Edition) 7M

© 1967, National Society of Professional Engineers

The date of Substantial Completion is the date upon which all guarantees and warranties begin, except as noted below.

The responsibilities between the Owner and the Contractor for maintenance, heat, and utilities shall be as set forth below.

ENGINEER	AUTHORIZED REPRESENTATIVE	DATE
----------	---------------------------	------

The Contractor accepts the above Certificate of Substantial Completion and agrees to complete and correct the items on the tentative list within the time indicated.

CONTRACTOR	AUTHORIZED REPRESENTATIVE	DATE
------------	---------------------------	------

RESPONSIBILITIES: (For heat, maintenance, utilities, etc.)

OWNER:

CONTRACTOR:

EXCEPTIONS AS TO GUARANTEES AND WARRANTIES:

ENCLOSURES:

**THE CITY OF WICHITA**

**OFFICE OF** Industrial Development

**DATE** February 28, 1980

**TO** Robert A. Lakin, Director of Planning

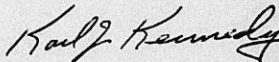
**FROM** Karl Kennedy, Industrial Analyst

**SUBJECT** Design Manual for  
Residential Streets

The Board of Land Use Economics, as a result of your presentation to the Board on February 6, 1980 regarding the Design Manual for Residential Streets within the Wichita Metropolitan Area, approved the following motion concerning the adoption of the Manual:

"The Board of Land Use Economics recommends that the Board of City Commissioners adopt the enabling ordinance to implement the Design Manual for Residential Streets. The Board also recommends that the City Commission instruct staff to conduct an annual review of the Manual for the purpose of updating it to reflect new developments in technology and to correct deficiencies of application in the field. The Board additionally recommends that clarification be made of the term 'licensed professional engineer' to mean an engineer from the private sector as well as a person on the City staff.

It is further recommended by the Board of Land Use Economics that the Board of County Commissioners also adopt the Manual on the same basis as stated above."



Karl J. Kennedy  
Industrial Analyst and  
Staff Ex officio member  
Board of Land Use Economics

KJK/st  
cc: Board of Land Use Economics Members  
Louise Alivarez, Senior Planner

**RECEIVED**

FEB 29 1980

METROPOLITAN PLANNING

ROUTE  \_\_\_\_\_  
 \_\_\_\_\_

EXCERPT FROM PLANNING COMMISSION MINUTES OF JANUARY 31, 1980

15. Consideration of "Design Manual" for Street Thickness.

LAKIN gave some background on the Design Manual. He said that the full report was prepared by Professional Engineering Consultants, and completed. It was reviewed by staff and agreed upon. He said that the consultants were asked to prepare a shortened version of the manual which could be used as a basis for design and perhaps tied to the Subdivision Regulations. He said that the City and County engineers were in agreement as to the basic parameters that are set forth in the manual, and the staff proposes that this become an official design criteria.

LAKIN commented that Commissioner Gardner had a question on slip form pavement and re-bar. He said that the City would accept slip form pavement and concrete projects without re-bar.

**MOTION:** Accept the design criteria with the understanding that, because of ongoing committee work, they anticipate developing several addendums to the Drainage Manual to clarify other elements that do relate to design criteria of streets. Gardner moved, Savina seconded and it carried unanimously. Jones and Lofton were absent.

-----

2-20-80

INSTRUCTIONS:

As an attachment, need both the original manual which is the April one, and the October supplement, which is the Supplementary Design Manual. Make sure that all design manuals that are supplementary design manual have page 3 modified as follows:

"On page 3 (see in marked of copy) Lakin has written in in the first four paragraphs the words (soaked samples) after the number 73. Make sure that all copies from this point forward go out with that.

In sending out this package to Public Works officials, etc., make sure there is a note attached to this report indicating "please see modification on page 3, re: soaked samples."

The third attachment would be the ordinance.

If we can do it, provide the minutes from the Planning Commission of <sup>1-31-80</sup>2/4/80, and see if copies can be gotten from Department of Economic Development, ~~the copies~~ of minutes of Land Use Economics Board where they approved it, <sup>2-4-80</sup>if so, put them as attachments also, making a total of 5 attachments.

When sending this out, there should be copies going to the full Planning Commission, full Land Use Economics Board, PEC, attn: both Carl Knop and Charles Freund; copy to BCOC Chairman; Freeman, Hill; Philbrick; Bruggeman, and Sellers. All of those people should have the original April 1979 book, and just put a sheet in there indicating

that copies have already been furnished. Everyone else (all people) should get the full package of minutes, ordinance, design supplements, etc.

3-11-80

Also, <sup>it</sup> this ~~does not~~ <sup>is</sup> scheduled to go on the City Commission agenda, send a notice of the fact that it is going on to the City Commission agenda, and the notices should be directed to Orville W. Daniels, Engineering Testing Company. Richard L. Luke, Wichita Testing Laboratories. Kent <sup>S</sup>chwieger, Wichita Testing Lab. Mike Thompson, Poe & Assoc. Fred Schoell, STSK, Inc.

Also a note directed to Daniels, Schoell and Luke; the same general subject and say:

The design supplement manual has been amended to require soak samples in ~~during~~ the testing for CBR values. This item will be on the City Commission agenda of March!! 1980

*OK from  
Dekker  
2-25*  
Have someone take this ordinance upstairs to Dekker and remind him that it was rewritten and prepared and remains unchanged as done by H. R. Kuhn.

The certificate of substantial completion should also be xeroxed and added to it.

Do same memorandum to the Board of County Commissioners with all of the packages going to all the same number of people, but

again they need not have two copies of the design manuals, etc., and just give them a copy of the County Resolution. Modify the note to the Soils Engineers indicating that this will go on the County Commission agenda at March 19 date.

Read through the memorandum and change whatever needs to be done to put it into the proper tense of going to the County Commission instead of the City Commission.

Please make sure somebody reads each and every line so that we don't put anything into it to give them a bad time.

Also a special note as soon as the resolution is done, sending it over to Craig Robinson at County Counselor's office:

done  
2-25-80

Craig:

Here's a revised copy of the street standard report. H. R. Kuhn did the City Ordinance over so that the Design Manual would be adopted by reference, and we meet the criteria of adopting a document by reference as per the State Statute. I believe the County falls under that same adoption by reference statute, so I have merely modified the City Ordinance to speak to County issues. The only thing that I have a question in is in the second paragraph of Section 5 relative to licensing or issuing permits

for street construction in the unincorporated area. I don't know whether you have such a procedure or not. ~~I have asked Galbraith of my staff to check that with Joe Freeman.~~

RAL

NOTE TO GALBRAITH:

✓  
Check the second paragraph, Section 5 of the County Resolution with Freeman. See if that should stay in. I am not sure they have contractor's permit for County folk. (Joe Freeman out of town until 3-3-80. Bill Payne said County does not have such a permit procedure).

RAL

✓  
One following note, and that's on the City Ordinance, I mentioned taking it up to Dekker and have him approve it with no changes, I did make a change in two words in Section 1. I don't think that creates any problem, but make sure it's pointed out.

OK  
See if you can get a bunch of copies of the Manuals off of Joe Freeman, particularly for distribution for the City Commission and County Commissioners. That would take about 8 or 10, depending on getting the Manager a copy, etc. You simply may have to xerox the rest of them. So before the County Resolution and stuff on, make sure you double check with Ted Hill, Craig Robinson and Freeman to make sure they have no problem with this going on.

*Pages and  
manuals  
available  
at County*

*11 studies  
provided by  
City Engineering*

*10 manuals  
to be provided  
by PEC*

Ruby:

There are two packs here, one with attachments to use for typing and attachments. The other is simply my notes to go along with things so that Jack can use them if he needs to. If there are any questions, make a note of it, and I can answer them if I call back in.

R E S O L U T I O N

A RESOLUTION ESTABLISHING DESIGN CRITERIA  
FOR URBAN TYPE RESIDENTIAL AND COLLECTOR  
STREETS AND INSPECTION PROCEDURES THEREFOR.

NOW BE IT RESOLVED BY THE BOARD OF COMMISS-  
IONERS OF SEDGWICK COUNTY, KANSAS, THAT:

*the unincorporated area of Sedgwick County*

SECTION 1. The "Supplementary Pavement Thickness Design Manual for Residential Streets Within the Wichita Metropolitan Area", published by Professional Engineering Consultants, P.A., October 1979 Edition, including the appendices and design graphs attached thereto, is by reference incorporated in and by this publication made a part of this ordinance as fully as though set forth at length herein, and is hereby adopted as the design, material and construction manual for all residential streets <sup>in</sup> of the City of Wichita, Kansas.

*urban*

*unincorporated area of Sedgwick County*

SECTION 2. All urban residential streets, as defined in the "Subdivision Regulations of the Wichita-Sedgwick County Metropolitan Area Planning Commission", hereinafter designed and constructed within the City of Wichita shall conform to the requirements set forth in the "manual" identified in Section 1 of this ordinance. Said regulations, to the extent necessary to give full effect to the provisions of this ordinance, are by reference incorporated in and by this publication made a part of this ordinance as fully as though set forth at length herein, and, to such extent, are hereby adopted as part of this ordinance.

*Resolution*

*Resolution*

*Resolution*

*County*

SECTION 3. The "manual" referred to in Section 1 and the "regulations" referred to in Section 2 of this ordinance, having been published as by law required, are on file in the offices of the City Clerk and the City Engineer of the City of Wichita, Kansas and are open to inspection and available to the public at all reasonable hours. The provisions of this ordinance shall be cumulative and are not intended to supercede other City of Wichita code provisions relating to street construction, licensing, traffic or use regulation.

*Resolution*

*Resolution*

SECTION 4. Plans for all streets covered by the provisions of this ordinance shall indicate that the design and proposed material conform to the criteria set forth in the "manual" identified in Section 1 of this ordinance and shall be signed with the name and seal of the Engineer responsible for their preparation.

*Sedgwick County*

*Resolution*

SECTION 5. Before any such street improvement shall be accepted by the City of Wichita, a certificate signed by the contractor and the licensed professional engineer responsible for project resident engineering shall be submitted to the City Commission stating that the construction is in compliance with the plans and specifications authorized under Section 1 hereof. In the event said construction fails to meet the above approved specifications, the matter shall be placed before the Board of Commissioners for determination of appropriate action. If during construction, the inspecting engineer determines there is a failure to meet specification, said inspecting engineer shall report the facts to the City Engineer who is hereby empowered to issue a stop work order until the job is brought back to specification. Final acceptance shall not free the Contractor from contractual agreements such as warranty or maintenance clauses provided in the contract documents.

*County*

*W. D. ...*

*the unincorporated area of Sedgewick County*

A contractor's permit for future street construction in the ~~City of Wichita~~ shall not be issued to any contractor who fails or refuses to fully comply with all rules and regulations necessary in the enforcement of this ~~ordinance~~.

<sup>*Resolution*</sup> SECTION 6. That this <sup>*Resolution*</sup> ordinance shall take effect and be in force from and after its adoption and publication in the official ~~City~~ paper.

<sup>*County*</sup> PASSED AND ADOPTED by the Board of County Commissioners at Wichita, Kansas, this \_\_\_\_\_ day of \_\_\_\_\_, 19\_\_.

\_\_\_\_\_, Chairman  
~~Tom Scott~~ *Everett Patrick*

\_\_\_\_\_, Commissioner  
Donald Gragg

\_\_\_\_\_, Commissioner  
~~Everett Patrick~~ *Tom Scott*

Approved as to form ~~City Attorney~~

*County Counselor*

ORDINANCE NO. \_\_\_\_\_

AN ORDINANCE REGULATING THE CONSTRUCTION OF RESIDENTIAL STREETS WITHIN THE CITY OF WICHITA, KANSAS; ESTABLISHING CRITERIA AS TO PAVEMENT DESIGN, MATERIAL AND CONSTRUCTION; AND PROVIDING FOR QUALITY CONTROL AND INSPECTION PROCEDURES THEREFOR.

BE IT ORDAINED BY THE GOVERNING BODY OF THE CITY OF WICHITA, KANSAS.

SECTION 1. The "Supplementary Pavement Thickness Design Manual for Residential Streets Within the Wichita Metropolitan Area", published by Professional Engineering Consultants, P.A., October 1979 Edition, including the appendices and design graphs attached thereto, is by reference incorporated in and by this publication made a part of this ordinance as fully as though set forth at length herein, and is hereby adopted as the design, material and construction manual for <sup>all</sup> residential streets of the City of Wichita, Kansas.

*Urban*  
SECTION 2. All urban residential streets, as defined in the "Subdivision Regulations of the Wichita-Sedgwick County Metropolitan Area Planning Commission", hereinafter designed and constructed within the City of Wichita shall conform to the requirements set forth in the "manual" identified in Section 1 of this ordinance. Said regulations, to the extent necessary to give full effect to the provisions of this ordinance, are by reference incorporated in and by this publication made a part of this ordinance as fully as though set forth at length herein, and, to such extent, are hereby adopted as part of this ordinance.

SECTION 3. The "manual" referred to in Section 1 and the "regulations" referred to in Section 2 of this ordinance, having been published as by law required, are on file in the offices of the City Clerk and the City Engineer of the City of Wichita, Kansas and are open to inspection and available to the public at all reasonable hours. The provisions of this ordinance shall be cumulative and are not intended to supercede other City of Wichita code provisions relating to street construction, licensing, traffic or use regulation.

SECTION 4. Plans for all streets covered by the provisions of this ordinance shall indicate that the design and proposed material conform to the criteria set forth in the "manual" identified in Section 1 of this ordinance and shall be signed with the name and seal of the Engineer responsible for their preparation.

SECTION 5. Before any such street improvement shall be accepted by the City of Wichita, a certificate signed by the contractor and the licensed professional engineer responsible for project resident engineering shall be submitted to the City Commission stating that the construction is in compliance with the plans and specifications authorized under Section 1 hereof. In the event said construction fails to meet the above approved specifications, the matter shall be placed before the Board of Commissioners for determination of appropriate action. If during construction, the inspecting engineer determines there is a failure to meet specification, said inspecting engineer shall report the facts to the City Engineer who is hereby empowered to issue a stop work order until the job is brought back to specification. Final acceptance shall not free the Contractor from contractual agreements such as warranty or maintenance clauses provided in the contract documents.

*City of Wichita*

A contractor's permit for future street construction in the City of Wichita shall not be issued to any contractor who fails or refuses to fully comply with all rules and regulations necessary in the enforcement of this ordinance.

SECTION 6. That this ordinance shall take effect and be in force from and after its adoption and publication in the official City paper.

ADOPTED AT WICHITA, KANSAS, \_\_\_\_\_.

ATTEST:

\_\_\_\_\_  
Tony Casado Mayor

\_\_\_\_\_  
Donald C. Giesick City Clerk  
(SEAL)

\_\_\_\_\_  
Approved as to form City Attorney

BOARD OF LAND USE ECONOMICS

City of Wichita

RECEIVED

FEB 1 1980

METROPOLITAN PLANNING

ROUTE

Regular Meeting  
9:00 a.m., Wednesday, February 6, 1980  
Department of Housing and Economic Development Conference Room  
City Hall - Eleventh Floor  
455 North Main Street  
Wichita, Kansas 67202

A G E N D A

1. Pavement Design

Mr. Robert Lakin, Director of Planning, has presented a document concerning street standards for the City and County. Mr. Lakin will be present at the Board's meeting to discuss the document and to recommend action for the Board to take.

ACTION: Discuss the document on street standards and take such action as the Board deems appropriate.

2. 1979 Annual Report

City of Wichita Administrative Regulation No. 15 requires that each city board and commission submit an annual report to the City Manager's office by March 1, 1980. Staff has prepared an annual report for the Board of Land Use Economics that also includes the Real Estate Advisory Board's activities for the months January through June of 1979.

ACTION: Approve the annual Report for submittal to the City Manager's office.

3. Discussion on Data Relating to Housing in the City

Staff has mailed a questionnaire to several cities across the United States requesting information on homes relating to costs and taxes. This same type of data has also been obtained for Wichita and eight other cities located in the central portion of the United States. Staff will present the information obtained from the questionnaires if any have returned prior to the meeting of the Board.

ACTION: Discuss the data obtained by staff and take such action as the Board deems necessary.

4. Other Items

5. Adjournment

Street Stnds

1-30-80  
PEC.

Robert G. Laska - MAPD.

Orval W. Daniels - Engineering Testing Co.

RICHARD LUKE WICHITA TESTING LABS

Kent Schwieger - Wichita Testing Labs.

Mike Thompson - Poe & Assoc.

Charles Freund PEC

Carl Knop PEC

Karl Horner PEC

FRED SCHOELL STSK, Inc

? on what are minimum  
Daniels - CBR, soaked or dry -

~~Schwieger~~  
Subgrade = min 6"

Need to add \*  
Reference

? 2x minimum ID - max 30 CBR.

**WTL** WICHITA TESTING LABORATORIES

A  
DIVISION  
OF

HOSKINS-WESTERN-SONDEREGGER, INC.  
ENGINEERS-ARCHITECTS-PLANNERS-SURVEYORS

810 EAST MURDOCK  
WICHITA, KS 67214  
PHONE: 316-264-4328

RICHARD L. LUKE  
MANAGER



ENGINEERING TESTING COMPANY  
WICHITA, KANSAS

ORVAL W. DANIELS

535 N. WASHINGTON  
PHONE 265-8553

WICHITA-SEDGWICK COUNTY

DATE

January 25, 1980

**METROPOLITAN AREA PLANNING DEPARTMENT**

TO Metropolitan Area Planning Commissioners

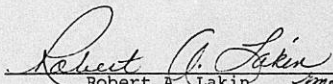
FROM Robert A. Lakin, Director of Planning

SUBJECT Pavement Design

Attached is a revised ordinance on pavement design. The changes basically provide for adoption by reference of the design manual as required by Statute.

On the issue of street widths, slip form pavement, etc., I would expect those items to come forth from the various subcommittees as subsequent actions from their meetings.

I will be prepared to discuss this further with you at your meeting.

  
Robert A. Lakin  
Director of Planning

RAL:rme  
Attachment

ORDINANCE NO. \_\_\_\_\_

AN ORDINANCE REGULATING THE CONSTRUCTION OF RESIDENTIAL STREETS WITHIN THE CITY OF WICHITA, KANSAS; ESTABLISHING CRITERIA AS TO PAVEMENT DESIGN, MATERIAL AND CONSTRUCTION; AND PROVIDING FOR QUALITY CONTROL AND INSPECTION PROCEDURES THEREFORE.

BE IT ORDAINED BY THE GOVERNING BODY OF THE CITY OF WICHITA, KANSAS.

SECTION 1. The "Supplementary Pavement Thickness Design Manual for Residential Streets Within the Wichita Metropolitan Area", published by Professional Engineering Consultants, P.A., October 1979 Edition, including the appendices and design graphs attached thereto, is by reference incorporated in and by this publication made a part of this ordinance as fully as though set forth at length herein, and is hereby adopted as the design, material and construction manual for residential streets of the City of Wichita, Kansas.

SECTION 2. All urban residential streets, as defined in the "Subdivision Regulations of the Wichita-Sedgwick County Metropolitan Area Planning Commission", hereinafter designed and constructed within the City of Wichita shall conform to the requirements set forth in the "manual" identified in Section 1 of this ordinance. Said regulations, to the extent necessary to give full effect to the provisions of this ordinance, are by reference incorporated in and by this publication made a part of this ordinance as fully as though set forth at length herein, and, to such extent, are hereby adopted as part of this ordinance.

SECTION 3. The "manual" referred to in Section 1 and the "regulations" referred to in Section 2 of this ordinance, having been published as by law required, are on file in the offices of the City Clerk and the City Engineer of the City of Wichita, Kansas and are open to inspection and available to the public at all reasonable hours. The provisions of this ordinance shall be cumulative and are not intended to supercede other City of Wichita code provisions relating to street construction, licensing, traffic or use regulation.

SECTION 4. Plans for all streets covered by the provisions of this ordinance shall indicate that the design and proposed material conform to the criteria set forth in the "manual" identified in Section 1 of this ordinance and shall be signed with the name and seal of the Engineer responsible for their preparation.

SECTION 5. Before any such street improvement shall be accepted by the City of Wichita, a certificate signed by the contractor and the licensed professional engineer responsible for project resident engineering shall be submitted to the City Commission stating that the construction is in compliance with the plans and specifications authorized under Section 1 hereof. In the event said construction fails to meet the above approved specifications, the matter shall be placed before the Board of Commissioners for determination of appropriate action. If during construction, the inspecting engineer determines there is a failure to meet specification, said inspecting engineer shall report the facts to the City Engineer who is hereby empowered to issue a stop work order until the job is brought back to specification. Final acceptance shall not free the Contractor from contractual agreements such as warranty or maintenance clauses provided in the contract documents.

A contractor's permit for future street construction in the City of Wichita shall not be issued to any contractor who fails or refuses to fully comply with all rules and regulations necessary in the enforcement of this ordinance.

SECTION 6. That this ordinance shall take effect and be in force from and after its adoption and publication in the official City paper.

ADOPTED AT WICHITA, KANSAS, \_\_\_\_\_

ATTEST:

\_\_\_\_\_  
Mayor

\_\_\_\_\_  
City Clerk

(SEAL)

\_\_\_\_\_  
Approved as to form City Attorney

WICHITA-SEDGWICK COUNTY

DATE  
January 10, 1980

METROPOLITAN AREA PLANNING DEPARTMENT

RE: AGENCY ITEM NO

TO Metropolitan Area Planning Commission  
Land Use Economic Board

FROM Robert Lakin, Director of Planning

SUBJECT Pavement Design

The City and County jointly have had prepared a pavement design and feasibility study prepared by Professional Engineering Consultants. This study examined construction design standards for residential and collector streets. Twenty and forty year, asphalt and concrete designs were evaluated. The results of the study include:

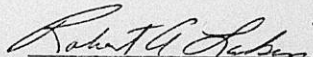
- design parameters for both concrete and asphalt streets.
- a conclusion that 40 year design life streets are cost efficient in this Wichita urban area.
- a reduction in thickness of streets if additional work (compaction) on the base is done.

Both City and County staffs have agreed to the conclusions and the attached Design Manual has been prepared by Professional Engineering Consultants as the basis for design. The special subcommittee has reviewed the study with staff and PEC and believes it is ready for submission to the governing bodies.

In order to ensure compliance to these design standards, it is felt that each governing body, the City and County, should adopt the Design Manual by Ordinance and Resolution respectively. This then will leave the design engineer latitude in design, trading cost of materials, i.e., concrete and asphalt, with base preparation costs, labor, and equipment. The inspecting engineer, either staff or consultant, would be bound to recommend accepting or not accepting a job based on its compliance with the design specifications given which in turn will be based on the attached design parameters.

Recommendation: Approve the design study and recommend its adoption by each governing body by appropriate Ordinance or Resolution.

Attachments: - Design Manual  
- Resolution  
- Ordinance

  
Robert A. Lakin, Director

CC: William Keltner, Professional Engineering Consultants, 1440  
East English, Wichita, Ks. 67211  
Charles Freund, Professional Engineering Consultants, 1440  
East English, Wichita, Ks. 67211  
Carl Knop, Professional Engineering Consultants, 1440 East  
English, Wichita, Ks. 67211  
Dave Ritchie, Ritchie Brothers, 1900 Amidon, Wichita, Ks. 67203  
Major Inc., 4323 W. 31st Street South, Wichita, Ks. 67215  
L. A. Knebler Construction Co., Inc., Rt. 1, Augusta, Ks.  
Mid-Kansas Construction Co., Inc., 1245 S. Santa Fe, Wichita, Ks.  
67211  
Wichita Association of Homebuilders, 730 N. Main, Wichita, Ks. 67203  
Wichita Board of Realtors, 717 N. Emporia, Wichita, Ks. 67214  
Delamater Freund & Associates PA, Century Plaza Bldg, 111 West  
Douglas, Wichita, Ks. 67202  
Moehring & Associates, Consulting Engineers, 433 South Hydraulic,  
Wichita, Ks. 67211  
Reiss & Goodness Engineers, 2160 W. 21st Street, Wichita, Ks. 67203  
Kenneth O. Taylor Consulting Engineer, 1542 S. St. Francis, Wichita,  
Kansas 67211  
Van Doren-Hazard-Stallings Architects/Engineers, 260 N. Rock Road,  
Wichita, Ks. 67206  
Wilson & Company Engineers & Architects, 218 North Waco, Wichita,  
Kansas 67202  
Castle PA Engineers, 4801 Irving, Wichita, Kansas 67209  
Poe & Associates Inc., 1720 East Morris, Wichita, Ks. 67211  
Ray Bruggeman, Director of Public Works  
Joe Freeman, County Department of Public Works  
Theodore H. Hill, County Counselor  
John Philbrick, County Department of Administration  
Dean Sellers, City Engineering  
E. H. Denton, City Manager  
John Dekker, Director of Law  
Thomas Powell, Assistant City Attorney

R E S O L U T I O N

A RESOLUTION ESTABLISHING DESIGN CRITERIA FOR  
URBAN TYPE RESIDENTIAL AND COLLECTOR STREETS  
AND INSPECTION PROCEDURES THEREFORE.

NOW BE IT RESOLVED BY THE BOARD OF COMMISSIONERS  
OF SEDGWICK COUNTY, KANSAS, THAT:

SECTION 1. All urban residential streets (as defined in the Subdivision Regulation) herein-after designed and built within the unincorporated area of Sedgwick County shall conform to the design criteria set forth in the document entitled "Supplementary Pavement Thickness Design Manual for Residential Streets within the Wichita Metropolitan Area", prepared by Professional Engineering Consultants, P.A. Engineer, October 1979. Plans for any such streets shall indicate that the design conforms to these criteria and shall be signed with the name and seal of the Engineer responsible for their preparation.

SECTION 2. Before any such street improvement shall be accepted by the County of Sedgwick, a certificate signed by the contractor and the licensed professional engineer responsible for project resident engineering shall be submitted to the County Commission stating that the construction is in compliance with the plans and specification authorized under Section 1 hereof. In the event said construction fails to meet the above approved specifications, the matter shall be placed before the Board of Commissioners for determination of appropriate action. If during construction, the inspecting engineer determines there is a failure to meet specification, said inspecting engineer shall report the facts to the Director of Public Works who is hereby empowered to issue a stop work order until the job is brought back to specification. Final acceptance shall not free the Contractor from contractual agreements such as warranty or maintenance clauses provided in the contract documents.

SECTION 3. That this Resolution shall take effect and be in force from and after its adoption and publication once in the official County paper.

PASSED AND ADOPTED by the Board of County Commissioners at Wichita, Kansas, this \_\_\_\_\_ day of \_\_\_\_\_, 1980.

\_\_\_\_\_, Chairman

\_\_\_\_\_, Commissioner

\_\_\_\_\_, Commissioner

ATTEST:

\_\_\_\_\_  
Dorothy K. White, County Clerk

(SEAL)

APPROVED AS TO FORM:

\_\_\_\_\_  
Theodore H. Hill, County Counselor

ORDINANCE NO. \_\_\_\_\_

**AN ORDINANCE ESTABLISHING DESIGN CRITERIA FOR  
URBAN TYPE RESIDENTIAL AND COLLECTOR STREETS  
AND INSPECTION PROCEDURES THEREFORE.**

**BE IT ORDAINED BY THE GOVERNING BODY OF THE  
CITY OF WICHITA, KANSAS.**

SECTION 1. All urban residential (as defined in the Subdivision Regulation) streets herein-after designed and built within the City of Wichita shall conform to the design criteria set forth in the document entitled "Supplementary Pavement Thickness Design Manual for Residential Streets within the Wichita Metropolitan Area", prepared by Professional Engineering Consultants, P.A. Engineer, October 1979. Plans for any such streets shall indicate that the design conforms to these criteria and shall be signed with the name and seal of the Engineer responsible for their preparation.

SECTION 2. Before any such street improvement shall be accepted by the City of Wichita, a certificate signed by the contractor and the licensed professional engineer responsible for project resident engineering shall be submitted to the City Commission stating that the construction is in compliance with the plans and specifications authorized under Section 1 hereof. In the event said construction fails to meet the above approved specifications, the matter shall be placed before the Board of Commissioners for determination of appropriate action. If during construction, the inspecting engineer determines there is a failure to meet specification, said inspecting engineer shall report the facts to the City Engineer who is hereby empowered to issue a stop work order until the job is brought back to specification. Final acceptance shall not free the Contractor from contractual agreements such as warranty or maintenance clauses provided in the contract documents.

SECTION 3. That this Ordinance shall take effect and be in force from and after its adoption and publication in the official City paper.

ADOPTED AT WICHITA, KANSAS, \_\_\_\_\_.

ATTEST:

\_\_\_\_\_  
Mayor

\_\_\_\_\_  
City Clerk

(SEAL)

\_\_\_\_\_  
Approved as to form City Attorney

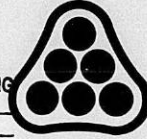
**DIRECTORS**

C. O. KNOP, P.E.  
R. B. FEUGH, P.E.  
C. J. FREUND, P.E.  
W. H. KELTNER, P.E.  
R. D. PLETCHER, P.E.  
P. D. MIDDLETON, JR., P.E.  
K. R. HORNER, P.E.  
D. E. MALTSIE, P.E.  
M. D. SCHOMAKER, P.E.

**RECEIVED**

JAN 10 1980

**METROPOLITAN PLANNING**  
ROUTE



**PROFESSIONAL  
ENGINEERING  
CONSULTANTS**  
PROFESSIONAL ASSOCIATION

January 9, 1980

Mr. Robert A. Lakin  
Director of Planning  
City Hall  
455 North Main Street  
Wichita, Kansas 67202

Re: Residential Street Pavement Design  
PEC File No. 30-78068-042

Dear Bob:

Attached is a copy of your suggested resolution for adopting pavement design criteria for Sedgwick County with possible verbiage changes in Section 2. (This would apply to the City Ordinance also.)

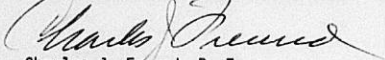
We have also enclosed a standard NSPE form we frequently use when we perform project resident services as we discussed in our telephone conversation. We assume use of this form would suffice for the intention and conditions of Section 2.

We wish to assure that the Contractor will be responsible for all construction deficiencies particularly during his warranty or maintenance period. Our general conditions stipulate that final acceptance of the work by the Engineer does not free the Contractor from contractual agreements provided in the Contract Documents.

We hope this will be of benefit to you.

Very truly yours,

PROFESSIONAL ENGINEERING CONSULTANTS, P. A.

  
Charles J. Freund, P. E.  
Vice President

CJF:1o  
Enclosures

1440 EAST ENGLISH  
WICHITA, KANSAS 67211  
(316) 262-2681

ROUTE SLIP

(PLEASE CIRCLE DESTINATION)

- |                                  |                               |                            |
|----------------------------------|-------------------------------|----------------------------|
| <b>Administration</b>            | <b>Community Facilities</b>   | <b>Park Department</b>     |
| Budget                           | Building Services             | Forestry                   |
| Contracts Admin.                 | Century II                    | Recreation                 |
| Controller                       | Community Arts                | <b>Planning Department</b> |
| Data Processing                  | Omnisphere                    | Empl. &                    |
| Purchasing                       | <b>Credit Union</b>           | Training Center            |
| Print Shop                       | <b>Emergency</b>              | Graphics                   |
| Stationery Stores                | <b>Communications</b>         | Job Teams                  |
| Ret. & Insurance                 | <b>Fire Department</b>        | <b>Police Department</b>   |
| Treasurer                        | Grievance Office              | Motor Pool                 |
| <b>Airport Authority</b>         | <b>Health Department</b>      | <b>Public Works</b>        |
| <b>Art Museum</b>                | <b>Housing &amp; Economic</b> | Administration             |
| <b>City Manager</b>              | <b>Development</b>            | Engineering                |
| C.P.O.                           | Adm. & Finance                | Flood Control              |
| City Clerk                       | Central Inspection            | Maintenance                |
| City Commission                  | Energy Resources              | Traffic Engineering        |
| Community Action                 | Industrial Development        | <b>Urban Renewal</b>       |
| Community Services               | Local Housing Authority       | <b>Water Department</b>    |
| Com./Status of Women             | <b>Law Department</b>         | Accounting                 |
| Personnel                        | Library                       | Engineering                |
| Personnel Training               | M.T.A.                        | Filter Plant               |
| Public Affairs                   | <b>Municipal Court</b>        | Gas Utility                |
| <b>Civil Rights &amp; E.E.O.</b> |                               | Mains & Services           |
|                                  |                               | Water Pol. Control         |

For: Thomas L. Lowell

For your information For your comments

MESSAGE:

Signed THALPD Date 1/7/80  
#000-013 R3 79

WICHITA-SEDGWICK COUNTY

METROPOLITAN AREA PLANNING DEPARTMENT

DATE

January 7, 1979

1980

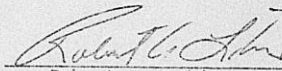
TO Ray Bruggeman, Director of Public Works  
Dean Sellers, City Engineering  
John Dekker, Director of Law  
✓ Thomas R. Powell, Assistant City Attorney  
Theodore H. Hill, County Counselor  
John Philbrick, County Department of Administration  
Joe Freeman, County Department of Public Works  
Charlie Freund, Professional Engineering Consultants

From: Robert A. Lakin, Director of Planning

Subject: Pavement Design

Attached is a draft memo with recommended actions which I would like to send to the Metropolitan Area Planning Commission on January 11 for their action on January 17. We will also send it to the Land Use Economics Board of the City for their next meeting (February 6).

Please review the memo and adopting Resolution/Ordinance. If you have suggested improvements or changes, call me at 268-4425.

  
Robert A. Lakin  
Director of Planning

RAI:irme  
Attachments



D R A F T

January 4, 1979

To ( Metropolitan Area Planning Commission  
Land Use Economic Board  
Pavement Design

The City and County jointly have had prepared a pavement design and feasibility study prepared by Professional Engineering Consultants. This study examined construction design standards for residential and collector streets. Twenty and forty year, asphalt and concrete designs were evaluated. The results of the study include:

- design parameters for both concrete and asphalt streets.
- a conclusion that 40 year design life streets are cost efficient in this Wichita urban area.
- a reduction in thickness of streets if additional work (compaction) on the base is done.

Both City and County staffs have agreed to the conclusion and the attached <sup>Design Manual</sup> ~~summary of the study~~ has been prepared by Professional Engineering Consultants as the basis for design. The special sub-committee has reviewed the study with staff and PEC and believes it is ready for submission to the governing bodies.

CC alt Eng  
PEC alt  
2 inches  
Vandy

Richard  
Kendall, PE  
Dagmar

Met. U.S. Comm.

WASH

B. J. Real Estate

Wichita

Wichita

Wichita

Wichita

Wichita

Wichita

Wichita

Wichita

Wichita

Wichita

Wichita

Wichita

Wichita

Wichita

1/11/79

In order to ensure compliance to these design standards, it is felt that each governing body, the City and County, should adopt the ~~Summary Guide~~ <sup>Design Manual</sup> by Ordinance and Resolution respectively. This then will leave the design engineer latitude in design trading cost of materials, i.e., concrete and asphalt with base preparation costs labor and equipment. The inspecting engineer, either staff or consultant would be bound to recommend accepting or not accepting a job based on its compliance with the design specifications given which in turn will be based on the attached design parameters.

Recommendation: Approve the design study and recommend its adoption by each governing body by appropriate Ordinance or Resolution.

Attach - Design Manual  
- Resolution  
- Ordinance

ORDINANCE NO. \_\_\_\_\_

AN ORDINANCE ESTABLISHING DESIGN CRITERIA  
FOR URBAN TYPE RESIDENTIAL AND COLLECTOR  
STREETS AND INSPECTION PROCEDURES THEREFORE.

BE IT ORDAINED BY THE GOVERNING BODY OF  
THE CITY OF WICHITA, KANSAS.

SECTION 1. All urban and residential streets herein  
after designed and built within the unincorporated area of <sup>CAW</sup>  
Sedgwick County shall conform to the design criteria set forth  
in the document entitled "Supplementary Pavement Thickness  
Design Manual for Residential Streets within the Wichita  
Metropolitan Area", prepared by Professional Engineering  
Consultants, P.A. Engineer, October 1979. Plans for any such  
streets shall indicate that the design conforms to these  
criteria and shall be signed with the name and seal of the  
Engineer responsible for their preparation.

SECTION 2. Before any such street shall be accepted  
by the City of Wichita, a certificate signed by a licensed  
professional engineer shall be submitted to the City Commis-  
sion stating that the construction meets the plans and specifi-  
cations authorized under Section 1 hereof. In the event said  
construction fails to meet the above approved specifications,  
the matter shall be placed before the Board of Commissioners  
for determination of appropriate action. If during construction,  
the inspecting engineer determines there is a failure to meet  
specification, said inspecting engineer shall report the facts  
to the City Engineer who is hereby empowered to issue a stop  
work order until the job is brought back to specification.

SECTION 3. That this Ordinance shall take effect and  
be in force from and after its adoption and publication in the  
official City paper.

ADOPTED AT WICHITA, KANSAS, \_\_\_\_\_.

ATTEST:

\_\_\_\_\_  
Mayor

\_\_\_\_\_  
City Clerk

(SEAL)

Approved as to form \_\_\_\_\_  
City Attorney

R E S O L U T I O N

A RESOLUTION ESTABLISHING DESIGN CRITERIA  
FOR URBAN TYPE RESIDENTIAL AND COLLECTOR  
STREETS AND INSPECTION PROCEDURES THEREFORE.

NOW BE IT RESOLVED BY THE BOARD OF COMMISS-  
SIONERS OF SEDGWICK COUNTY, KANSAS, THAT:

SECTION 1. All urban and residential streets herein-  
after designed and built within the unincorporated area of  
Sedgwick County shall conform to the design criteria set forth  
in the document entitled "Supplementary Pavement Thickness  
Design Manual for Residential Streets within the Wichita  
Metropolitan Area", prepared by Professional Engineering  
Consultants, P.A. Engineer, October 1979. Plans for any such  
streets shall indicate that the design conforms to these  
criteria and shall be signed with the name and seal of the  
Engineer responsible for their preparation.

SECTION 2. Before any such street shall be accepted  
by the County of Sedgwick, a certificate signed by a licensed  
professional engineer shall be submitted to the County Commis-  
sion stating that the construction meets the plans and specifi-  
cation authorized under Section 1 hereof. In the event said  
construction fails to meet the above approved specifications,  
the matter shall be placed before the Board of Commissioners  
for determination of appropriate action. If during construction,  
the inspecting engineer determines there is a failure to meet  
specification, said inspecting engineer shall report the facts  
to the Director of Public Works who is hereby empowered to issue  
a stop work order until the job is brought back to specification.

SECTION 3. That this Resolution shall take effect and  
be in force from and after its adoption and publication once in  
the official County paper.

PASSED AND ADOPTED by the Board of County Commissioners  
at Wichita, Kansas, this \_\_\_\_\_ day of \_\_\_\_\_, 19\_\_\_\_.

\_\_\_\_\_, Chairman  
Tom Scott

\_\_\_\_\_, Commissioner  
Donald Gragg

\_\_\_\_\_, Commissioner  
Everett Patrick

ATTEST:

\_\_\_\_\_  
Dorothy K. White, County Clerk

(SEAL)

APPROVED AS TO FORM:

Theodore H. Hill, County Counselor