PAVEMENT DESIGN CRITERIA

FOR

CITY OF PUEBLO COLORADO

DEPARTMENT OF PUBLIC WORKS
211 EAST "D" STREET
PUEBLO, COLORADO 81003

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ADOPTED September 22, 2025

city of PUEBLO colorado

RESOLUTION NO. 16144

A RESOLUTION ADOPTING AND APPROVING THE PAVEMENT DESIGN CRITERIA FOR THE CITY OF PUEBLO DATED SEPTEMBER 22, 2025

BE IT RESOLVED BY THE CITY COUNCIL OF PUEBLO, that

SECTION 1.

Pursuant to and in furtherance of Sections 4-2-2(i), 12-4-7, 12-4-6(b)(2)(g) and 12-4-7(J)(2) of the Pueblo Municipal Code, as amended, and upon recommendation by the City Engineer, The City Council does hereby adopt and approve Pavement Design Criteria for the City of Pueblo, Dated September 22, 2025, a true copy of which is attached hereto and made a part hereof by reference (hereinafter referred to as the "Pavement Design Criteria"). The City Council declares that the design and construction of all classifications of streets within the public right-of-way and all private streets, alleys, or access roads constructed on private property which are subject to a public access easement for all subdivision (and resubdivisions) approved by the City Council after the date of approval of this Resolution shall comply with said Pavement Design Criteria and all other provisions of Title 12 of the Pueblo Municipal Code, as amended.

SECTION 2.

After adoption of this Resolution, a true copy of the Pavement Design Criteria shall be maintained on file in the office of the City Clerk for public inspection. Copies of the Pavement Design Criteria shall be made available through the City's Department of Public Works for purchase by the public at a moderate price.

SECTION 3.

This Resolution and the Pavement Design Criteria hereby approved and adopted amend and supersede in their entirety Resolution Number 10041 and the prior Pavement Design Criteria.

SECTION 4.

The officers of the City are authorized to perform any and all acts consistent with the intent of the Resolution to implement the policies and procedures described herein.

SECTION 5.

This Resolution shall become effective immediately upon final approval.

INTRODUCED: September 22, 2025

BY: Brett Boston
MEMBER OF CITY COUNCIL

DocuSigned by:
APPROVED: Mark Aliff
B7A4E51823AB462...
PRESIDENT OF CITY COUNCIL

DocuSigned by:
ATTESTED BY: ______________
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CITY CLERK

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PAVEMENT DESIGN CRITERIA FOR THE CITY OF PUEBLO

CHAPTER 1. GENERAL PROVISIONS

1.1 Jurisdiction

The pavement design criteria set forth in this manual is adopted pursuant to the authority of Sections 4-2-2(i), 12-4-2(7), 12-4-6(b)(2)(g) and 12-4-7(J)(2) of the Pueblo Municipal Code, and shall apply to the design and construction of all classifications of streets and alleys constructed within the public right-of-way, and those private streets, alleys, or access roads constructed on private property which are subject to a public access easement.

1.2 Purpose and Intent

It is the purpose and intent of the pavement design criteria contained in this manual to promote the health, safety, convenience, and general welfare of the people of Pueblo, Colorado. They are not intended, nor should they be construed, to create any new rights, remedies, or benefits for any person, firm, corporation or entity.

All Master Development Plans, Subdivision, Resubdivisions, Planned Unit Developments, Special Area Plans, or other proposed construction submitted for approval under the provisions of Title 12, Chapter 4 of the Pueblo Municipal Code shall comply with the pavement design criteria set forth herein. All pavement designs, analyses, and reports shall be prepared under the supervision of a Professional Engineer (Engineer), licensed as such in the State of Colorado.

1.3 Permits and Other Requirements

The developer, land owner and/or land owner's representative shall be required to obtain all permits required by Federal, State, or local Agencies in conjunction with work covered under this manual, and shall be required to comply with requirements which may be imposed directly by such agencies or which may be indirectly necessitated in order for the City to comply with any system wide permit which may be issued to the City.

1.4 Liability

The adoption of this manual shall not create any duty to any person, firm, corporation, or other entity with regard to the application, enforcement or nonenforcement of this manual. No persons, firm, corporation, or other entity shall have a private right of action, claim or civil liability remedy against the City of Pueblo, or its officers, employees or agents, for any damage arising out of or in any way connected with the adoption, application, enforcement, or nonenforcement of this manual. Nothing in this manual shall be construed to create any liability under, or to waive any of the immunities, limitations on liability, or other provisions of, the Governmental Immunity Act, C. R. S.

24-10-101 et seq., or to waive any immunities or limitations on liability otherwise available to the City of Pueblo or its officers, employees or agents.

Review and approval by the City of pavement improvements proposed in submittals does not relieve the engineer who designed such improvements from his professional responsibilities for the adequacy of the design of said improvements.

CHAPTER 2 - GEOTECHNICAL INVESTIGATION FOR PAVEMENT DESIGN

2.1 General

The purpose of this chapter is to present the City of Pueblo (City) requirements for geotechnical investigations for pavement design on all streets within the City. The requirements outlined hereafter are the minimum accepted standard for geotechnical investigations and reports submitted to the City whether the pavement design is being performed by the City, Contractor, or Developer.

2.2 Geotechnical Investigation

2.2.1 Field Investigation

The field investigation shall consist of borings or other suitable methods of sampling the subgrade soils at horizontal spacings not greater than about 350 feet; however, a minimum of one boring shall be obtained for any roadway segment. A roadway segment is defined as a portion of roadway beginning at an intersection and ending at the next intersection or a termination point such as a cul-de-sac. Where proposed roadways include 2 or more lanes in each direction, boring locations shall be alternated between direction of travel at horizontal spacings not greater than about 250 feet. The City may require more frequent testing at its discretion.

Borings shall be taken to a minimum depth of 10 feet below the design subgrade elevation. Samples of each material type encountered in each boring shall be collected for testing.

Borings shall be performed after roadways have been rough graded and installation of utilities within the roadways have been completed. Samples collected should be representative of the soils and bedrock conditions present, including utility trench backfill, imported fill materials, and native subgrade materials.

The City may allow borings to be performed prior to completion of rough grading and utility installation, provided proposed fill materials (if required) for roadway construction can be clearly identified and sampled, utility trenches will be backfilled with excavated materials, and borings extend to a minimum depth of 10 feet below the design subgrade elevation.

If borings are performed prior to completion of rough grading and utility installation, the owner / developer shall submit a signed and sealed letter from the geotechnical engineer upon completion of rough grading confirming the conditions observed subsequent to rough grading do not change the pavement design recommendations. In addition, the City may require additional sampling be performed as rough grading and utility installation are completed to confirm that similar conditions to those identified in the report exist.

No paving shall be performed until a Pavement Release Form has been issued by the City Engineer.

2.2.2 Classification Testing

Subgrade samples collected from each boring and proposed borrow site shall be tested for the following properties:

- Liquid Limit
- Plastic Limit
- Percent Swell
- Percent Passing 200 Sieve
- Gradation (AASHTO A-1 and A-3 soils)
- Moisture Content

The results of these tests shall be used to calculate the AASHTO Classification and Group Index in accordance with AASHTO method M-145.

2.2.3 Soil Grouping

To facilitate laboratory testing for Hveem Stabilometer (R-value) and California Bearing Ratio (CBR), field samples can be combined to form composite samples. Composite samples shall be obtained by combining soils with the same AASHTO Classification. The difference between the highest and lowest Group Index value of soil samples used in a composite sample shall not exceed 10. As such, where the difference in Group Index values within a given classification exceeds 10, it may be necessary to create more than one composite sample within a given AASHTO Classification. Composite samples shall be subject to Classification Testing as outlined in Section 2.2.2.

2.2.4 Subgrade Support Testing

Individual subgrade or composite samples shall be tested to determine the subgrade support value using Hveem Stabilometer (R-value). The design R-value shall be 300 pounds per square inch (psi) exudation pressure. Reported data for each sample shall include test procedure reference, dry density and moisture content, expansion pressure, and exudation pressure with corrected R-value curve showing the 300-psi design R-value.

As an alternative, subgrade support values can be determined using the California Bearing Ratio (CBR) test. Reported data for each sample shall include test procedure reference, values requested in AASHTO T-193, stress versus penetration curves, CBR versus dry density curves and Proctor curves.

2.2.5 Swell Testing

Relatively undisturbed or remolded samples representative of potentially expansive subgrade materials shall be tested for percent swell. Samples shall be remolded to not less than the minimum recommended compaction criteria specified by the geotechnical engineer at not more than the lowest recommended moisture content. Swell tests shall generally be performed under a surcharge pressure of 150 pounds per square foot (psf). However, the surcharge pressure may be modified as determined by the geotechnical engineer to account for predicted overburden conditions.

CHAPTER 3 - PAVEMENT DESIGN CRITERIA

3.1 General

The purpose of this chapter is to present the City of Pueblo (City) requirements for pavement design on all streets within the City. The requirements outlined hereafter are the minimum accepted standard for pavement design and reports submitted to the City.

3.2 Subgrade Characteristics

3.2.1 Swell Potential

All soil groups, excluding A-1 through A-4, shall be tested to determine swell or settlement potential. Tests shall be run on the “California Spoon” samples in accordance with ASTM D 4546 at a surcharge of 200 psf. The swell tests shall be plotted and the precent swell/settlement and swell pressure (psf) shall be determined and reported. Test results which are suspected of being too high or too low for the soil type shall not be considered in the design of the pavement, but shall be reported. In the field these soils not consistent with the remainder of the site’s soils shall be removed by over excavation. The project’s geotechnical engineer shall define the limits of the over excavation in the field. Any deletion of data shall be justified in the report.

As a minimum, the report shall stipulate the following: the required depth of moisture treatment of the subgrade and shall be determined by the highest percentage of swell as recorded as a whole number.

Moisture treatment shall achieve moisture content and compaction as specified in the City of Pueblo Standard Construction Specifications and Standard Details, most current revision.
Soils with >5% swell shall require swell mitigation in addition to moisture treatment.

3.2.2 Resilient Modulus

Subgrade support characteristics for AASHTO and City of Pueblo designs are measured using Resilient Modulus. Since it is not practical to use Resilient Modulus testing for most projects, alternative established laboratory testing methods and correlations are provided.

3.2.2.1 A-1, A-2-5, A-2-7, A-3, A-4, and A-5

For soil types, A-1, A-2-5, A-2-7, A-3, A-4, and A-5 Resilient Modulus, M_R shall be determined by R-Value conversion. R-Value shall be determined in accordance with AASHTO T 190. The following formula based on the Colorado Department of Transportation; “Roadway Design Manual” shall be utilized to convert Hveem “R” to M_R.

$$M_R = (0.75)10^Z; where\ Z = 0.0142R + 3.4098$$

3.2.2.2 A-2-4, A-2-6, A-6, A-7-6, and Claystone

For soil types A-2-4 and A-2-6:	$M_R = 1.67\ q_u$
For soil type A-6:	$M_R = 1.61\ q_u$
For soil type A-7-6:	$M_R = 2.35\ q_u$
For Claystone:	$M_R = 1.26\ q_u$

Where q_u = Unconfined Compressive Strength (remolded at 2% over OMC and 95% of MDD) in psf, AASHTO T 208; and where M_R is in psi.

3.2.2.3 From CBR

For fine-grained soils with a soaked CBR between 5 and 10, use the following equation to correlate CBR to resilient modulus:

$$M_R = 1{,}500\ x\ CBR$$

For non-fine-grained soils where a soaked CBR greater than 10, use the following equation:

$$M_R = 3{,}000\ x\ CBR^{0.65}$$

The above values may be multiplied by a coefficient of 1.33, if one of the following applies: subgrade permeability is greater than 10 feet per day; it is a Low Density Rural roadway section with drainage ditches; or the subgrade is gneiss or granite in nature.

3.2.2.4 Effective Modulus of Subgrade Reaction

For rigid pavement design, laboratory soil resilient Modulus MUST be converted to Modulus of Subgrade Reaction based on the formula: K=MR/19.4 or Figure 3.3 or 3.4 of the AASHTO Guide. Figure 3.6 of the AASHTO Guide must also be applied with LS = 2.5 to obtain the Effective Modulus of Subgrade Reaction, k, before entering this value into the appropriate rigid pavement design nomograph, N-5.3 or N-5.4, or computer program.

3.2.2.5 R-Values

As a general trend, lower R-values are associated with higher AASHTO soil classification categories. For example, it is not uncommon to obtain an R-value < 5 for a highly plastic clay, which may be classified as an A-7-6 soil. This type of soil would be considered undesirable for a roadway subgrade. On the other extreme, a well-graded sandy gravel (classification A-1-a) may have an R-value of 80 and would constitute an excellent subgrade material.

An inverse relationship exists between the subgrade R-value and the thickness of the pavement section. In other words, a site that has a low R-value will require a thicker pavement section (pavement, base course, subbase) than a site with a high R-value subgrade soil. The typical ranges of R-values shown in Table 3.2.2.5 are useful for conceptual design and estimating purposes, and for checking the reasonableness of laboratory test results. However, because the final pavement section thickness is based on the R-value (and anticipated traffic volumes), it is imperative that representative soil samples be obtained and tested to obtain values for design. For purposes of determining the City of Pueblo "Flexible Pavement Design Criterium", the lowest R-value for the given range has been selected, with a minimum value being 5.

TABLE 3.2.2.5
R-values by AASHTO soil classification

Soil Classification	Type of Soil	R-Value Range
A-1-a	Sandy gravel	50 – 85
A-1-b	Gravely sand	50 – 75
A-3	Find sand	50 – 75
A-2-4	Silty or clayey sand, PI < 10	10 – 45
A-2-6	Silty or clayey sand, PI > 11	<5 – 30
A-4	Silty soil with LL < 40	<5 – 50
A-5	Silty soil with LL > 41	<5 – 40
A-6	Clayey soil with LL < 40	<5 – 30
A-7-5	Clayey soil with LL > 41 and PI < (LL-30)	<5 – 30
A-7-6	Clayey soil with LL > 41 and PI > (LL-30)	<5 – 20

3.3 Traffic – Equivalent Single Axle Loads (ESAL)

3.3.1 Equivalent Single Axle Loads (ESAL)

ESAL is defined as total number of equivalent 18,000 lb. single axle load applications for the design lane. Local streets shall use a 20-year design period. Collectors and Arterials shall use a 30-year design period. Calculated ESALs must be equal to or greater than the Minimum ESALs listed in Table 3.3-1 below. For Collectors and Arterial streets the ESALs shall be weighted by a factor of 1.5 on the right lane due to the Pueblo Transit Authority's bus routes. The intersections of Collector and Arterial streets shall increase the ESALs by a factor of 1.5. The City Engineer may increase the minimum ESAL at any location, if in their opinion, traffic conditions warrant.

TABLE 3.3-1
MINIMUM ESAL ($X10^6$)

	Residential	Mixed Use	Business	Industrial
Arterials	1.4	2.2	3	4
Collectors	0.2	0.4	0.4	0.7
Local Streets	0.07	0.07	0.07	0.4

* To deviate to a less than the minimum indicated ESAL an axle-load analysis must be approved by the City Engineer.

3.3.2 Roadway zoning classifications

Roadway zoning classifications are based on the projected land use of the areas served by the subject segment of roadway. Residential roadways service only areas with a minimum of 80% residential zoned property. Commercial and Industrial classifications service areas with 20% or more of the land to be used as Commercial or Industrial. If less than 80% of the area served is residential, the Classification will be either Commercial or Industrial. If any of the non-residential area served is Industrial, the classification will be Industrial. If none of the non-residential area served is Industrial, the Classification will be Commercial. Any classification with a calculated ESAL of 1.4×10^6 or more will be considered an arterial.

Pavement design traffic studies are a method of determining 20/30-year design ESALs. ESAL calculations in traffic studies shall be based on the AASHTO "Guide for Design of Pavement Structures," latest edition. The traffic study, when required, shall be submitted with the pavement design and subject to review and acceptance.

3.3.2.1 Residential

If a traffic study for a residential roadway is not available, traffic loads can be determined using the following equation:

$$ESAL_{20} = 62{,}000 + 80\,R$$

Where, R = number of residential density units serviced by the street

3.3.2.2 Commercial

For roadways where any individual commercial site is 10 acres of more, traffic loading shall be determined by an approved traffic study only. For commercial roadway with sites less than 10 acres, traffic loading can be calculated using the following equation:

$$ESAL_{30} = 93{,}000 + 120\,R + 390{,}000\,C_A$$

Where, C_A = Commercial Acres serviced by the street

3.3.2.3 Industrial

For roadways where any individual industrial site is 10 acres or more, traffic loading shall be determined by an approved traffic study only. The City may require a traffic study for any industrial roadway. For industrial roadways with sites less than 10 acres, traffic can be calculated using the following equation:

$$ESAL_{30} = 390{,}000\,C_A + 600{,}000\,I_A$$

Where, I_A = Industrial Acres serviced by the street

3.4 Minimum Pavement Sections

If the calculated pavement sections indicate thinner sections than the Minimum Pavement Sections listed in Table 3.4-1 through 3.4-3 below, the Minimum Pavement Sections shall govern. The City Engineer may increase the minimum pavement section at any location if, in his opinion, conditions warrant. All asphalt roadways will be paved with a minimum of two (2) lifts, regardless of minimal thickness.

Temporary Pavement Sections shall meet all other requirements and minimum thickness for a permanent roadway of the same roadway classification.

TABLE 3.4-1
FLEXIBLE PAVEMENT DESIGN CRITERIA
ARTERIALS[2]

	Minor Arterial	**Principal Arterial**	**Bus Route[1]**
Minimum ESAL ($x10^6$)	1.4	2.2	3.3
SOIL Type A-1 **A-I-a, A-1-b**			
Hot Mix Asphalt	6"	6"	6"
Aggregate Base Course	6"	7.5"	9"
SOIL Type A-3			
Hot Mix Asphalt	6"	6"	6"
Aggregate Base Course	6"	7.5"	9"
SOIL Type A-2 **A-2-4, A-2-5, A-2-6, A-2-7**			
Hot Mix Asphalt	6"	6"	6"
Aggregate Base Course	13"	14"	16"
SOIL Type A-4			
Hot Mix Asphalt	6"	6"	6"
Aggregate Base Course	18"	20.5"	22.5"
SOIL Type A-5			
Hot Mix Asphalt	6"	6"	6"
Aggregate Base Course	18"	20.5"	22.5"
SOIL Type A-6			
Hot Mix Asphalt	6"	6"	6"
Aggregate Base Course	18"	20.5"	22.5"
SOIL Type A-7 **A-7-5, A-7-6**			
Hot Mix Asphalt	6"	6"	6"
Aggregate Base Course	18"	20.5"	22.5"

Note 1: This extra depth of pavement to be in the outside lane only. The City reserves the right to review location and length of bus stops with RTD and change the size and location of the extra-depth pavement.
Note 2: All arterial streets shall have a top lift of three-inches of ¾-inch SMA over the HMA or ½-inch SMA upon approval by the City Engineer on a case-by-case basis.
Note 3: Assumes soil R-values of AASHTO minimum.

TABLE 3.4-2
FLEXIBLE PAVEMENT DESIGN CRITERIA
COLLECTORS

	Neighborhood Collector	Mixed Use Collector	Business Collector	Industrial	Bus Route
Minimum ESAL ($x10^6$)	0.18	0.365	0.365	0.73	1.1
SOIL Type A-1 **A-I-a, A-1-b**					
Hot Mix Asphalt	5"	5"	5"	5"	5"
Aggregate Base Course	6"	6"	6"	7"	8"
SOIL Type A-3					
Hot Mix Asphalt	5"	5"	5"	5"	5"
Aggregate Base Course	6"	6"	6"	7"	8"
SOIL Type A-2 **A-2-4, A-2-5, A-2-6, A-2-7**					
Hot Mix Asphalt	5"	5"	5"	5"	5"
Aggregate Base Course	7"	9.5"	9.5"	12"	13.5"
SOIL Type A-4					
Hot Mix Asphalt	5"	5"	5"	5"	5"
Aggregate Base Course	11.5"	14.5"	14.5"	17"	18.5"
SOIL Type A-5					
Hot Mix Asphalt	5"	5"	5"	5"	5"
Aggregate Base Course	11.5"	14.5"	14.5"	17"	18.5"
SOIL Type A-6					
Hot Mix Asphalt	5"	5"	5"	5"	5"
Aggregate Base Course	11.5"	14.5"	14.5"	17"	18.5"
SOIL Type A-7 **A-7-5, A-7-6**					
Hot Mix Asphalt	5"	5"	5"	5"	5"
Aggregate Base Course	11.5"	14.5"	14.5"	17"	18.5"

TABLE 3.4-3
FLEXIBLE PAVEMENT DESIGN CRITERIA
LOCAL

	Local Street (30' to 36')	Business Local	Industrial - Commercial	Bus Route	Alley
Minimum ESAL ($x10^6$)	0.073	0.073	0.073	0.18	0.18
SOIL Type A-1 A-I-a, A-1-b					
Hot Mix Asphalt	4"	4"	4"	5"	5"
Aggregate Base Course	6.5"	6.5"	6.5"	8"	8"
SOIL Type A-3					
Hot Mix Asphalt	4"	4"	4"	5"	5"
Aggregate Base Course	6.5"	6.5"	6.5"	8"	8"
SOIL Type A-2 A-2-4, A-2-5, A-2-6, A-2-7					
Hot Mix Asphalt	4"	4"	4"	5"	5"
Aggregate Base Course	6.5"	6.5"	6.5"	8"	8"
SOIL Type A-4					
Hot Mix Asphalt	4"	4"	4"	5"	5"
Aggregate Base Course	10.5"	10.5"	10.5"	10"	10"
SOIL Type A-5					
Hot Mix Asphalt	4"	4"	4"	5"	5"
Aggregate Base Course	10.5"	10.5"	10.5"	10"	10"
SOIL Type A-6					
Hot Mix Asphalt	4"	4"	4"	5"	5"
Aggregate Base Course	10.5"	10.5"	10.5"	10"	10"
SOIL Type A-7 A-7-5, A-7-6					
Hot Mix Asphalt	4"	4"	4"	5"	5"
Aggregate Base Course	10.5"	10.5"	10.5"	10"	10"

3.5 Pavement Design Procedure

The following is the method for design with the structural number using the nomographs in this specification. The design process may alternatively involve various software packages whose use is not explained here. All designs must be clearly justified to the satisfaction of the City Engineer by the signing engineer in the pavement design report.

3.5.1 Flexible Pavement

1. Determine the street classification, zoning, and ESAL.
2. Choose Nomograph N5.1 or N5.2 depending on street classification.
3. Using MR and ESAL, determine SN.
4. Using the strength coefficients from Table 3.5-1 for the base and subbase layers, calculate the thickness of the various pavement layers by the following formula. Keep in mind the Minimum Pavement Sections (Table 3.3-1 through 3.3-3) govern when thinner sections are indicated.

$$SN = a_1(D_1) + a_2(D_2) + \ldots + a_n(D_n)$$

Where a_1, a_2, a_n = strength coefficients
D_1, D_2, D_n = thickness of pavement layers

TABLE 3.5-1
STRENGTH COEFFICIENTS

COMPONENTS	COEFFICEINT (a)
Stone Matrix Asphalt (SMA)	0.44
Hot Bituminous Pavement	0.44
Existing Bituminous Pavement	0.3
Hot Mix Aspahlt Grading Fines (ST and SX)	0.34
Plant Mix Bituminous Base	0.34
Verification of testing required for items listed below:	
100% RAP with R-Value >89	0.19
100% RAP with R-Value <90	0.15
Aggregate Base Course with R-Value > 83	0.15
Aggregate Base Course with R-Value > 77, < 83	0.12
Aggregate Base Course with R-Value > 69, < 77	0.11
Aggregate Base Course with R-Value >59, < 69	0.1
Treated Subgrade unconfined 7-day Strength > 425 psi	0.15
Treated Subgrade unconfined 7-day Strength 350-424 psi	0.14
Treated Subgrade unconfined 7-day Strength 275 - 349 psi	0.13
Treated Subgrade unconfined 7-day Strength 200 - 274 psi	0.12
Treated Subgrade unconfined 7-day Strength 125 - 199 psi	0.11

It is up to the design engineer to identify what level of quality of drainage is achieved under a specific set of drainage conditions.

3.5.2 Alternatives

Alternatives to the use of the above-mentioned nomographs may be presented as follows: computer printouts presenting results in accordance with the equations shown on the respective nomographs and the AASHTO Guide will be allowed for review. The printout must reiterate all design parameters. The report must justify to the satisfaction of the City Engineer any deviations from the design parameters specified herein.

3.5.3 Factors for Design of Pavement Structures

Factors for Design of Pavement Structures utilizing 1993 AASHTO "Guide for Design of Pavement Structures", 4th Edition with 1998 Supplement.

- Reliability (R)
  - 95% for Arterials and Business Collectors
  - 90% for Mixed Use Collectors, and Industrial Commercial Collectors
  - 85% for Neighborhood Collectors, Industrial Commercial Local, Alleys, and Local Streets (30'- 36')

- Overall Standard Deviation (S_0) Use 0.45 for flexible pavements.
- Design Serviceability Loss

Flexible	
2.2	Local roadways, neigbhoorhood streets, residential parkways and collector roadways, other than commerical and industrial drives.
1.7	Arterials, bolevards, all commercial and industrial roadways.

- Concrete Elastic Modulus (EC) Use 3.6 x 10^6 psi
- Mean Concrete Modulus of Rupture (S'C) Use 600 psi
- Load Transfer Coefficient (J) If monolithic or tied curb and gutter are placed on both sides of the pavement use 3.6, otherwise use 4.2.
- Drainage Coefficient (Cd) Use 1.0.
- Loss of Support (LS) Use 2.5 in Figure 3.6 of the AASHTO Guide, to correct the Effective Modulus of Subgrade Reaction, K, for Potential Loss of Support.

3.6 Nomographs

3.6.1 Nomograph N-3.1

Flexible Pavement Design Chart for Arterials and all Commercial and Industrial sites.

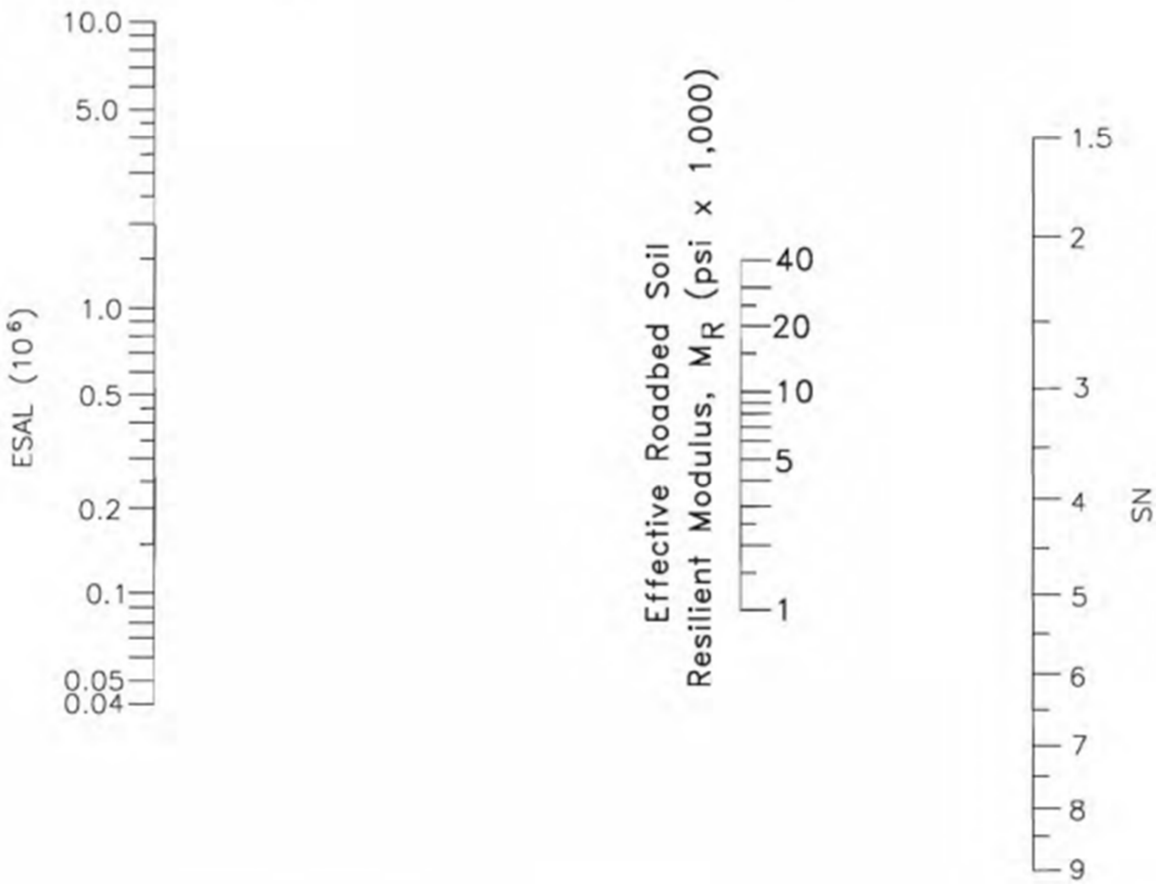
3.6.2 Nomograph N-3.2

Flexible Pavement Design Chart for Local and Collector Streets except Commercial and Industrial sites.

NOMOGRAPH N-3.1

ARTERIALS
ALL COMMERCIAL & INDUSTRAIL

Design chart for flexible pavements



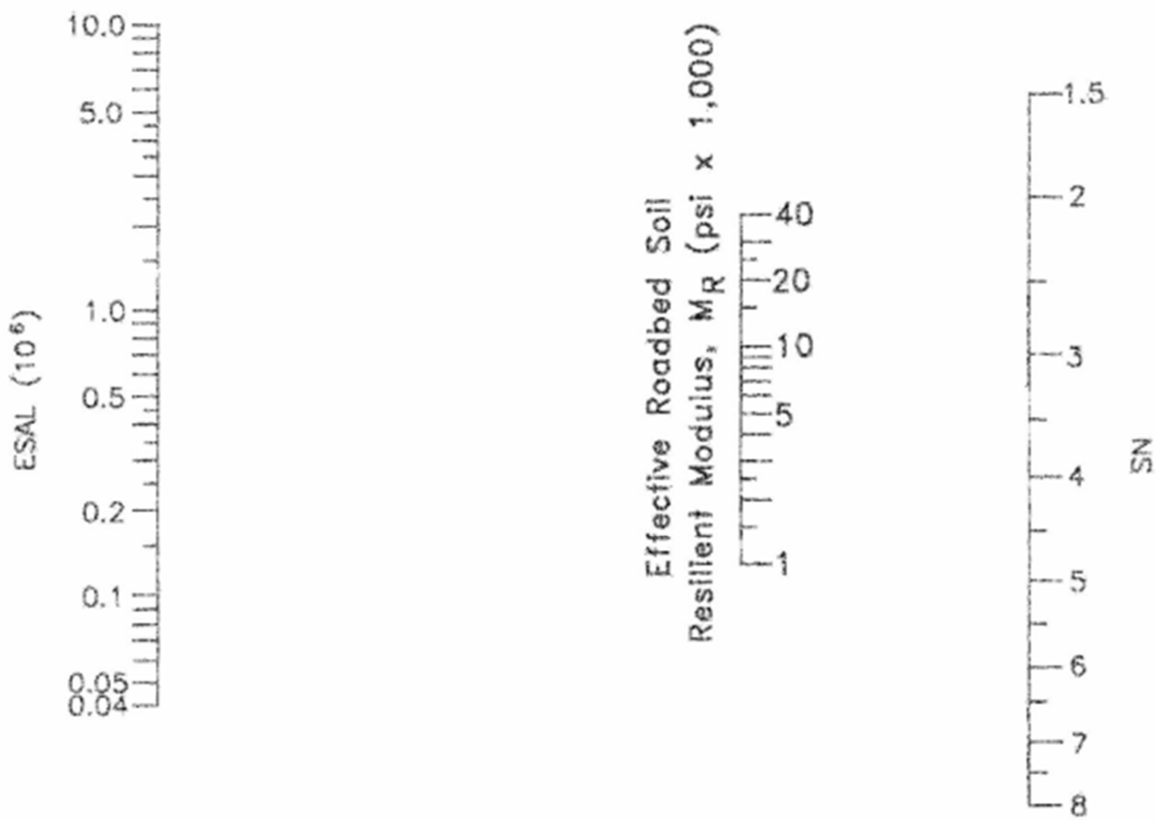
NOMOGRAPH SOLVES:

$$\log_{10} W_{18} = Z_R * S_0 + 9.36 * \log_{10}(SN+1) - 0.20 + \frac{\log_{10}\left[\frac{\Delta PSI}{4.2-1.5}\right]}{0.40+\frac{1094}{(SN+1)^{5.19}}} + 2.32 * \log_{10} M_R - 8.07$$

NOMOGRAPH N-3.2

LOCAL & COLLECTOR
EXCEPT COMMERCIAL & INDUSTRIAL

Design chart for flexible pavements



3.7 Pavement Design Report

3.7.1 Required Information for Pavement Design Report

After completion of field investigation, laboratory testing, and engineering design, a report summarizing the data collected and pavement section calculations shall be prepared by or under the supervision of a Professional Engineer registered in the State of Colorado. The information listed below shall be required for all pavement design reports.

- Vicinity map showing the area of investigation.
- Scaled drawings showing street names and the location of borings.
- Tabular listing of laboratory test data required in section 2.2.2.
- R-value or CBR test results as required in section 2.2.4.
- Boring logs with AASHTO Classifications and Group Index Values.
- A discussion of soil, bedrock and groundwater conditions, including anticipated seasonal variation in groundwater levels.
- A discussion of utility trench backfill, including results of field density testing. If report is prepared prior to completion of utility trench backfill, it will be necessary to submit field density test results and a statement by the geotechnical engineer that utility trench backfill has been placed in general accordance with the Standard Construction Specifications of the City of Pueblo. Additionally, the geotechnical engineer shall provide a statement confirming the conditions observed subsequent to utility trench backfill placement do not change the pavement design recommendations. This report can be included in the pavement design report or submitted separately to the City for review prior to construction of the pavement section.
- A discussion of potential subgrade soil problems and recommended mitigation measures. Include mix design test results where chemical stabilization is required.
- Recommendations relative to preparation of subgrade prior to paving, including options for cold weather construction, chemical stabilization, and mitigation of unstable subgrade observed during proof-rolling operations.
- Pavement design calculations including computer printouts and nomographs showing all design coefficients. It should be noted, the City reserves the right to verify pavement calculations submitted through independent analyses.
- Statement by the geotechnical engineer that the pavement design is in conformance with the City of Pueblo Pavement Design Criteria.
- Engineer seal and signature

3.8 Special Considerations

3.8.1 Staged Construction

This is an alternative to the owner/developer to provide a minimum thickness of pavement during construction, and after repairs, construct the final lift of asphalt, providing for a new finished pavement surface. If the full pavement section is not to be placed immediately, a pavement design for staged construction may be required by the City. The staged construction design must include asphalt thickness for each proposed stage. Calculations, traffic values (EDLA), and construction truck traffic values supporting the staged design must also be submitted.

It should be noted that where staged construction is proposed, the reliability factor must be increased such that the overall reliability for the staged construction is equal to or greater than that as required in section 3.5.3. If a two-stage construction plan is proposed for a minor collector with a reliability factor of 85%, each stage would need to be designed for a reliability of 85% or 92%.

For staged construction, accommodation must be provided for the paved surface to drain with no water left standing on the pavement after a period of 24 hours.

Where staged constructions is proposed, the final stage of construction shall be performed at the end of the 2-year warranty period, after all warranty repairs have been made. Warranty period begins from the date of acceptance of improvements by the City. The contractor shall pave a minimum 1-inch overlay. Overlay thickness should generally be not less than 3 times the maximum aggregate size in the asphalt concrete mix.

The report shall instruct the Contractor to pave an inch less than the required pavement section at initial construction, leaving the finish asphalt inch below the design crown elevation. After a period of 2 years from acceptance of improvements by the City, and after all warranty repairs have been made, the Contractor shall perform a tapered milling of the outside 4 feet of pavement along gutters prior to placing the minimum 1-inch overlay.

All manholes, valve boxes and monument boxes shall be set at grade for the interim paving surface. Manholes and valve boxes must be adjusted to final grade prior to placement of the final overlay.

The above shall be accomplished before the City accepts the streets.