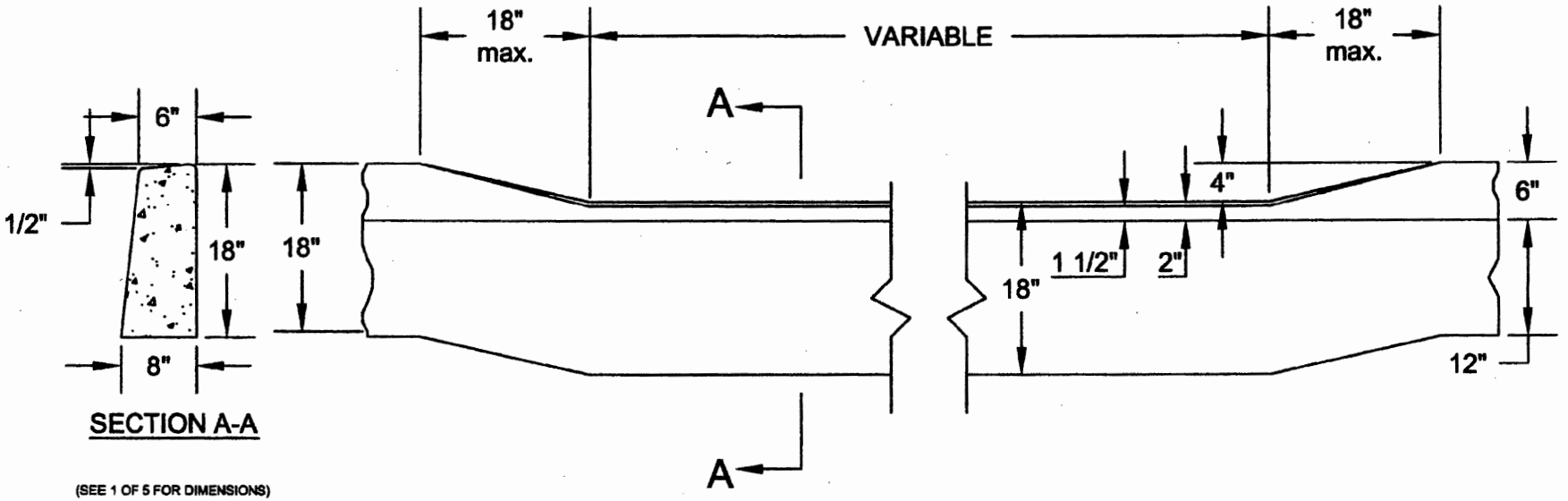
Figure 4.1
(6 of 6)



DROP CURB AT DRIVEWAYS

DETAIL SHOWN IS FOR CONCRETE CURB. DETAIL FOR GRANITE BLOCK CURB SHALL FOLLOW SAME DIMENSIONS IN THE DRIVEWAY AREA.

Administrative correction.
See: 29 N.J.R. 1296(a).
Amended by R.1999 d.374, effective November 1, 1999 (operative May 1, 2000).
See: 31 N.J.R. 477(a), 31 N.J.R. 3259(a).
Administrative correction.
See: 32 N.J.R. 684(b).
Amended by R.2000 d.480, effective December 4, 2000 (operative June 3, 2001).
See: 32 N.J.R. 2670(b), 32 N.J.R. 4277(a).
In Figure 4.1, amended (1 of 5), (2 of 5) and (3 of 5).
Amended by R.2002 d.399, effective December 16, 2002.
See: 34 N.J.R. 2615(a), 34 N.J.R. 4412(a).
Added Figure 4.1 (4 of 6); the elements of Figure 4.1 redesignated from "of 5" to "of 6"; amended Figure 4.1 (3 of 6).
Public Notice: Notice regarding the Publication of two Notices of Adoption in the December 16, 2002 New Jersey Register.
See: 34 N.J.R. 4343(a), 4412(a), 35 N.J.R. 219(b).

5:21–4.18 Sidewalks and bikeways construction standards

(a) The following apply to sidewalks and graded areas:

1. Sidewalks of concrete shall be four inches thick except at points of vehicular crossing, where they shall be at least six inches thick. At vehicular crossings, concrete sidewalks shall be reinforced with welded wire fabric mesh or an equivalent.

2. Concrete, air-entrained sidewalks shall be Class B concrete, having a 28–day verification strength of 4,500 p.s.i. Other materials may be permitted, depending on the design of the development.

3. Graded areas shall be planted with grass or treated with other suitable ground cover, and their width and cross slope shall correspond to that of sidewalks.

(b) The following apply to bikeways:

1. The construction of bikeways shall conform to the New Jersey Department of Transportation Planning and Design Guidelines for Bicycle Compatible Roadways and Bikeways (November 1995) and the AASHTO Guide for the Development of Bicycle Facilities (1999), incorporated herein by reference.

2. Bicycle-safe drainage grates shall be used in the construction of all residential streets.

Administrative correction.
See: 29 N.J.R. 1296(a).
Amended by R.2000 d.480, effective December 4, 2000 (operative June 3, 2001).
See: 32 N.J.R. 2670(b), 32 N.J.R. 4277(a).
Rewrote (b)1.
Amended by R.2002 d.399, effective December 16, 2002.
See: 34 N.J.R. 2615(a), 34 N.J.R. 4412(a).
In (a)2, substituted "Class B concrete" for "Class C concrete" and substituted "4,500 p.s.i." for "4,000 p.s.i.".
Public Notice: Notice regarding the Publication of two Notices of Adoption in the December 16, 2002 New Jersey Register.
See: 34 N.J.R. 4343(a), 4412(a), 35 N.J.R. 219(b).

5:21–4.19 Street grade, intersections, pavement, and lighting construction standards

(a) The following apply to street grade:

1. Minimum street grade permitted for all streets shall be 0.5 percent.

2. Maximum street grade shall vary by road hierarchy with flatter grades required for roads with higher ADTs, in accordance with the requirements shown in Table 4.6. Where terrain makes it necessary, the allowable maximum grade may be increased by up to two percent, but shall not exceed a maximum grade of 16 percent.

(b) The following shall apply to intersections:

1. Street intersections shall be as nearly at right angles as possible and in no case shall be less than 75 degrees.

2. New intersections along one side of an existing street shall, if possible, coincide with an existing intersection on the opposite of each street. Where provided, offsets shall be at least 150 feet between right-of-way centerlines.

3. Intersections shall be rounded at the curbline with the street having the highest radius requirement, as shown in Table 4.6 below, determining the minimum standard for all curblines.

4. Intersections shall be designed with a flat grade wherever practical.

5. The minimum centerline radius, minimum tangent length between reverse curves, and curb radii shall be as shown in Table 4.6 below.

6. Sight triangles shall be in accordance with 1990 AASHTO's "A Policy on Geometric Design of Highways and Streets" standards and based on the speed limits established by the government agency having jurisdiction. Sight triangle easements shall be required and shall include the area on each street corner that is bounded by the line which connects the sight or "connecting" points located on each of the right-of-way lines of the intersecting street. The planting of trees or other plantings, or the location of structures exceeding 30 inches in height that would obstruct the clear sight across the area of the easements, shall be prohibited, and a public right-of-entry shall be reserved for the purpose of removing any object, material or otherwise, that obstructs the clear sight.

TABLE 4.6
STREET GRADE AND INTERSECTION DESIGN CRITERIA

	Street Hierarchy				
	Special purpose street: alley	Special purpose street: cul-de-sac	Rural, residential access, and neighborhood	Minor collector	Major collector
Minimum Grade	0.5%	0.5%	0.5%	0.5%	0.5%

	Special purpose street: alley	Special purpose street: cul-de-sac	Rural, residential access, and neighborhood	Minor collector	Major collector
Maximum Grade	15%	12%	12%	10%	8%
Maximum Grade of Secondary Street within 50 feet of Intersection†	5%	5%	5%	5%	5%
Minimum Center–Line Radius	100 ft	100 ft	100 ft	150 ft	300 ft
Minimum Tangent Length between Reverse Curves	0 ft	50 ft	50 ft	100 ft	150 ft
Curb Radii	20 ft	25 ft	25 ft	30 ft	35 ft

Note: †As measured from the nearest right-of-way line.

(c) Pavement shall be designed using either Figures 4.2 through 4.5, the structural number method, or the alternate pavement design methods referenced in (c)3 below.

1. Pavement design using figures: Pavement design for special-purpose streets (cul-de-sac, rural, etc.), residential access, neighborhood, minor collector, and major collector shall follow the specifications shown in Figures 4.2 through 4.5 based on the street type. Subgrade categories are shown in Table 4.7 below.

2. Structural number method: As an alternative to using Figures 4.2 through 4.5, applicants may design pavement using the structural numbers found in Table 4.9 below.

i. The designated structural number must be achieved by choosing the appropriate layers of bituminous stabilized surface course (Mix I–4, Mix I–5), bituminous stabilized base course (Mix I–2, stone mix), bituminous stabilized base course (Mix I–2, gravel mix), dense graded aggregate base course, soil aggregate base course, and subbase. The structural values and minimum layer thicknesses for the various materials are listed in Table 4.8 below.

TABLE 4.8

PER–INCH STRUCTURAL VALUE FOR VARIOUS PAVING MATERIALS

Layer material	Structural value per-inch thickness	Minimum thickness
Bituminous stabilized concrete surface (Mix I–4, Mix I–5)[1]	0.44	2 inches
Bituminous stabilized base course (Mix I–2, stone mix)[2]	0.44	3 inches
Bituminous stabilized base course (Mix I–2, gravel mix)[2]	0.37	3 inches
Dense graded aggregate base course[2]	0.14	4 inches
Soil aggregate base course[2]	0.11	4 inches
Subbase	0.08	6 inches

Notes:

1 Materials for asphalt concrete surface shall conform to Section 404.02 of the New Jersey Department of Transportation's Standard Specification for Road and Bridge Construction (1989).

2 Materials for asphalt concrete base shall conform to Sections 301.02 and 304.02 of the New Jersey Department of Transportation's Standard Specification for Road and Bridge Construction (1989).

ii. Thicknesses shall be provided in 0.5 inch increments.

TABLE 4.9

STRUCTURAL NUMBER VALUES AS A FUNCTION OF ADT AND M_r[1]

	SN_0 prior to two-inch asphalt concrete surface course		
Maximum ADT[2]	M_r = 3,000 psi Poor Subgrade	M_r = 5,000 psi Medium Subgrade	M_r = 7,500 psi Good/Excellent Subgrade
200	1.60	1.15	0.84
250	1.69	1.23	0.91
500	1.99	1.49	1.14
750	2.17	1.65	1.29
1,000	2.31	1.77	1.40
1,250	2.42	1.87	1.48

1,500	2.52	1.95	1.55
1,750	2.60	2.02	1.61
2,000	2.67	2.08	1.67
2,250	2.73	2.13	1.72
2,500	2.79	2.18	1.76
2,750	2.84	2.23	1.80
3,000	2.89	2.27	1.84
3,250	2.93	2.31	1.88
3,500	2.97	2.35	1.91
3,750	3.17	2.52	2.06
4,000	3.21	2.55	2.09
4,250	3.24	2.58	2.12
4,500	3.28	2.61	2.15
4,750	3.31	2.64	2.17
5,000	3.34	2.67	2.20
5,250	3.37	2.69	2.22
5,500	3.40	2.72	2.24
5,750	3.42	2.74	2.26
6,000	3.45	2.76	2.28
6,250	3.48	2.79	2.30
6,500	3.50	2.81	2.32
6,750	3.52	2.83	2.34
7,000	3.55	2.85	2.36
7,250	3.57	2.87	2.38
7,500	3.59	2.89	2.39

Notes:

1 All subgrades shall be considered "poor," unless the applicant proves otherwise through CBR testing or field evaluation of soil classification. Test results shall be reviewed by the municipal engineer.

2 ADT ranges for street types listed in the standards are as follows:

Rural Residential Lane	0–200
Cul-de-sac	0–250
Rural Street	0–500
Alley	0–500
Multifamily Access Cul-de-sac	0–1,000
Residential Access	0–1,500
Residential Neighborhood	0–1,500
Minor Collector	1,501–3,500
Major Collector	3,501–7,500

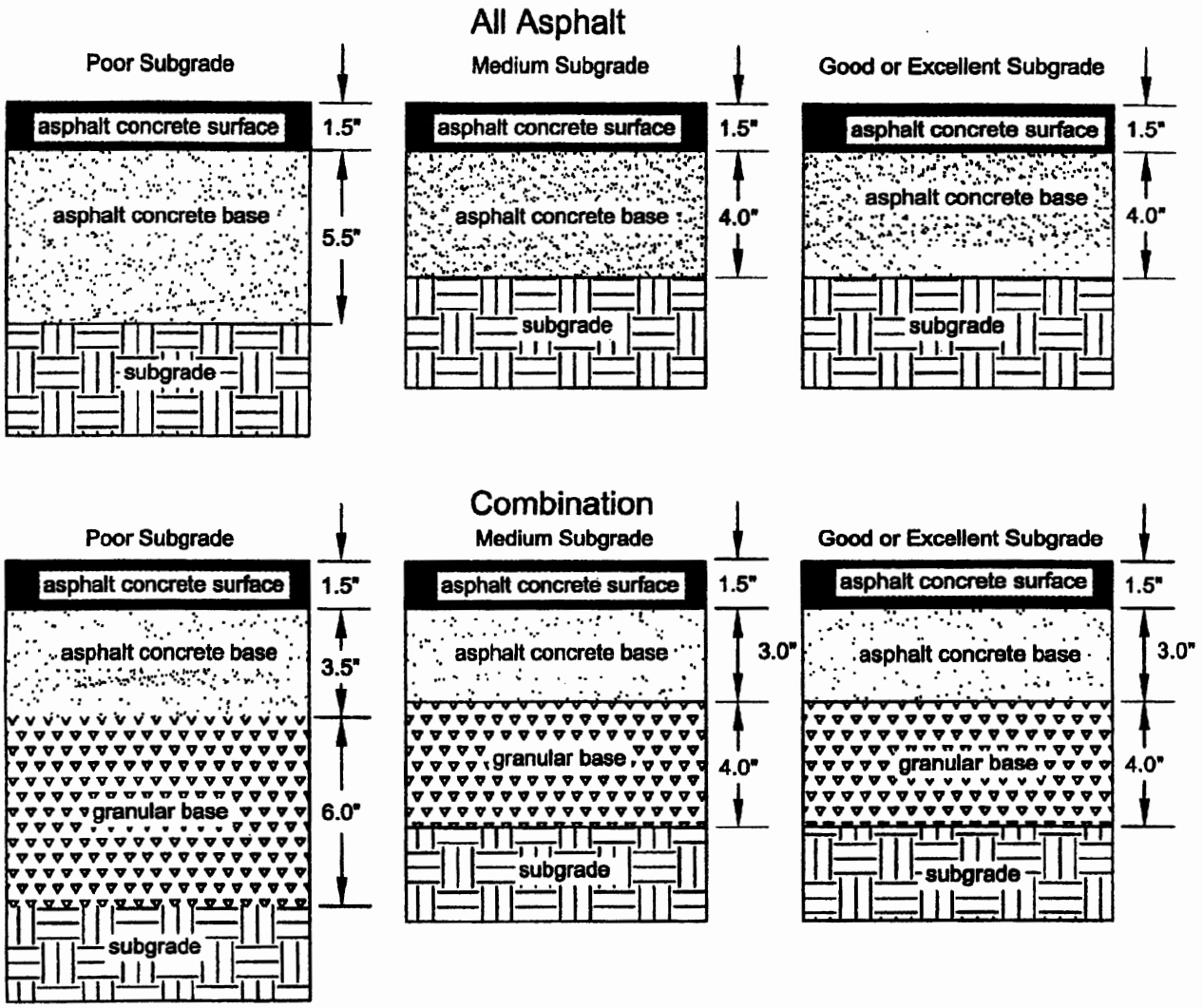
Source: The Table is derived from the AASHTO Guide for Design of Pavement Structures (1993).

3. Alternate pavement design: Alternate pavement design shall be allowed provided it conforms with one of the following: AASHTO Method of Flexible Pavement Design, AASHTO Method of Rigid Pavement Design, Fatigue Strength Method of Design, Multilayer Elastic Analysis, or the National Crushed Stone Association Design, incorporated herein by reference.

(d) Lighting (Reserved)

Figure 4.2

Pavement Sections for Rural Residential Lanes, Rural Streets, Cul-de-Sacs, and Alleys (ADT ≤ 500) (EAL≤ 30,000)



Source: N.J.S.M.E., *Asphalt Handbook for County and Municipal Engineers*, 3rd Edition, March 2000. The figures were derived by applying the Asphalt Institute's *Thickness Design – Full Depth Asphalt Pavement Structures for Highways and Streets.*

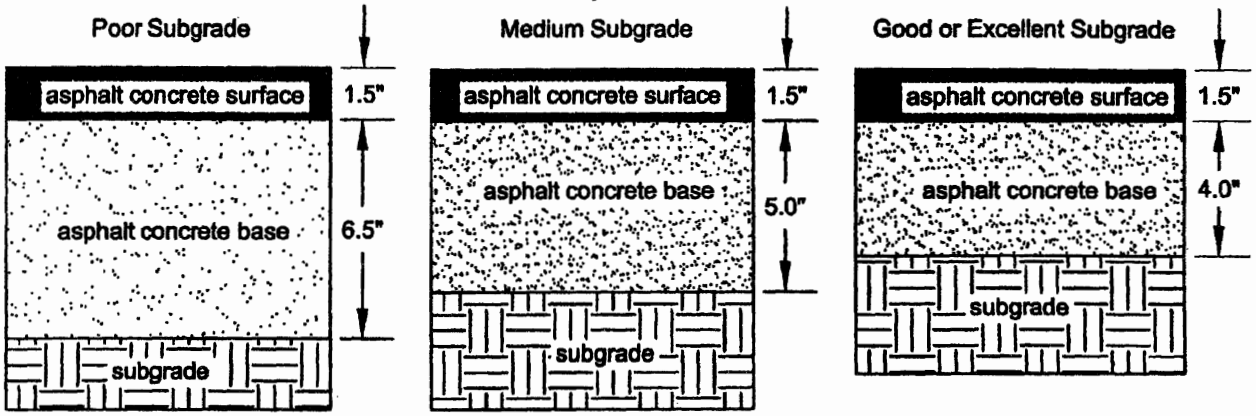
NOTES:

1. Materials for the asphalt concrete surface shall conform to Section 404.02 of the New Jersey Department of Transportation's *Standard Specifications for Road and Bridge Construction* (1989).
2. Materials for the asphalt concrete base shall conform to Sections 301.02 and 304.02 of the N.J. Department of Transportation's *Standard Specifications for Road and Bridge Construction* (1989).
3. Thicknesses may have to be constructed in multiple lifts, based on equipment capabilities.
4. The granular base shall be dense graded aggregate conforming to Section 901.08 or soil aggregate designated I-5 conforming to Section 901.09 and shown in Table 901-2 of the N.J. Department of Transportation's *Standard Specifications for Road and Bridge Construction* (1989).
5. All subgrades shall be considered "poor," unless the applicant proves otherwise through CBR testing or field evaluation of soil classification. Test results shall be reveiwed by the municipal engineer.
6. Subgrade compaction shall be approved by the municipal engineer.
7. Drawings are based on the following design assumptions: A 20-year design period with staged construction is used. Base courses are designed to withstand the construction traffic anticipated during a 3-year construction period and have a residual life of 17 years at the end of the 3-year period. The entire pavement section, base course plus finish course, is designed to withstand the traffic loading for the remaining 17 years of the 20-year design period.

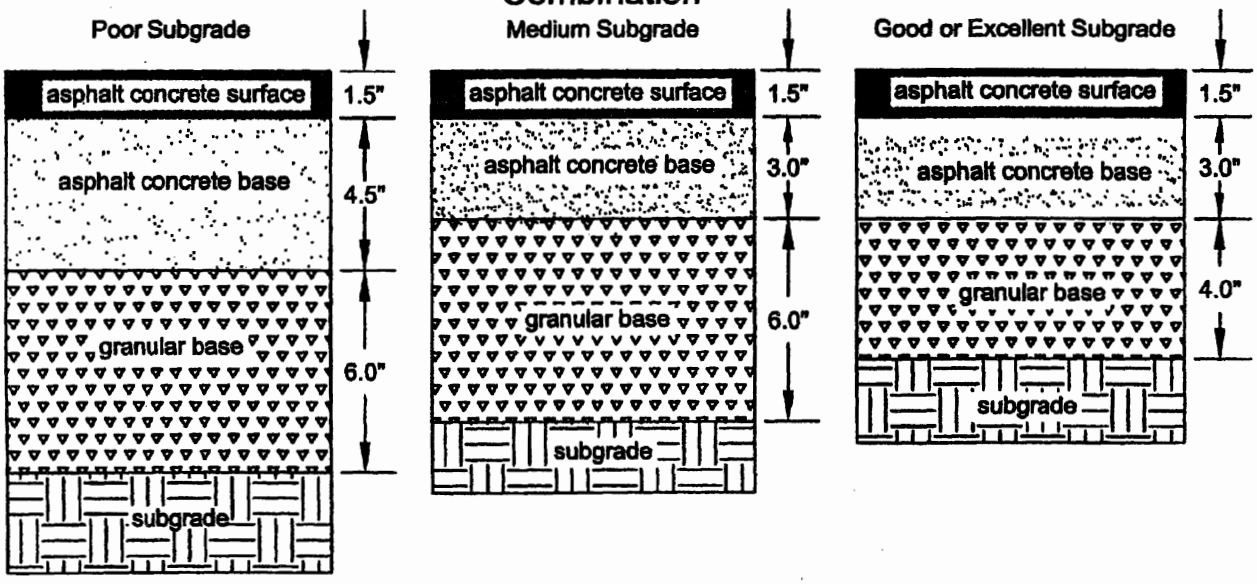
Figure 4.3

Pavement Sections for Residential Access and Neighborhood Streets (ADT ≤ 1,500)(EAL ≤ 80,000)

All Asphalt



Combination

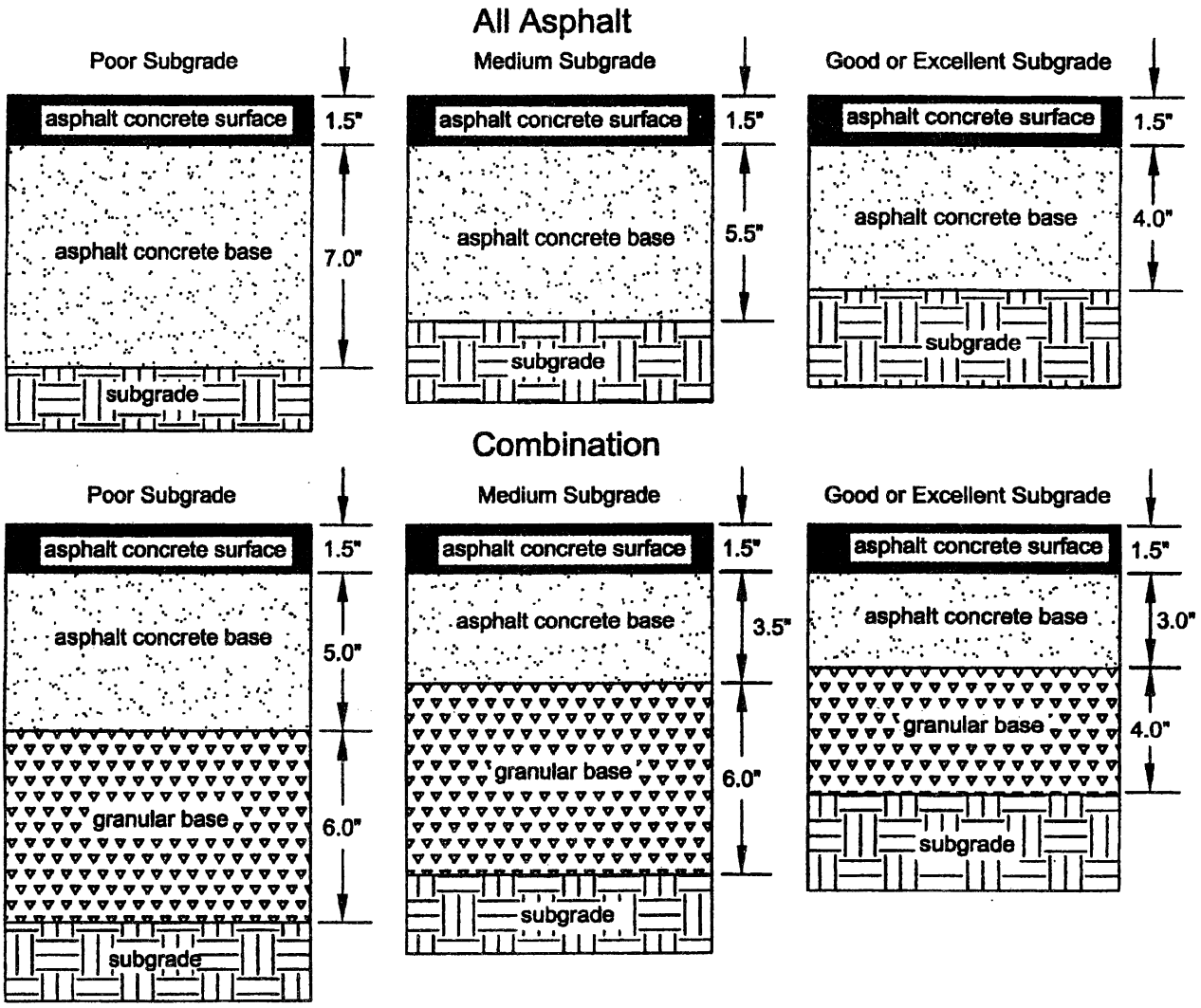


Source: N.J.S.M.E., *Asphalt Handbook for County and Municipal Engineers*, 3rd Edition, March 2000. The figures were derived by applying the Asphalt Institute's *Thickness Design – Full Depth Asphalt Pavement Structures for Highways and Streets.*

NOTES:

1. Materials for the asphalt concrete surface shall conform to Section 404.02 of the New Jersey Department of Transportation's *Standard Specifications for Road and Bridge Construction* (1989).
2. Materials for the asphalt concrete base shall conform to Sections 301.02 and 304.02 of the N.J. Department of Transportation's *Standard Specifications for Road and Bridge Construction* (1989).
3. Thicknesses may have to be constructed in multiple lifts, based on equipment capabilities.
4. The granular base shall be dense graded aggregate conforming to Section 901.08 or soil aggregate designated I-5 conforming to Section 901.09 and shown in Table 901-2 of the N.J. Department of Transportation's *Standard Specifications for Road and Bridge Construction* (1989).
5. All subgrades shall be considered "poor," unless the applicant proves otherwise through CBR testing or field evaluation of soil classification. Test results shall be reveiwed by the municipal engineer.
6. Subgrade compaction shall be approved by the municipal engineer.
7. Drawings are based on the following design assumptions: A 20-year design period with staged construction is used. Base courses are designed to withstand the construction traffic anticipated during a 3-year construction period and have a residual life of 17 years at the end of the 3-year period. The entire pavement section, base course plus finish course, is designed to withstand the traffic loading for the remaining 17 years of the 20-year design period.

Figure 4.4
Pavement Sections for Minor Collectors (ADT≤ 3,500) (EAL ≤ 200,000)

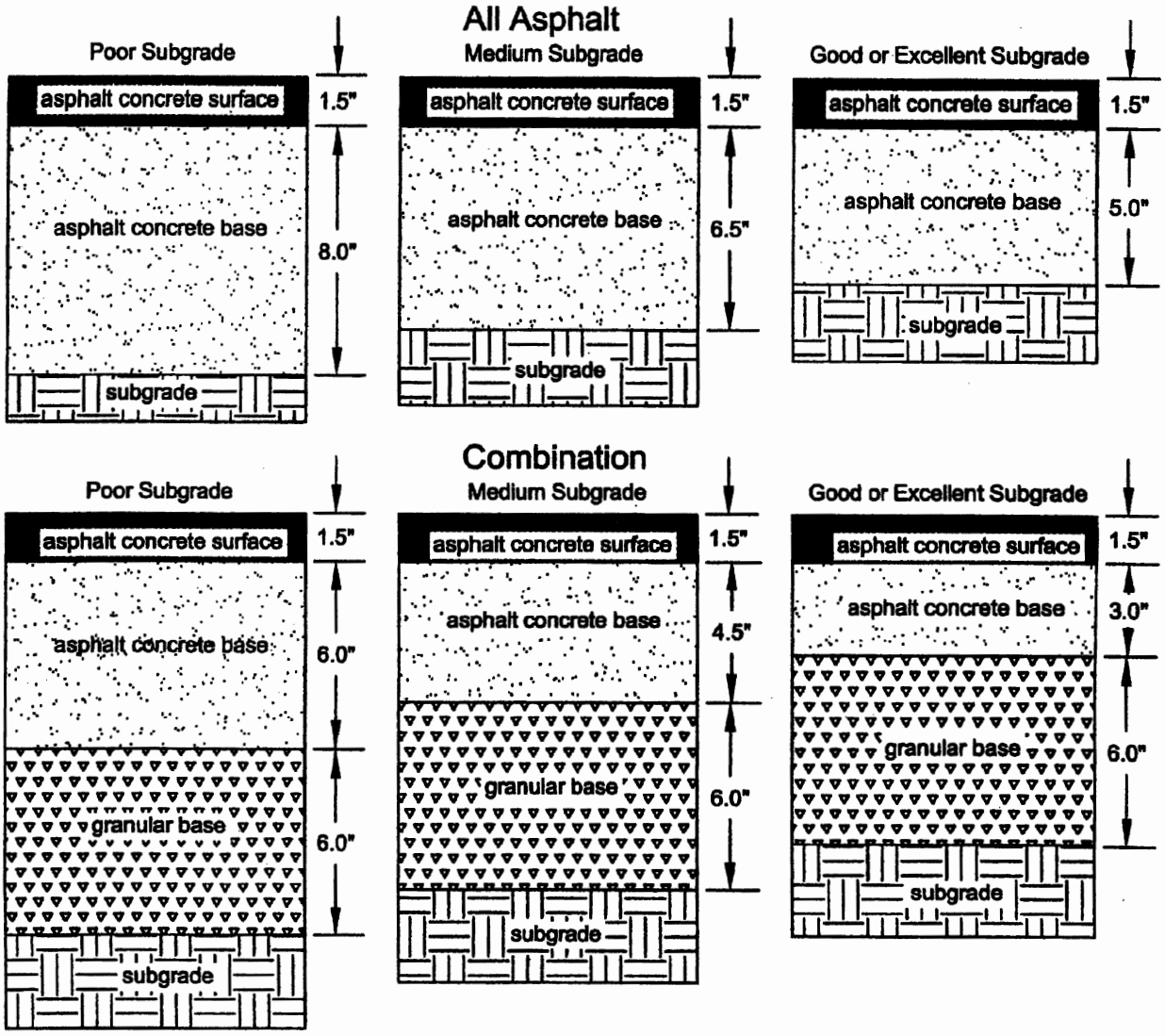


Source: N.J.S.M.E., *Asphalt Handbook for County and Municipal Engineers* , 3rd Edition, March 2000. The figures were derived by applying the Asphalt Institute's *Thickness Design – Full Depth Asphalt Pavement Structures for Highways and Streets.*

NOTES:

1. Materials for the asphalt concrete surface shall conform to Section 404.02 of the New Jersey Department of Transportation's *Standard Specifications for Road and Bridge Construction* (1989).
2. Materials for the asphalt concrete base shall conform to Sections 301.02 and 304.02 of the N.J. Department of Transportation's *Standard Specifications for Road and Bridge Construction* (1989).
3. Thicknesses may have to be constructed in multiple lifts, based on equipment capabilities.
4. The granular base shall be dense graded aggregate conforming to Section 901.08 or soil aggregate designated I-5 conforming to Section 901.09 and shown in Table 901-2 of the N.J. Department of Transportation's *Standard Specifications for Road and Bridge Construction* (1989).
5. All subgrades shall be considered "poor," unless the applicant proves otherwise through CBR testing or field evaluation of soil classification. Test results shall be reveiwed by the municipal engineer.
6. Subgrade compaction shall be approved by the municipal engineer.
7. Drawings are based on the following design assumptions: A 20-year design period with staged construction is used. Base courses are designed to withstand the construction traffic anticipated during a 3-year construction period and have a residual life of 17 years at the end of the 3-year period. The entire pavement section, base course plus finish course, is designed to withstand the traffic loading for the remaining 17 years of the 20-year design period.

Figure 4.5
Pavement Sections for Major Collectors (ADT ≤ 7,500) (EAL ≤ 400,000)



Source: N.J.S.M.E., *Asphalt Handbook for County and Municipal Engineers*, 3rd Edition, March 2000. The figures were derived by applying the Asphalt Institute's *Thickness Design – Full Depth Asphalt Pavement Structures for Highways and Streets.*

NOTES:

1. Materials for the asphalt concrete surface shall conform to Section 404.02 of the New Jersey Department of Transportation's *Standard Specifications for Road and Bridge Construction* (1989).
2. Materials for the asphalt concrete base shall conform to Sections 301.02 and 304.02 of the N.J. Department of Transportation's *Standard Specification for Road and Bridge Construction* (1989).
3. Thicknesses may have to be constructed in multiple lifts, based on equipment capabilities.
4. The granular base shall be dense graded aggregate conforming to Section 901.08 or soil aggregate designated I-5 conforming to Section 901.09 and shown in Table 901-2 of the N.J. Department of Transportation's *Standard Specifications for Road and Bridge Construction* (1989).
5. All subgrades shall be considered "poor," unless the applicant proves otherwise through CBR testing or field evaluation of soil classification. Test results shall be reveiwed by the municipal engineer.
6. Subgrade compaction shall be approved by the municipal engineer.
7. Drawings are based on the following design assumptions: A 20-year design period with staged construction is used. Base courses are designed to withstand the construction traffic anticipated during a 3-year construction period and have a residual life of 17 years at the end of the 3-year period. The entire pavement section, base course plus finish course, is designed to withstand the traffic loading for the remaining 17 years of the 20-year design period.

TABLE 4.7
SUBGRADE CATEGORIES
A. BASED ON STRENGTH TEST

Subgrade category	California Bearing Ratio (Cbr)	Resilient Modules Mr Value
Good to excellent	+10	Above 15,000
Medium	+5 to 9	7,500 to 13,500
Poor	2 to 4	3,000 to 6,000

B. BASED ON SOIL CLASSIFICATION

Subgrade category	Material	Unified System[a]	AASHTO System[a]
Good to excellent	Gravels and sands	GW, GP, GM, GC, SW, SP, SM, SC	A–1, A–2–4, A–2–5, A–2–6, A–2–7, A–3
Good or poor	Silts and clays	ML, CL, OL, MH, CH, OH	A–4, A–5, A–6, A–7–5, A–7–6

Notes: [a]Refers to categories of soil types and properties
Sources: Per the Rutgers Model Subdivision and Site Plan Ordinance by David Listokin and Carole W. Baker, January 1987—Original strength test and soil classification information derived from the Asphalt Institute, "Thickness Design—Full–Depth Asphalt Pavement Structures for Highways and Streets," MS–1, 8th Edition, August 1970 in Robert F. Baker et al. (editor), Handbook of Highway Engineering. Inclusion of SW, SP, SC soil classifications based on information from the Portland Cement Association's Thickness Design for Concrete Highway and Street Pavements.

Revised CBR strength test and M_r value information are from the Asphalt Handbook for County and Municipal Engineers, November 1991 (Second Edition), published by the New Jersey Society of Municipal Engineers.

Administrative correction.
See: 29 N.J.R. 1296(a).
Administrative correction.
See: 29 N.J.R. 2816(a).
Amended by R.1999 d.374, effective November 1, 1999 (operative May 1, 2000).
See: 31 N.J.R. 477(a), 31 N.J.R. 3259(a).
Rewrote (b)2; and in Table 4.6, deleted Intersection Standard heading, and substituted a reference to Maximum Grade of Secondary Street for a reference to Maximum Grade.
Amended by R.2000 d.480, effective December 4, 2000 (operative June 3, 2001).
See: 32 N.J.R. 2670(b), 32 N.J.R. 4277(a).
Rewrote (c); amended Figures 4.2 and 4.3; and inserted Figures 4.4 and 4.5.
Amended by R.2002 d.399, effective December 16, 2002.
See: 34 N.J.R. 2615(a), 34 N.J.R. 4412(a).
Added new (c), including Tables 4.8 and 4.9; deleted former (c); recodified former (d) as new (c)3; added new Figures 4.2 through 4.5 and deleted former Figures 4.2 through 4.5.
Public Notice: Notice regarding the Publication of two Notices of Adoption in the December 16, 2002 New Jersey Register.
See: 34 N.J.R. 4343(a), 4412(a), 35 N.J.R. 219(b).

5:21–4.20 Curves

(a) Vertical and horizontal curves shall be designed in accordance with 1990 AASHTO's "A Policy on Geometric Design of Highways and Streets" standards, incorporated herein by reference.

(b) Sight easements on vertical and horizontal curves shall be required and determined based on the sight distance requirements contained in the 1990 AASHTO's "A Policy on Geometric Design of Highways and Streets" standards, taking into consideration the speed limits established by the government agency having jurisdiction. Residential access, residential neighborhood, and rural street design shall be based on a speed limit of 25 miles an hour. Minor collector street design shall be based on a speed limit of 30 miles per hour. Major collector design shall be based on a speed limit of 30 miles per hour or five miles over the anticipated posted speed limit, whichever is higher.

Amended by R.2000 d.480, effective December 4, 2000 (operative June 3, 2001).
See: 32 N.J.R. 2670(b), 32 N.J.R. 4277(a).
In (b), substituted "shall" for "should" in the second and third sentences, deleted "and major" following "Minor" in the third sentence, and the last sentence was added.

SUBCHAPTER 5. WATER SUPPLY

5:21–5.1 Water supply system

Water supply systems, where installed, shall conform to the standards contained in this subchapter.

5:21–5.2 Capacity

(a) The water supply system shall be adequate to handle the necessary flow, based on complete development of the tract.

(b) When plans for future development necessitate oversizing of the water supply system, the municipality or utility authority may enter into an agreement with the developer to address the fair share of the costs.

(c) The demand rates for all uses shall be considered in computing the total system demand. Where fire protection is provided in accordance with (e) below, the system shall be capable of providing the required fire demand plus the required maximum daily residential demand, or the peak hour flows indicated in Table 5.2 below, whichever is greater. The maximum daily demand shall be calculated by multiplying the average daily residential demand indicated in Table 5.1 by a factor of 1.5.

(d) Average daily residential consumption shall be computed in accordance with the housing unit type and size data shown in Table 5.1. The peak daily flows shall be computed by applying a peaking factor of three times the average daily residential consumption. The municipality may require deviations in the peaking factor value provided appropriate documentation and justification for the deviation from the standards is provided.

(e) The design of the on-site water distribution system shall be adequate to provide fire protection as per ISO standard, *Fire Suppression Rating Schedule,* or per AWWA M31, "Manual of Water Supply Practices—Distribution System Requirements for Fire Protection," ISO method on pages 3–9, incorporated herein by reference.

TABLE 5.1

WATER DEMAND/GENERATION BY TYPE /SIZE OF HOUSING

Type/size housing	Number of residents	Residential Water Demand[a] (daily) (gallons per day)
Single-family detached		
2 bedroom	2.13	215
3 bedroom	3.21	320
4 bedroom	3.93	395
5 bedroom	4.73	475
Garden Apartment		
1 bedroom	1.57	120
2 bedroom	2.33	175
3 bedroom	3.56	270
Townhouse		
1 bedroom	1.69	125
2 bedroom	2.02	150
3 bedroom	2.83	210
4 bedroom	3.67	275
High-rise		
studio	1.07	80
1 bedroom	1.34	100
2 bedroom	2.14	160
Mobile home		
1 bedroom	1.73	130
2 bedroom	2.01	150
3 bedroom	3.47	260

Notes: [a] Based on 100 gallons per person per day for single-family detached units and 75 gallons per person per day for other housing types (rounded).

Source: U.S. Census, Public Use File—New Jersey (Units built 1975-1980).

TABLE 5.2

DESIGN STANDARDS FOR PEAK HOUR FLOW

Total houses served	Peak hourly rates (gallons per minute per house)
5	8.0
10	5.0
50	3.0
100	2.0
250	1.3
500	0.8
750	0.7
1,000 or more	0.6

Amended by R.1999 d.374, effective November 1, 1999 (operative May 1, 2000).

See: 31 N.J.R. 477(a), 31 N.J.R. 3259(a).

Rewrote (c); and in Table 5.2, added Peak Hourly Rate for 1,000 or more Total Houses Served.

5:21–5.3 System design and placement

(a) System design and placement shall comply with the following construction specifications, incorporated herein by reference: all applicable NJ Department of Environmental Protection (NJDEP) rules, the American Water Works Association (AWWA) standards, and in the Pinelands Area, the Standards of the Pinelands Comprehensive Management Plan, with the strictest standards governing.

(b) Distribution mains of the overall system shall be connected into loops so that the supply may be brought to the consumer from more than one direction. In balancing loops in a design, the Hardy-Cross, or an equivalent, method shall be used (see subchapter Appendix, incorporated herein by reference). Manning roughness coefficients listed in Table 7.1 in N.J.A.C. 5:21–7.1 may be used in these calculations. Dead-end lines shall be permitted within the design of a looped system provided that there are no more than 20 dwelling units permanently, or no more than 50 dwelling units temporarily, on a dead-end line. When dead-end lines are used, they shall be provided with a hydrant or blowoff at the terminus as a means of flushing.

(c) Valves, except on a permitted dead end, shall be located on distribution mains so that no more than one hydrant would be out of service as a result of a single water main break. They shall be located in all small branches off larger mains; and where eight-inch or larger mains lines intersect, a valve shall be located in each branch. At street intersections, valves shall be located near pipe intersections for ease in finding in the event of a water main break.

(d) In addition to the above requirements, water mains shall be valved so that not more than one-fifth of a mile would be affected by a single water main break. Geared valves on 16–inch mains or larger shall be furnished when required by the municipality.