620 Surfacing Materials and Pavement Design

620.1 General

This chapter explains the New Mexico Department of Transportation's (NMDOT's) procedures for surfacing materials investigations and pavement design pertaining to roadways.

The NMDOT's procedure for geotechnical investigations for structures is outlined in Chapter 600 of the Design Manual.

NMDOT's pavement design elements include the following:

1. Prepare preliminary pavement design using as-built sections and projected equivalent single-axle loads (ESALs).
2. Prepare final pavement design using pavement profile test results and ESALs.

NMDOT's intention is to select and design pavements that best accommodate current and predicted traffic needs in a safe, durable, and cost effective manner. To achieve this intent, the pavement designer must evaluate various pavement alternatives where detailed engineering and economic considerations are given to alternative combinations of subbase, base, and surface materials that will provide adequate vehicular load carrying capacity. Factors to be considered include materials, soil support characteristics, traffic, ESALs (one 18,000 pound [18 kip] single-axle load is one ESAL), climate, maintenance, drainage, and life-cycle costs. In instances where a dispute on pavement thickness design arises, NMDOT's Director of Infrastructure may resolve the dispute, refer the dispute to the Dispute Resolution Board, or delegate the dispute resolution to an appropriate technically-qualified engineer within the NMDOT.

This procedure allows designers to consider flexible, rigid, and composite pavement structures. It also allows designers to consider standard and other innovative pavement rehabilitation and maintenance strategies such as:

- The use of recycled materials
- Fabric reinforcements
- Other materials and processes that will economically enhance and extend the life of the State's roadway system

Structural pavement selection and design is dynamic in that concepts are continually changing as analysis and design techniques, materials, and construction processes evolve and new approaches are adopted by the NMDOT. Accordingly, these design procedures will be periodically reviewed and updated to accurately reflect NMDOT's current practices and procedures. The NMDOT believes that this will result in better consistency in pavement selection and design in the NMDOT and private consultant community.

While every effort has been made in preparing this chapter to address as many considerations as possible, not all possible considerations and/or alternatives that a given pavement designer may want to consider have been or will be addressed. This is due to an individual designer's actual experience in pavement type selection and design procedures as well as that designer's experience at a given geographical location in New Mexico. Therefore, it is highly encouraged that before a final pavement design recommendation is made, that the pavement designer review adjacent and/or similar projects. This will ensure that all design assumptions and recommendations are consistent and, if not, that any design inconsistencies are justified and warranted for that particular project.

The pavement designer must use the latest revision of the NMDOT's Microsoft Excel 2003 pavement design worksheets and must also have purchased the latest version of the @Risk 4.5 Professional Version from Palisade Corporation (www.palisade.com/). Information regarding these resources is provided in Section 620.2.

As an alternative, Portland cement concrete pavement (PCCP) and flexible pavement may be designed using accepted industry approach and pavement design software developed by the American Concrete Pavement Association (StreetPave) or the American Association of State Highway and Transportation Officials (AASHTO).

620.2 References

- AASHTO Guide for Design of Pavement Structures, 1993.
- AASHTO T190, Resistance R-Value and Expansion Pressure of Compacted Soils.
- Design Guideline for Flexible Pavements with Tensar Geogrid Reinforced Bases, Tensar Corporation, March, 1987.
- Federal Highway Administration (FHWA) Publication No. FHWA-IP-80-2, Soil Stabilization in Pavement Structures - A User's Manual, Volumes 1 and 2, 1980.
- FHWA Publication No, FHWA/RD-86/133 Dynamic Compaction for Highway Construction, Volume 1, 1986.
- NMDOT Release 2.0 Probabilistic Flexible and Rigid Pavement Design @ Risk 4.5 Professional Version and updates Excel spreadsheet by Palisade Corporation, 2003.
- NMDOT Standard Specifications for Highway and Bridge Construction, current edition.

620.3 Pavement Designer Approval Procedure

All NMDOT project-related pavement designers must be on NMDOT's approved list. If an individual is not on NMDOT's approved list, the NMDOT will reject his or her submitted pavement design recommendations.

Each individual designer who prepares pavement designs for use on any NMDOT project must demonstrate, to the satisfaction of the NMDOT, his or her proficiency in using the NMDOT's current design procedures. Once this proficiency has been demonstrated to the satisfaction of the NMDOT, that individual designer's name will be placed on an approved NMDOT Pavement Designer List. At that point, any pavement design from the approved individual will be accepted by the NMDOT for final review by the NMDOT's Pavement Design Engineer.

All pavement design-related recommendations, drawings, specifications, or reports that are produced by or for the practice of pavement designs for use on any NMDOT project shall bear the seal and signature of the Professional Engineer registered in New Mexico in responsible charge of and directly responsible for the work issued. Additionally, that individual must be on the approved NMDOT Pavement Designer List. In the case of practice through partnership, at least one of the partners shall be a Professional Engineer registered in New Mexico who is approved on NMDOT's Pavement Designer List and who shall be directly responsible for all plans, designs, drawings, specifications, or reports that are produced for the NMDOT.

To pre-qualify for the advanced training that the NMDOT's Pavement Design Unit will provide, each prospective pavement designer must have evidence of a grade of "C" or better in either an undergraduate-level or graduate-level pavement design course or equivalent course in pavement design based on AASHTO methodology.

Once this requirement has been completed and furnished for approval, the NMDOT will provide the needed advanced training for any prospective pavement designer in the use of the NMDOT's pavement design procedures. The prospective pavement designer must contact the NMDOT's Pavement Engineer at (505) 827-3245 to set up an individual appointment, schedule the training, and demonstrate the required proficiency. The intent of the qualification requirement is for the pavement designer to demonstrate an understanding of pavement design theory, principles, and practical design application.

620.4 Field Investigation

The purpose of the requirements in this section is to outline the minimum exploration that is needed to adequately characterize the existing layer thickness and subgrade strength of a pavement structure for pavement design. The information developed from these procedures will be used by the pavement designer in determining the minimum pavement structure thickness that is required to support a given number of ESALs.

Prior to the field investigation, the pavement designer will need to:

1. Review the existing pavement surfacing data and site conditions to prepare the pavement surfacing exploration plan.
2. Acquire all applicable access permits, environmental permits, traffic control plan (where required), and utility locates. A minimum five working day advance notice must be given to the respective District Traffic Engineer for any proposed lane closures.
3. Locate and drill soil borings or perform rock coring operations to determine the geologic lithology and characterize subsurface subgrade and/or groundwater conditions.
4. Survey boring locations for horizontal and vertical control. This is done by the NMDOT or by the consultant's project surveyor.
5. Perform field soil and/or rock testing and/or geophysical activities to assess bedrock and potential excavation difficulties.
6. Properly abandon borings by backfilling with soil spoils and patching with quick pavement repair (where required). Grout or lean fill backfill may be required in existing waterways or where settlement needs to be minimized
7. Collect soil and/or rock samples and submit them to the NMDOT Geotechnical Materials Lab.

620.4.1 Safety and Utility Coordination

When performing this work, all pertinent federal Occupational Safety and Health Administration (OSHA) procedures and regulations for safe operations of equipment and excavation procedures shall be observed at all times. Traffic control shall meet the requirements established in the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD). Finally, prior to actual sampling, all utility clearances shall be coordinated and cleared with New Mexico One Call System, Inc., Albuquerque, New Mexico, by calling 1-800-321-2537, or, in the case of non-membership in New Mexico One-Call, all utilities will be cleared with the local governing entity.

620.4.2 Minimum Requirements

Prior to sampling the existing pavement materials, an on-site review of the project area will be conducted by a certified geologist or a field technician who is under the direct supervision of a certified geologist. The purpose of this review is to determine what type of sampling equipment and utility clearances will be required on a particular project based on, but not limited to, project plans and profiles, maps, photos, and interviews with the local NMDOT maintenance foremen to identify problem areas. After this on-site review has been completed, the certified geologist or field technician will randomly locate and then mark each test hole along the proposed roadway to meet the minimum sampling frequency shown in Exhibit 620-1 for two-lane roadways or Exhibit 620-2 for highways with four or more lanes.

Exhibit 620-1

Minimum Number of Test Borings for Two-Lane Highway

	Deflection Testing Conducted?	
Project Length (Miles)	**Yes**	**No**
Less than four	4 per mile	6 per mile
Greater than or equal to four	4 per mile	4 per mile
Existing shoulders	1 per mile	1 per mile

All tests will be performed in the lane of increasing milepost direction.
All signalization projects are exempt from this table.

Exhibit 620-2

Minimum Number of Test Borings for Four-Lane Highway

	Deflection Testing Conducted?	
Project Length (Miles)	**Yes**	**No**
Less than four	4 per mile each direction	6 per mile each direction
Greater than or equal to four	4 per mile each direction	4 per mile each direction
Existing shoulders	1 per mile each direction	1 per mile each direction

All tests will be performed in the lane of increasing milepost direction for two-lane roadways.
All signalization projects are exempt from this table.

The actual location of the randomly selected and marked test holes shall be accurately tied to either a centerline survey station or to an existing milepost using an odometer that is accurate to within one-hundredth of a mile.

The sampling of the existing materials shall extend a minimum of three feet into the subgrade through the top of the existing surface unless bedrock or boulders are encountered. Within each test hole, each soil type encountered will have a minimum 40 pound sample removed and placed in a plastic-lined sample sack to prevent moisture loss. Each sample sack shall be identified using the NMDOT's Form MT-88 (Rev 9/91). Also, an accurate geotechnical boring log recording all material types, depth, and field location will be maintained and given to the pavement designer.

After the test hole has been sampled and logged it shall be backfilled and compacted. Any excess and/or other suitable material may be used for backfill except that the final top surface must be comparable material to that which was removed from the top surface. Every effort shall be made to obtain adequate compaction so that the test boring repair does not fail under traffic. Under no circumstances will a test hole be left open to traffic overnight.

620.4.3 Additional Requirements for Existing Roadways

Additional requirements apply to work that is to be done when a project involves no major or substantial grade or alignment changes and is primarily a "3R" project (resurfacing, restoration, and rehabilitation) or an overlay. For these projects, the test borings shall be located in the center of each lane. Additionally, base course and subbase materials will be sampled separately. On projects where cold in-situ recycling may be used, the existing asphalt material shall be sampled by obtaining a core with a minimum diameter of four inches.

620.4.4 Additional Requirements for New or Reconstruction Projects

Additional requirements apply to work that is to be done on projects involving the investigation of a new centerline and/or an alignment that will undergo a significant grade change. For these projects, test holes shall be a minimum of three feet into natural ground or three feet below the final subgrade elevation in the cut section, except if rock is encountered. Also, test holes shall be located on centerline when there is no appreciable side slope. In offset situations, offset holes shall be used where one or both edges of the roadway section may be cutting into a hillside, even if the centerline profile indicates a fill section. The distance right or left of the centerline, together with the elevation of the top of the test hole, shall be logged.

If it is not possible to excavate to the desired depths with a backhoe, foundation drilling shall be used to log the nature of the type of materials. In the event that solid rock is encountered, holes should be drilled and logged, including such data as feet per second drilled and type of equipment used.

620.5 Falling Weight Deflectometer Testing

The purpose of the requirements in this section is to outline the minimum testing requirements for falling weight deflectometer testing of existing pavement structures. This type of testing should be used on all NMDOT overlay or rehabilitation projects to supplement the test boring results.

620.5.1 Minimum Equipment Requirements

All equipment used for deflection testing will meet the latest requirements given in the American Society for Testing and Materials (ASTM) Procedure D-4694. Additionally, the most recent annual equipment calibration and certification that is issued by an FHWA-approved calibration and certification center shall be on file with the NMDOT's Pavement Investigation and Design Section Head. The last equipment calibration and certification will not be more than one year old at the time the testing is performed on any NMDOT project. A minimum of seven deflection measurement devices shall each be located at zero inches, eight inches, 12 inches, 18 inches, 24 inches, 30 inches, and 48 inches from the applied impulse load center of impact. The loading plate shall have a diameter of 12 inches with a four-inch diameter hole in the center through which a deflection sensor is located.

620.5.2 Testing Procedures

The interval between successive test locations will be 250 feet unless otherwise directed by the project's pavement designer. An impulse load of 9,000 pounds of force will be used unless this load causes any of the deflection measurement devices to exceed their capabilities. If this occurs, then the impulse load may be reduced by a maximum of 2,000 pounds of force, but should be kept as high as possible depending on the measurement capabilities of the deflection sensors. A single test will be taken and reported at each test location. However, the operator needs to monitor the recorded deflections at each location to ensure that the measured deflections decrease with increasing radial distance. If this does not occur, the operator needs to determine why (e.g., a small rock might be under one of the sensors, the pavement might have a large crack between two or more sensors, or there may be an equipment malfunction), correct the problem, and either retest at that location or move up 10 feet and test again.

On two-lane highways, testing shall be performed only on the lane of increasing milepost direction. While keeping the established testing interval, if a profile testing hole is encountered, an additional test will be conducted and logged at that location throughout the project's limit.

On highways with four lanes or more, testing will be performed in both directions of travel in the outside lane. If a profile testing hole is encountered while keeping the established testing interval, an additional test will be conducted and logged at that location throughout the project's limit.

620.5.3 Final Report

The final data file for each NMDOT project tested shall include the following information:

- Project control number
- Route name
- Date of test
- Location and direction of the lane tested
- The relative milepost location of each test point

- The actual load-deflection data for each test point
- Pavement surface temperature for each test point

620.6 Laboratory Testing

All profile samples shall be tested in accordance with AASHTO procedures. All samples shall be preliminarily tested for gradation, Atterberg Limits, and moisture content. Each sample shall be classified using the AASHTO classification criteria for soil type by the NMDOT or an approved private laboratory when requested by the NMDOT. The pavement designer shall then, based on the preliminary test results, select those samples that need to be tested for R-Value strength. For lime or cement stabilization testing, a preliminary assessment will be made by a representative of the NMDOT Materials Laboratory and a recommendation will be made. At that time, the NMDOT Pavement Engineer and the pavement designer, with aid from the design team, will determine whether lime or cement testing should be performed. No samples shall be discarded until the pavement designer has accepted the final complete test results for a given project.

620.7 Flexible Pavement Design Procedure Policy

Flexible pavement alternatives shall be considered on all pavement design studies and should be compared to rigid pavement design alternatives when warranted as discussed in Section 620.8. For all flexible pavement construction, the following design requirements, materials, and procedures will be used.

620.7.1 Minimum Pavement Design Life

The minimum pavement design life shall be as listed in Exhibit 620-3 unless the project’s design team leader decides that a different design life is desirable due to individual project cost constraints.

Exhibit 620-3

Minimum Structural Pavement Design Life Criteria

Type of Project	Number of Years	Remarks
New Construction Project	20	
Reconstruction Project	20	
Rehabilitation Project	10	a
Structural Preventative Maintenance Projects	5	b
Special Condition Projects		c

a For pavements that exhibit overall medium or higher severity distresses.

b For pavements in good condition that exhibit overall low severity distresses.

c The District Engineer shall request and obtain concurrence from the Deputy Secretary of Operations (or Designee), for design life not consistent with Exhibit 620-3.

Requests must include estimated pavement design life determined in accordance with these guidelines.

620.7.2 Probabilistic Design Reliability

The minimum probabilistic design reliability shall be as shown in Exhibit 620-4. If a District desires a higher design reliability than the minimum shown so that the designed pavement structure will have reduced future maintenance needs, the District can notify the pavement designer accordingly, in writing. These higher design reliability options will be discussed with the project's design team prior to the issuance of the final pavement design recommendations.

Exhibit 620-4

Minimum Probabilistic Design Reliability

Type of Facility	Percent Trucks or Location	Minimum Design Reliability
Interstate Highways	Urban	85%
	Rural	80%
National Highway System	< 15%	75%
	15% or more	85%
All New Mexico Routes	< 15%	65%
	15% or more	75%
Frontage Roads	---	65%
Turnouts and Detours	---	50%
Interchange Ramps	---	Note 1

Note 1: Design to same reliability as the mainline section.

620.7.3 Serviceability Index

The initial serviceability index (Pi) shall be 4.2 on all projects. This value is based on the measured smoothness of recently completed projects. The terminal serviceability index (Pt) shall be 2.5 on all interstate and four-lane National Highway System (NHS) projects and 2.0 for all other projects. Requests for a given project's ESALs shall include which Pt value will be used on a particular design so that the correct ESAL projections can be calculated.

620.7.4 Regional Design Factors and Performance Graded (PG) Binder Grade

The design factors for projects located in each District shall be determined using FHWA's LTPPBind Version 3.1 or greater, the appropriate exhibit (shown below), and the actual referenced location. If a project is located between two referenced locations, the design factors shall be interpolated using the two closest referenced locations. The recommended PG base grade and regional design factors for flexible pavement design are outlined in Exhibit 620-5 through Exhibit 620-11.

Exhibit 620-5

District No. 1 Base PG Grades

County	Station Name	Longitude (Degrees)	Latitude (Degrees)	Regional Factor	PG Base Grade
Dona Ana	Hatch	107.18	32.67	0.6	70-22
	Jornada Experimental Range	106.73	32.62	1.0	
	New Mexico State University	106.75	32.28	0.5	
Grant	Cliff	108.52	32.83	1.1	64-22
	Faywood	107.87	32.63	0.7	
	Fort Bayard	108.15	32.80	0.9	
	Gila Hot Springs	108.22	33.20	1.2	
	Mimbres Ranger Station	108.02	32.93	1.3	
	White Signal	108.37	32.55	0.9	
	Hachita	108.32	31.93	0.8	70-22
	Redrock	108.73	32.70	0.7	
Hidalgo	Animas	108.82	31.95	0.9	70-22
	Lordsburg	108.65	32.30	0.7	
Luna	Columbus	107.63	31.83	0.7	70-22
	Deming	107.73	32.25	0.7	
	Florida	107.48	32.43	0.9	
	Gage	108.02	32.22	0.9	
Sierra	Aleman Ranch	106.93	32.92	1.0	64-22
	Hillsboro	107.57	32.93	1.0	
	Winston	107.65	33.35	1.3	
	Cabello Dam	107.30	32.90	0.7	70-22
	Elephant Butte Dam	107.18	33.15	0.5	
	Truth or Consequences	107.22	33.15	0.5	
Socorro	Augustine	107.62	34.08	1.9	58-28
	Bingham	106.35	33.92	1.3	64-22
	Gran Quivera National Monument	106.08	34.27	1.5	
	Magdalena	107.23	34.12	1.6	
	Bernardo	106.83	34.42	1.4	70-22
	Bosque Del Apache	106.90	33.70	1.4	
	Socorro	106.88	34.08	1.1	

Note: For all interstate projects within District 1, the PG base grade will be PG 70-16.

Exhibit 620-6

District No. 2 Base PG Grades

County Name	Station Name	Longitude (Degrees)	Latitude (Degrees)	Regional Factor	PG Base Grade
Chaves	Elk	105.30	32.95	1.5	70-22
	Bitter Lakes Wildlife Refuge	104.40	33.47	1.7	
	Roswell Municipal Airport	104.53	33.40	1.4	
Curry	Clovis	103.20	34.42	1.4	64-22
	Melrose	103.62	34.43	1.5	
De Baca	Fort Sumner	104.25	34.47	1.5	64-22
	Yeso	104.62	34.40	1.2	
	Sumner Lake	104.38	34.60	1.4	
Eddy	Carlsbad Caverns	104.45	32.18	0.6	64-22
	Artesia	104.38	32.77	1.3	70-22
	Brantley Dam	104.38	32.52	0.8	
	Carlsbad	104.23	32.42	0.7	
	Carlsbad Cavern City	104.27	32.33	0.9	
	Hope	104.73	32.82	1.1	
	Waste Isolation Pilot Plant	103.80	32.38	0.8	
Lea	Crossroads	103.35	33.52	1.4	64-22
	Pearl	103.38	32.65	1.1	
	Tatum	103.32	33.27	1.4	
	Hobbs	103.13	32.70	0.8	70-22
	Jal	103.20	32.10	0.8	
	Maljamar	103.70	32.82	1.1	
Lincoln	Capitan	105.60	33.53	1.5	58-28
	Corona	105.58	34.25	1.8	
	Ruidoso	105.68	33.33	2 .2	
	Carrizozo	105.88	33.63	1.3	64-22
	Circle F Ranch	105.00	33.90	1.5	
	Picacho	105.17	33.35	1.2	
	Ramon	105.00	34.15	1.5	
Otero	Mescalero	105.78	33.15	1.5	58-28
	Cloudcroft	105.75	32.97	3.4	
	Mountain Park	105.82	32 .95	1.1	
	Alamogordo	105.95	32.88	0.7	70-22
	Orogrande	106.10	32.38	0.7	
	Tularosa	106.05	33.08	0.6	
	White Sands National Monument	106.18	32.78	1.1	
Roosevelt	Elida	103.65	33 .95	1.5	64-22
	Portales	103.35	34.18	1.5	

Exhibit 620-7

District No. 3 Base PG Grades

County Name	Station Name	Longitude (Degrees)	Latitude (Degrees)	Regional Factor	PG Base Grade
Bernalillo	Sandia Park	106.37	35.17	1.8	58-28
	Albuquerque International Airport	106.62	35.03	1.1	64-22
Sandoval	Wolf Canyon	106.75	35.95	3.2	58-28
	Bernalillo	106.55	35.55	1.7	64-22
	Cochiti Dam	106.32	35.63	1.4	
	Corrales	106.60	35.23	1.3	
Valencia	San Mateo	107.65	35.33	1.6	58-28
	Belen	106.77	34.67	1.4	64-22
	Lacuna	107.37	35.03	1.6	
	Los Lunas	106.75	34 .77	1.3	

Note: For all interstate projects within District 3, the PG base grade will be a PG 64-22.

Exhibit 620-8

District No. 4 Base PG Grades

County Name	Station Name	Longitude (Degrees)	Latitude (Degrees)	Regional Factor	PG Base Grade
Colfax	Cimarron	104.95	36.47	2.2	58-28
	Eagle Nest	105.27	36.55	3.4	
	Lake Maloya	104.37	36.98	2.6	
	Maxwell	104.57	36.57	2.5	
	Raton Crews Field	104.50	36.75	2.5	
	Springer	104.58	36.37	2.6	64-28
Guadalupe	Dilia	105.05	35.18	1.7	64-22
	Newkirk	104.25	35.07	1.6	
	Santa Rosa	104.68	34 .95	1.4	
Harding	Roy	104.20	35.95	1.9	58-28
	Mosquero	103.93	35.80	1.8	64-22
Mora	Gascon	105.43	35.90	2.2	58-28
	Ocate	105.05	36.18	2.5	
	Valmora	104.93	35.82	2.4	
Quay	Cameron	103.43	34 .90	1.6	64-22
	McCarty Ranch	103.37	35.60	1.7	
	Ragland	103.75	34 .80	1.6	
	Tucumcari	103.68	35.20	1.4	
	San Jon	103.33	35.12	1.7	70-22

Exhibit 620-8 (Continued)

District No. 4 Base PG Grades

County Name	Station Name	Longitude (Degrees)	Latitude (Degrees)	Regional Factor	PG Base Grade
San Miguel	Las Vegas	105.27	35.62	2.6	58-28
	Pecos Ranger Station	105.68	35.58	2.1	
	Bell Ranch	104.10	35.53	1.7	64-22
	Conchas Dam	104.18	35.40	1.3	
Union	Des Moines	103.83	36.75	2.3	58-28
	Grenville	103.62	36.60	2.1	
	Amistad	103.17	35.87	1.9	64-22
	Clayton Municipal Airpark	103.15	36.45	1.8	
	Pasamonte	103.73	36.30	2.1	

Note: For all I-25 projects within District 4, the PG base grade will be a PG 58-28

Note: For all I-40 projects within District 4, the PG base grade will be a PG 64-22.

Exhibit 620-9

District No. 5 Base PG Grades

County Name	Station Name	Longitude (Degrees)	Latitude (Degrees)	Regional Factor	PG Base Grade
Los Alamos	Los Alamos	106.32	35.87	1.7	58-28
Rio Arriba	Abiquiu Dam	106.43	36.23	1.5	58-28
	Chama	106.58	36.92	2.8	
	Dulce	107.00	36.95	3.2	
	El Rito	106.18	36.33	1.8	
	El Vado Dam	106.73	36.60	2.9	
	Gavilan	106.97	36.43	3.5	
	Lindreth	107.03	36.28	2.9	
	Lybrook	107.57	36.23	2.8	
	Tierra Amarilla	106.55	36.77	2.9	
	Alcalde	106.07	36.10	1.8	64-22
	Espanola	106.07	36.00	1.7	
San Juan	Otis	107.87	36.32	1.9	58-28
	Aztec Ruins National Monument	108.00	36.83	1.8	64-22
	Bloomfield	107.97	36.67	1.7	
	Farmington	108.17	36.75	2.1	
	Fruitland	108.37	36.73	1 .5	
	Navajo Dam	107.62	36.82	1 .3	
	Shiprock	108.68	36.80	1 .7	
	Chaco Canyon National Monument	107.90	36.03	2.7	64-28

Exhibit 620-9 (Continued)

District No. 5 Base PG Grades

County Name	Station Name	Longitude (Degrees)	Latitude (Degrees)	Regional Factor	PG Base Grade
Santa Fe	Santa Fe	105.90	35.68	1.6	58-28
	Stanley	105.97	35.17	2.1	
Taos	Cerro	105.60	36.75	2 .9	58-28
	Red River	105.40	36.70	3.0	
	Taos	105.60	36.38	2 .5	
Torrance	Clines Corners	105.58	34.93	2 .0	58-28
	Mountainair	106.25	34.52	1 .8	64-22
	Pedernal	105.57	34.63	2.0	
	Estancia	106.07	34.75	2.2	64-28
	McIntosh	106.08	34.92	2.3	

Note: For all interstate projects in District 5, the PG base grade will be a PG 58-28.

Exhibit 620-10

District No. 6 Base PG Grades

County Name	Station Name	Longitude (Degrees)	Latitude (Degrees)	Regional Factor	PG Base Grade
Catron	Adobe Ranch	107.90	33.57	2.7	58-28
	Beaverhead Ranger Station	108.12	33.42	2.3	
	Hickman	107.93	34.52	2.8	
	Luna Ranger Station	108.93	33.83	2.6	
	Quemado Ranger Station	108.50	34.35	2.5	
	Reserve Ranger Station	108.78	33.72	1.7	64-22
Cibola	El Morro National Monument	108.35	35.05	2.6	58-28
	Fence Lake	108.67	34.65	2.4	
	Cubero	107.52	35.08	1.6	64-22
	Grants-Milan Municipal Airport	107.90	35.17	2.1	64-28
McKinley	McGaffey	108.45	35.33	2.7	58-28
	Star Lake	107.47	35.93	2 .7	
	Thoreau	108.23	35.42	1.7	
	Tohatchi	108.73	35.85	1.3	64-22
	Zuni	108.83	35.07	2.0	
	Gallup Senator Clarke Field	108.78	35.52	2.4	64-28
Sandoval	Cuba	106.97	36.03	2.6	58-28
	Wolf Canyon	106.75	35.95	2.7	
	Jemez Springs	106.68	35.77	1.5	64-22
	Torreon Navajo Mission	107.18	35.80	1.9	64-28

Note: For all interstate projects within District 6, the PG base grade will be a PG 64-28.

The PG base grade in the above tables will be modified per the following guidelines to determine the actual minimum PG asphalt binder that may be used on a given project as indicated in Exhibit 620-11.

Exhibit 620-11
PG Base Modification

20-Year Design ESALs (Millions)	Adjustments to PG Base Binder Grade [a]		
	Traffic Loading Rate		
	Standing [b]	Slow [c]	Standard [d]
< 0.3	1	--	--
0.3 to < 3	2	1	--
3 to <10	2	1	--
>10	2	1	1

a *Increase the high-end temperature grade by the number of grade(s) indicated (one grade is equivalent to 6°C)*
b *Standing Traffic – the average traffic speed is less than 15 mph*
c *Slow Traffic – the average traffic speed ranges from 15 mph to less than 45 mph*
d *Standard Traffic – the average traffic speed is 45 mph or greater*

620.7.5 R-Value

All existing surfacing, base, subbase, and subgrade materials for pavement construction shall be sampled per the requirements presented in Section 620.4. Subgrade material strengths shall be based on AASHTO T190, Resistance R-Value and Expansion Pressure of Compacted Soils using a 300 pounds per square inch (psi) exudation pressure. Other testing procedures that have been specifically approved for a given project by the NMDOT’s Pavement Design Engineer or State Infrastructure Bureau may also be considered provided that a correlation exists that will convert those testing results to an equivalent laboratory R-value test result. The actual project design R-value shall be determined using the NMDOT’s probabilistic design procedure.

Design R-value material will be used in the upper two feet of all fill areas that are constructed. Construction areas that are at grade or being cut to grade shall not be identified for subgrade excavation and replacement unless the anticipated R-value is less than the design R-value.

The performance of pavement structures is directly related to the physical and chemical properties of the subgrade soils. Pavement performance problems can develop from subgrade soils that are expansive, collapsible, excessively resilient, frost susceptible, and/or highly organic. Other subgrade soil problems may develop when non-uniform subgrade support exists beneath the pavement structure due to a wide variation in subgrade soil types and/or moisture conditions.

The point-to-point subgrade R-value that will be used to determine the probabilistic best fit distribution shall be calculated using a weighted average based on the material in the top two feet of the final subgrade elevation. The following formula is used to calculate this representative composite layer R-value:

Composite Layer R-Value = $0.5 \times \Sigma\ (t_i \times RV_i)$

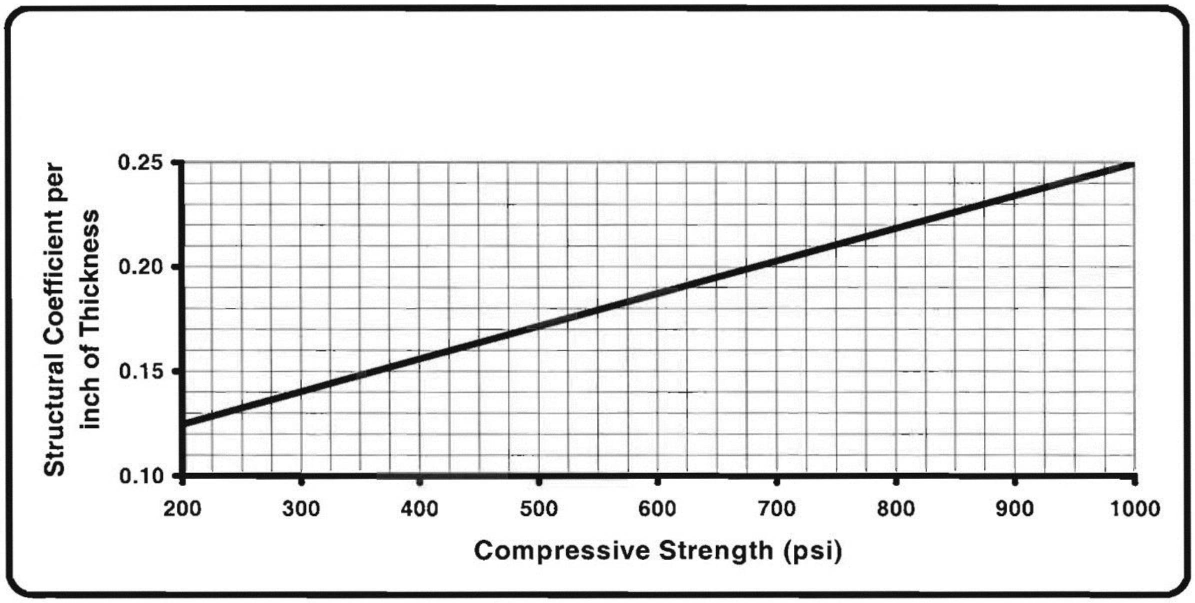
Where: t_i - layer thickness (feet)

RV_i - layer R-Value

An engineering analysis and evaluation of the R-value data will be performed prior to the determination of the design R-value. For projects where similar R-values can be grouped into sections, two or more pavement designs should be considered.

The designer shall consider the use of subgrade soil stabilization on all subgrade soils with an AASHTO soil classification of A-2-6, A-2-7, A-3, A-6, or A-7 material. When these soils are encountered, the guidelines contained in FHWA-IP-80-2, Soil Stabilization in Pavement Structures - A User's Manual, Volumes 1 and 2, shall be used as a guide for determining the appropriate subgrade stabilization method and procedures, including the appropriate laboratory testing procedures. The pavement designer shall then use the results as an alternative consideration for the pavement section. For pavement design purposes, the structural coefficient for this stabilized material shall be determined based on Exhibit 620-12. When subgrade stabilization is considered as an alternative, it shall be compared to removing and replacing the top two feet of the existing subgrade material for cost effectiveness.

Exhibit 620-12
Cement or Lime Slurry Stabilized Subgrade Strengths

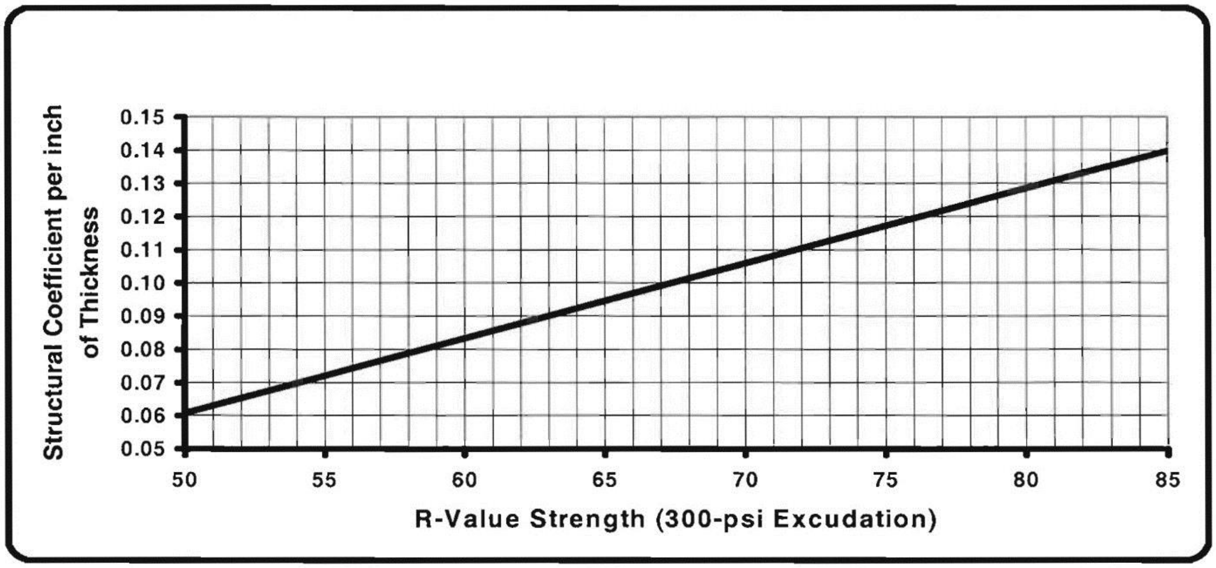


Note: Exhibit 620-13 is based on unconfined compressive strength of either lime-treated or cement-treated specimens prepared by AASHTO T 134 and tested at seven days for cement-treated materials or at 21 days for lime-treated materials. If the specimen unconfined compressive strength is less than 200 psi, then the specimen's layer structural coefficient should be determined using test results by performing AASHTO T 190 and Exhibit 620-13.

On new construction or reconstruction projects, and on reconstruction areas within rehabilitation projects only, the pavement designer shall confer with the respective District in regards to the subgrade design R-value on a given project. This design subgrade R-value shall be based on the existing subgrade R-value test results and the given project's minimum reliability shown in Exhibit 620-4. If the District believes that a borrow source of higher subgrade R-value material is readily available for use on a given project, the pavement designer will change the design R-value for the project to that particular design R-value once the District submits, in writing, their recommendation to the pavement designer.

An engineering analysis and evaluation of the R-value data will be performed prior to the determination of the design R-value. For projects where similar R-values may be grouped into sections, two or more pavement designs should be considered.

Exhibit 620-13
Untreated Aggregate Base Course Strengths



The designer shall also consider the use of reinforcing geotextile and/or geogrid materials at the subgrade/untreated aggregate base interface whenever the subgrade design R-value is less than 20 or when the subgrade material is saturated or unstable. The pavement designer shall only use engineering design procedures that have received prior approval for use by the NMDOT's State Materials Engineer. These procedures are included in Design Guideline for Flexible Pavements with Tensar Geogrid Reinforced Bases, Tensar Corporation, March, 1987, or an approved equal procedure. When using these procedures, the final recommendation shall not be less than the indicated layer thickness shown in Exhibit 620-16.

If the pavement designer encounters subgrade soils that are loose and collapsible, these subgrade soils should be considered for dynamic compaction techniques. The guidelines contained in FHWA/RD-86/133, Dynamic Compaction for Highway Construction, Volume 1, shall be used as a guide for selecting the appropriate design and construction procedures. Techniques such as chemical injection and stone columns may also be considered to stabilize these types of soils.

Chemical stabilization and/or geogrid alternatives are included to provide additional structural strength to the pavement section. In addition, they provide a working platform for placing the remaining pavement section materials. In some instances, additional chemical stabilization or removal and replacement of the bearing soils is necessary to provide a more substantial working platform. Many times this additional expense is not accounted for in the project cost estimate. Therefore, where chemical stabilization and/or geogrid pavement sections are provided, and based on the in-situ subbase moistures and plasticity index, removal and replacement of these bearing soils or additional subgrade stabilization techniques including cement or lime stabilization or geogrid may be necessary.

620.7.6 NMDOT Structural Layer Coefficients

The structural coefficients for new pavement materials to be used in the design shall be in accordance with Exhibit 620-14.

Exhibit 620-14

Recommended Structural Layer Coefficients

Material	Minimum Value
New Hot Mix Asphalt (HMA)	0.44
New Stone Matrix Asphalt (SMA)	0.44
New Hot Recycled HMA	0.44
New Hot In-Situ Recycled HMA	0.30
PCCP Crack and Seat	0.30
New Cold In-Situ Hot-Lime Recycled HMA	0.30
Central Plant Recycling	0.30
Full-Depth Reclamation – Foamed Asphalt	0.25
Asphalt Treated Aggregate Base Course	0.25
Cold-Mixed Asphalt Pavement	0.15
New Treated Open Graded Aggregate Base Course	0.15
New Untreated Aggregate Base Course	0.11
New Lime or Cement Stabilized Subgrade	See Exhibit 620-12

a Section 620.7.5

620.7.7 Minimum Flexible Pavement Total Layer Thickness for New and Rehabilitation Projects

The minimum HMA and/or untreated aggregate base course (UTBC) material thickness shall be per Exhibit 620-15 for all new and reconstruction projects only. The engineer may adjust the pavement thickness section (HMA, UTBC, or treated subgrade) based on the structural number to accommodate the UTBC depth increase of up to two inches in order to provide a constructible pavement section without roundup for structural number and without roundup for HMA lift depths caused by the nominal size of aggregate per the HMA mix type.

The final pavement section described in the construction plan documents shall be back-calculated for structural number to assure agreement with the State Materials Bureau original structural number calculation.

Exhibit 620-15

Minimum Flexible Pavement Total Layer Thickness for New and Rehabilitation Projects Only

Traffic ESALs	New HMA	UTBC
Less than 50,000	Surface treatment	4 inches
50,001 to 150,000	2 inches	4 inches
150,001 to 500,000	2.5 inches	4 inches
500,001 to 2,000,000	3 inches	6 inches
2,000,001 to 7,000,000	3.5 inches	6 inches
Greater than 7,000,000	4 inches	6 inches

620.7.8 Open Graded Friction Course

Construction projects with a design speed of 40 miles per hour (mph) or higher shall use either an open graded friction course (OGFC) or other alternative material. For construction projects with a design speed less than 40 mph, alternative materials may or may not be used at the discretion of the project design team.

620.7.9 HMA Type Selection Recommendations

Exhibit 620-16 shall be used to determine the type of HMA material that will be used on a project. Additionally, Exhibit 620-16 shows the recommended minimum and maximum lift thickness that should be considered for design with the selected HMA material. The minimum lift thickness shall not be less than the recommended minimum lift thickness in Exhibit 620-16 for that particular HMA material type.

Exhibit 620-16
HMA Type Selection Recommendations

HMA Type	Lift Thickness (inches)	
	Minimum	Maximum
SP-II	3.0	3.5
SP-III	2.5	3.5
SP-IV	1.5	3.0
Stone Matrix Asphalt (SMA)	1.5	2.0
Cold In-Situ Recycled (CIR)	3.0	6.0
Hot In-Situ Recycled (HIR)	1.5	2.0

Engineering analysis should be performed to determine the appropriate HMA type to meet the required thickness. Unnecessary adjustment of the HMA thickness should be evaluated and an optimum thickness should be determined based on the available HMA types. This may require different HMA type gradations. Thickness increments of 0.25 inches shall be considered to determine the final recommended thickness of the individual constructed layer. Adjustments may be made as described above.

620.7.10 Asphalt Binder

The proper selection of the asphalt binder that will be used on a given project is dependent on the climate, projected ESALs, and vehicle travel speed. For all HMA types, a performance graded asphalt shall be used based on the criteria presented in Section 620.4.4. Additionally, prior to the preparation of the final pavement design recommendations, the pavement designer shall contact the NMDOT's Pavement Design Engineer to obtain concurrence for the selected project asphalt binder.

The final recommended PG asphalt binder grade and HMA thickness shall conform to the guidelines shown in Exhibit 620-17 or Exhibit 620-18.

Exhibit 620-17

HMA Over Base Course Materials Selection Guidelines

HMA Layer	Material	20-Year Traffic ESALs			
		< 10.0 Million		> 10.0 Million	
		< 5.5″ New HMA	5.5″ New HMA	< 8.0″ New HMA	8.0″ New HMA
Surface Layer	HMA	Specify either an SP-III or SP-IV	Specify SP-IV (3.0″ Thick)	Specify either an SP-II or SP-III	Specify SP-III (5.0″ minimum thickness)
	PG Binder	Specify required PG asphalt binder **(BUMPED FOR ESAL AND TRAFFIC SPEED)**			
Bottom Layer	HMA	Specify same SP material as the surface layer	Specify SP-III for remainder of thickness	Specify same SP material as the surface layer	Specify SP-II for remainder of thickness
	PG Binder	Specify same PG asphalt binder as the surface layer	Specify base PG asphalt Binder (NO BUMP)	Specify same PG asphalt binder as the surface layer	Specify base PG asphalt Binder (NO BUMP)

Exhibit 620-18

HMA Over Existing HMA Materials Selection Guidelines

HMA Layer	Material	20-Year Traffic ESALs			
		< 10.0 Million		> 10.0 Million	
		< 5.5″ New HMA	5.5″ New HMA	< 8.0″ New HMA	8.0″ New HMA
Surface Layer	HMA	Specify either an SP-III or SP-IV	Specify SP-IV (3.0″ Thick)	Specify either an SP-II or SP-III	Specify SP-III (5.0″ minimum thickness)
	PG Binder	Specify required PG asphalt binder **(BUMPED FOR ESAL AND TRAFFIC SPEED)**			
Bottom Layer	HMA	Specify same SP material as the surface layer	Specify SP-III for remainder of thickness	Specify same SP material as the surface layer	Specify SP-II for remainder of thickness
	PG Binder	Specify same PG asphalt binder as the surface layer			

With the exception of interstate highways, pavement designs for passing lanes and shoulders may be designed using a reduction in ESALs. An engineering analysis of the facility will be performed based on ESALs, average annual daily traffic, percentage of commercial traffic, and other factors, to determine if this is a valid and reasonable approach.

Tack and prime coat application rates are presented in Exhibit 620-19.

Exhibit 620-19
Tack and Prime Coat Application Rates

Item	Application Rate (Gallons/Sq Yd)	Application Rate (Liters/m^2)	Unit Weight (Gallons/Ton)	Unit Weight (Liters/t)
Tack Coat	0.08	0.4	240	1,001
Prime Coat	0.45	2.0	240	1,001

620.7.11 Rehabilitation Project Considerations

Cold in-situ flexible pavement recycling, using the hot-lime process, may be used. However, there are situations where this strategy should not be used. These situations are:

- In areas where this material may come in contact with water from an underlying water-saturated layer or a high moisture subgrade material.
- In areas where the material to be recycled does not meet minimum aggregate quality standards for HMA as outlined in Division 400 of the NMDOT's Standard Specifications.

An HMA overlay shall be constructed on top of the cold in-situ recycled material and shall meet the minimum design life requirements presented in Exhibit 620-3. The maximum amount of untreated aggregate base material that can be recycled into the existing HMA material shall be limited to 25 percent of the planned cold in-situ recycled total design thickness.

Hot in-situ flexible pavement recycling is another option that a pavement designer may consider. However, there are situations where this strategy should not be used. These situations are:

- In areas where the OGFC appears to be rich in asphalt cement. If this exists, it is recommended that this layer be milled off before hot in-situ recycling operations begin.
- In areas where the existing flexible pavement is highly oxidized and/or severely cracked. The maximum depth for hot in-situ recycling is two inches.

Prior to beginning this operation, representative samples of the material to be recycled must be analyzed by the NMDOT or by a laboratory that is approved by the NMDOT to perform these tests.

The purpose of this testing is to determine what the type and amount of new asphalt material, if any, needs to be added to the existing flexible pavement material. An HMA overlay shall be constructed on top of the hot in-situ recycled material if it is structurally needed to meet the requirements of Exhibit 620-3.

Cold mill and inlay/overlay pavement design considerations shall be based on the design recommendations presented in Exhibit 620-3.

HMA overlay pavement design considerations shall be based on the minimum design life presented in Exhibit 620-3. In addition, if the existing pavement is rutted, then the pavement shall either be milled or it shall be micro-surfaced so that the entire rut is removed prior to actual overlay.

620.7.12 Temporary Detour Design

Temporary detour pavements shall be designed consistent with current NMDOT practice described in Section 405 of NMDOT's Standard Specifications.

620.7.13 Bridge Replacement Approach and Departure Design

When a bridge is being replaced on a roadway where the projected 20-year ESAL is equal to or greater than 500,000, the designed bridge approach pavement life shall be for 20 years. For a roadway with a projected 20-year ESAL less than 500,000, the pavement designer should consider other standard and innovative alternatives along with the standard use of flexible pavement structures. Examples of other standard and innovative alternatives are the use of untreated aggregate base course with a chip-sealed surface, emulsified cold-mix pavement materials, and flexible pavement millings with a chip-sealed surface. The typical length of both the approach and departure pavement is generally from 300 to 450 feet.

620.8 Rigid Pavement Design Procedure Policy

Per NMDOT, projects that include new construction, reconstruction, an urban interchange and/or an urban intersection as the project scope will require a PCCP alternative.

620.8.1 Field Investigation

This shall be the same as detailed in Section 620.4.

620.8.2 Laboratory Testing

This shall be the same as detailed in Section 620.6.

620.8.3 Portland Cement Concrete

Plain jointed PCCP shall be designed on all projects.

620.8.4 Compressive Strength

- Class F (3,000 psi for 14 days) Portland cement concrete shall be used on all slip-formed pavements.
- Class AA (4,000 psi for 28 days) Portland cement concrete shall be used on all cast-in-place pavements.

620.8.5 Serviceability

The initial serviceability index (Pi) shall be modeled as a normal distribution with a mean of 4.20 and standard deviation of 0.20. For probabilistic analysis, the best fit function will be risk normal (4.20, 0.20) with the final Pi being selected based on reliability presented in Exhibit 620-4.

The terminal serviceability index (Pt) shall be 2.5 on all interstate and four-lane NHS projects and 2.0 for all other projects. Requests for a project-specific ESAL shall include the Pt value that will be used so that the correct ESAL projections can be calculated.

620.8.6 Loss of Support (LS) for Base Materials.

The loss of support values outlined in Exhibit 620-20 shall be used in the design.

Exhibit 620-20
Typical Ranges of Loss of Subgrade Support Values

Type of Material	Elastic or Resilient Modulus (psi)		Loss of Support	
	Minimum	Maximum	Minimum	Maximum
Cement Treated Aggregate Base	1,000,000	2,000,000	0.0	1.0
Cement Aggregate Mixtures	500,000	1,000,000	0.0	1.0
Asphalt Treated Base	350,000	1,000,000	0.0	1.0
Asphalt Stabilized Mixtures	40,000	300,000	0.0	1.0
Lime Stabilized	20,000	70,000	1.0	3.0
Unbound Granular Materials	15,000	45,000	1.0	3.0
Fine Grained or Natural Subgrade Materials	3,000	40,000	2.0	3.0

620.8.7 Load Transfer Coefficient (J)

The load transfer coefficients (J) outlined in Exhibit 620-21 shall be used in the design.

Exhibit 620-21
Load Transfer Coefficients

Shoulder Type	Load Transfer Devices	
	Yes	No
Asphalt	3.2	4.2
Tied PCCP	2.9	4.0

620.8.8 Overall Drainage Coefficient (C_d)

The overall drainage coefficients in Exhibit 620-22 shall be used in the design.

Exhibit 620-22
Overall Drainage Coefficients

Quality of Drainage	Percent of Time Pavement Structure is Exposed to Moisture Levels Approaching Saturation			
	Less Than 1%	1 to 5%	5 to 25%	Greater Than 25%
Excellent	1.25 to 1.20	1.20 to 1.15	1.15 to 1.10	1.10
Good	1.20 to 1.15	1.15 to 1.10	1.10 to 1.00	1.00
Fair	1.15 to 1.10	1.10 to 1.00	1.00 to 0.90	0.90
Poor	1.10 to 1.00	1.00 to 0.90	0.90 to 0.80	0.80
Very Poor	1.00 to 0.90	0.90 to 0.80	0.80 to 0.70	0.70

620.8.9 Other Design Considerations

For the construction of all rigid pavement structures, the following should be considered:

- The most recent NMDOT specifications, Standard Drawings, and Special Provisions shall be used.
- The pavement designer shall consider incremental thickness increases of 0.25 inches for rigid pavement design.
- A Type 1 untreated aggregate base course layer shall be used for both rural and urban sections. This base course material shall be a minimum of six inches in thickness.
- On all urban projects, a PCCP shoulder shall be used and shall be tied with a 30-inch tie bar spacing to the mainline roadway in conformance with the NMDOT's latest joint detail Standard Drawings.
- On all rural projects, a widened PCCP lane shall be used. This lane shall extend a minimum of two feet beyond the edge of the travel lane and may be used in combination with the construction of flexible pavement shoulders.
- The designer shall consider the use of subgrade soil stabilization on all subgrade soils with an AASHTO soil classification or A-2-6, A-2-7, A-3, A-6, or A-7. When these soils are encountered, the guidelines contained in FHWA-IP- 80-2, Soil Stabilization in Pavement Structures - A User's Manual, Volumes 1 and 2, shall be used as a guide for determining the appropriate subgrade stabilization method and procedures. The pavement designer shall then use the results as an alternative consideration for the pavement section. When subgrade stabilization is considered as an alternative, it shall be compared to removing and replacing the top two feet of the existing subgrade material for cost effectiveness.
- Rigid pavements generally will be designed for a 20-year life; however, for urban projects a 30-year design life may be used at the discretion of the project design team.

- Life cycle cost analysis will be used to determine cost effectiveness of the design. The analysis period will be for 50 years and will include the following considerations:
  - All normally expected pavement maintenance activities that would occur over the entire analysis period.
  - All normally expected rehabilitation projects or projects that would occur after the pavement's 20-year or 30-year design life that will extend its total service life to 35 years. This may include the use of white-topping and ultra-thin white-topping.
- Underdrains should be evaluated whenever PCCP is an alternative, especially in the presence of a fine-grained subbase.
- As an alternative, PCCP design may be determined by use of accepted industry approach and software such as the American Concrete Pavement Association StreetPave software.

620.8.10 Shoulders and Shoulder Widening

Shoulder pavement structural sections on all new and reconstruction projects shall be constructed of the same materials and thickness as the mainline roadway. This shall also apply to pavement structural sections associated with the construction of additional lanes and acceleration and deceleration lanes. The subgrade for roadway shoulders shall be in the same plane for drainage considerations.

620.8.11 Rehabilitation Project Considerations

Cracking and seating of PCCPs shall have a minimum HMA overlay of five inches constructed over the top of the cracked and seated PCCP with a reinforcement fabric located between the HMA leveling course and the HMA overlay. The HMA leveling course may include an additional 25 percent material to account for leveling needs.

PCCP restoration consists of slab under-sealing, when determined to be cost effective, full and partial slab replacement, slab grinding, and joint sealing.

620.8.12 Bridge Replacement Approach and Departure Pavement Design

This shall be the same as detailed in Section 620.7.13.

620.9 District-Developed Projects

On all projects, both construction and maintenance, where a District is responsible for preparing either a book format project or a full set of construction plans, the District will have the responsibility for the final pavement design. However, the District will consult with a NMDOT-approved pavement designer who meets the requirements presented in Section 620.3, for both non-federal and federal projects. The purpose of this consultation is to ensure that the final pavement design is the most cost-effective possible for the available funding. All District deviations from this policy should be brought to the attention of the State Materials Bureau Chief so that needed modifications to this policy may be considered. This will ensure that this policy will reflect the most current acceptable practices for future District use.

620.9.1 Non-Federally Funded Project Pavement Designs

A District may request that the NMDOT's Pavement Design and Field Exploration Section prepare a project's pavement design recommendations as described in this chapter of the Design Manual. If the NMDOT's Pavement Design and Field Exploration Section is requested to prepare a project's pavement design recommendation, then adequate lead time must be given so that all traffic projections for design ESALs, field investigation, material testing, and design work can be scheduled and performed without affecting already scheduled pavement design and testing activities. This time period may range from six to eight months depending on the project's scope. If a District elects to prepare the pavement design recommendations, the NMDOT Pavement Design and Field Exploration Section will assist the District as requested.

620.9.2 Federally Funded Project Pavement Designs

In addition to the requirements and conditions described above in Section 620.9.1, a representative from the appropriate oversight authority must be involved in all field reviews and approval of the project's final pavement design recommendations. It is the District's responsibility to coordinate these field reviews with the appropriate oversight authority. Once the final pavement design recommendation has been received and concurred with by the NMDOT Pavement Design Engineer, the Pavement Design Engineer will then forward the final pavement recommendation to the appropriate oversight authority for their review and approval. If the appropriate oversight authority does not approve the forwarded pavement design recommendations, the NMDOT Pavement Design Engineer will coordinate any resolution process that needs to occur between the appropriate oversight authority and the District.

620.10 Life Cycle Cost Analysis

Costs for competing products may be determined by evaluating the capital investment required to build the pavement structure (rigid or flexible) and the associated recurring annual costs required to keep the pavement structure functional. The recurring annual costs may be calculated as present value. The recurring annual present value cost can be calculated from the following equation:

$$PV=A_r\ [((1+d)^n-1)/(d(1+d)^n)]$$

Where A_r = Recurring annual amount

d = Discount Rate - use four percent

(n) = number of years

and where Discount Rate equals:

$d_r = (1+d_n/(1+I))-1$ or $d_n = (1+d_r)(1+I) -1$

where I is the general rate of inflation - use three percent

Flexible, rigid, or composite pavement life cycle costs shall be calculated using net present value analysis. The analysis shall use a capital cost analysis period and 50-year maintenance period. In this method, all costs that will be associated with a given project, both current and future, are combined in terms of a current payment in current dollars where capital costs are considered along with the present value of the recurring annual costs. The advantages of this method are:

- The benefits and costs of the various alternatives are related and are expressed as a capital cost of investment and a present value cost of recurring annual costs.
- Alternatives with different construction and maintenance costs can be compared.
- All monetary costs are expressed in current dollar terms.
- This method is computationally simple and straightforward.

This analysis shall consider, at a minimum, initial construction and future rehabilitation costs. Actual routine maintenance costs may be considered by the pavement designer to further refine the analysis, but this is not a requirement because of the minimal impact these costs have on any given analysis. A comparative life cycle cost analysis should be performed between flexible and rigid pavement whenever rigid pavement is considered as an alternative.

620.10.1 Alternative Bidding for Pavement Type Selection

Reconstruction and new construction projects that meet the following criteria shall be let as alternative pavement bids with the life cycle cost analysis (LCCA) adjustment bid factor.

620.10.1.1 Criteria 1

All reconstruction or new construction federally funded NHS and non-NHS projects shall have alternative pavement designs with an LCCA adjustment bid factor for construction greater than or equal to two lane-miles in length unless waived at the General Office level for documented reasons.

620.10.1.2 Criteria 2

For warm mix asphalt (WMA) and HMA cement pavements, the pavement structure shall be designed based on 20-year ESALs. For PCCPs, the pavement structure shall be designed based on 20-year ESALs.

620.10.2 Life Cycle Cost Analysis Determination

- FHWA RealCost 2.5 Software shall be used to determine the LCCA-based adjustment bid factor.
- The LCCA will be performed for a period of 45 years.
- Salvage costs will not be considered.
- User costs will not be considered.
- Deterministic analysis will be used.
- The real discount rate will be determined by the 30-year maturity and 10-year Office of Management and Budget Circular A-94 moving average.
- Initial treatment cost will not be used in the adjustment bid factor.

620.10.3 Pavement Rehabilitation Treatments and Year Intervals

The following pavement rehabilitation treatments and intervals shall be used for NMDOT highways.

- Asphalt cement pavement:
  - At 16 years, mill and inlay OGFC (where applicable) and surface course to a depth of 2.5 inches in driving lanes.
  - At 33 years, mill and inlay OGFC (where applicable) and surface course to a depth of 2.5 inches in driving lanes.
- Portland cement concrete pavement:
  - At 15 years, full depth repair of 1.5 percent of the area in driving lanes and diamond grind driving lanes.
  - At 30 years, full depth repair of 1.5 percent of area in driving lanes and diamond grind driving lanes.

620.10.4 Asphalt Cement Pavement Rehabilitation Average Unit Bid

Costs for the following are included in the average unit bid price for asphalt cement pavement milling operations on NMDOT highways:

- Tack coat
- 2.5 inch inlay:
  - The same type of asphalt cement pavement (HMA versus WMA) used in the initial construction will be used for rehabilitation cost analysis.
  - OGFC (where applicable).

620.10.5 Portland Cement Concrete Rehabilitation Average Unit Bid

Costs for the following are included in the average unit bid price for PCCP rehabilitation on NMDOT highways:

- Concrete panel replacement - cost per square yard
- Items include:
  - Concrete panel removals
  - Concrete panel replacement - dowel and tie bars, concrete materials
  - Resealing of concrete pavement joints
- Grinding (an additional 1/4 inch of thickness will be added to the design thickness to accommodate future rehabilitation diamond grind treatment) - cost per square yard