COMPREHENSIVE PAVEMENT DESIGN MANUAL

Chapter 1: Introduction and Glossary

JUNE 30, 2000
CHAPTER 1
INTRODUCTION AND GLOSSARY

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1.1 PURPOSE

The primary function of the Comprehensive Pavement Design Manual (CPDM) is to provide the project designer with a single-source compilation of current Department policy and guidance pertaining to pavement design. This manual should be used in combination with the Highway Design Manual (HDM) for designing pavements.

Variations from this manual will be necessary for special conditions, or between the issuances of new or revised source documents and any corresponding updates of the CPDM. Consequently, instructions in this document are not intended to preclude the exercise of individual initiative and engineering judgment in reaction to site-specific conditions or the application of current state of the art practices. Rather, such initiative and judgment is encouraged when it is appropriate and there is a rational basis for deviation. However, it is equally important that there be consistency statewide in the application of this manual. The objective is uniformity of design for the same or similar conditions.

The CPDM consists primarily of documents, that prior to the CPDM, have been published elsewhere in the Department. With the CPDM, it is planned to continuously update this document to provide a current cohesive text that addresses pavement evaluation and design with well organized cross-referencing to supporting documents where appropriate. Relevant excerpts of related documents are included and commentary is provided as necessary.

The organization of this manual is intended to reflect the sequence of events that a typical project might follow: evaluation of an existing distressed pavement, determination of the scope of the remedial effort, detailed design of the selected alternative, construction, and maintenance of the completed project.

Development of the CPDM was recommended by the Technical Services Division Joint Standing Committee on Pavement Design. The committee also determined that the Geotechnical Engineering Bureau shall be responsible for updating the manual in cooperation with Design Quality Assurance Bureau (DQAB) to keep it current with NYSDOT approved pavement design policy and procedures.
1.2 CHAPTER OUTLINE

The following is an outline of the CPDM with a brief description of each chapter:

Chapter 1, *Introduction and Glossary* - states the purpose and objectives of the CPDM, a brief overview of each chapter and a glossary of common pavement related terms.


Chapter 3, *Project Development Process* - references the manuals that contain the required procedures and documentation for the design of a NYSDOT pavement project from the project initiation stage through the preliminary and detailed design stages. Relevant excerpts from the *Scoping Procedure Manual* and the *Design Procedure Manual*, are included which highlight some of the specific steps in the design process where pavement issues must be addressed and decisions documented. Section 3.3 - *Pavement Treatment and Type Selection Process*, describes specific design procedures for NYSDOT pavement projects and identifies when further documentation is required (e.g., a *Pavement Evaluation and Treatment Selection Report* (PETSР) and/or a *Pavement Type Selection Report*). Section 3.3 also includes criteria to determine which process applies to maintenance projects. Section 3.4 includes the goal report *Programmatic Quality Assurance Pavement Rehabilitation Treatment Selection Process*, to monitor the quality and uniformity of project-level PETSРs. The above documents reference the Pavement Rehabilitation Manual, Volume II, *Treatment Selection*. Note that while Volume II contains key information on preparing a PETSР and the economic considerations involved in pavement treatment selection, it is included in Chapter 5 of the CPDM entitled *Rehabilitation*, since Volume II also contains significant guidance on pavement overlay design.

Chapter 4, *New Construction/Reconstruction* - contains guidance on the design and construction of new and reconstructed pavements, from the Highway Design Manual (HDM), Chapter 3, *Typical Sections*. The ESAL-based design procedure is an improved version of the *New York State Thickness Design Manual for New and Reconstructed Pavements*, which has been incorporated into this chapter.

Chapter 5, *Rehabilitation* - contains guidance on the design and construction of pavement overlays. Excerpts from the HDM, Chapter 3, *Typical Sections*, are included along with the entire Pavement Rehabilitation Manual, Volume II, *Treatment Selection*, which contain most of the current guidance on pavement overlay design.

Chapter 6, *Materials* - contains guidance of current design-related materials issues for HMA and PCC pavements.

Chapter 7, *Shoulders* - contains new guidance on the design of full-depth and partial-depth shoulders for new construction/reconstruction and rehabilitation projects.

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Chapter 8, *Pavement Joints* - contains guidance on the design and construction of transverse and longitudinal joints for PCC and HMA pavements and considerations for isolating utilities (e.g., catch basins) in PCC pavements in urban areas.

Chapter 9, Subsurface *Pavement Drainage* - contains new guidance on the design of pavement drainage systems for new construction/reconstruction and rehabilitation projects.

Chapter 10, *Preventive Maintenance* - contains guidance on preventive maintenance treatments (e.g., crack sealing) that may be used to repair deteriorated components of a pavement so that it may achieve its intended design service life.

Due to size restraints, the pavement-related specifications referred to in the CPDM will not be included in the manual. These specifications are easily obtainable from the Design Quality Assurance Bureau of Design Division or from the NYSDOT Design Division server.
1.3 GLOSSARY

1.3.1 Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>AADT</td>
<td>Average Annual Daily Traffic</td>
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<tr>
<td>AASHTO</td>
<td>American Association of State Highway and Transportation Officials</td>
</tr>
<tr>
<td>AC</td>
<td>Asphalt Cement (see also HMA)</td>
</tr>
<tr>
<td>CPR</td>
<td>Concrete Pavement Restoration</td>
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<tr>
<td>DAD</td>
<td>Design Approval Document</td>
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<tr>
<td>DPM</td>
<td>Design Procedure Manual</td>
</tr>
<tr>
<td>DQAB</td>
<td>Design Quality Assurance Bureau</td>
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<tr>
<td>EPP</td>
<td>Expanded Project Proposal</td>
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<tr>
<td>ESAL</td>
<td>Equivalent Single Axle Loading</td>
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<tr>
<td>FDR</td>
<td>Final Design Report</td>
</tr>
<tr>
<td>FHWA</td>
<td>Federal Highway Administration</td>
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<tr>
<td>FOB</td>
<td>Freight on Board - Purchasing agency picks up the paving material and delivers it to the paving site. Who does the paving is not specified. The State pays for the material at the production facility.</td>
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<tr>
<td>FWD</td>
<td>Falling Weight Deflectometer</td>
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<td>HDM</td>
<td>Highway Design Manual</td>
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<td>HMA</td>
<td>Hot Mix Asphalt</td>
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<td>IPP</td>
<td>Initial Project Proposal</td>
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<tr>
<td>JPCP</td>
<td>Jointed Plain Concrete Pavement</td>
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<tr>
<td>JRCP</td>
<td>Jointed Reinforced Concrete Pavement</td>
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LCC  Life Cycle Cost
LCCA  Life Cycle Cost Analysis
M&PT  Maintenance and Protection of Traffic
NEPA  National Environmental Policy Act (1969 et seq)
PCC  Portland Cement Concrete
PETSR  Pavement Evaluation and Treatment Selection Report
PIL  Priority Investigation Location
PMS  Pavement Management System
PRM  Pavement Rehabilitation Manual
PS&E  Plans, Specification, and Estimate
RGE  Regional Geotechnical Engineer
RME  Regional Materials or Maintenance Engineer
RTS  Regional Technical Services
SEQR  State Environmental Quality Review Act (1988 et seq)
SSM  Scope Summary Memorandum - A brief report documenting the scope of a proposed, minor project. The SSM is used by NYSDOT to obtain approval from upper level management of a project's scope before beginning preliminary design.
SUPERPAVE  Superior Performing Asphalt Pavement - It is a comprehensive method of designing paving mixes tailored to the unique performance requirements dictated by the traffic, climate, and structural section at a particular pavement site. It facilitates selecting and combining asphalt binder, aggregate, and any necessary modifier to achieve the required level of pavement performance. It was developed under Strategic Highway Research Program (SHRP).
T&L  Truing and Leveling - HMA layer used on rehabilitation projects to change cross...
slope, grade, or level out dips in the roadway. This layer usually consists of base or binder materials. Important to note that it is not to be used over substantial lengths of the project to effectively increase the overall maximum overlay thickness or add a second pavement course.

**VPP**  
**Vendor Placed Paving** - vendor delivers, vendor places. The State pays for the material in place.

**WIM**  
**Weigh In-Motion** - A device placed in the pavement lane to count and measure vehicle weight.

### 1.3.2 Definition of Common Terms

**Asphalt - Treated Permeable Base** - Asphalt layer with limited fine aggregate, that is placed at the bottom of an asphalt section where needed to provide drainage and support. It satisfies the requirement of ESAL-based design for a 100 mm drainable layer below HMA pavements.

**Base Course** - The layer or layers of a specified designed thickness placed on a subbase to support surface and binder courses.

**Binder Course** - The asphalt layer between the top and base courses.

**Bleeding** - Identified by a film of bituminous material on the pavement surface that creates a shiny, glass-like, reflective surface that may be tacky to the touch in warm weather.

**Block Cracking** - Cracks that divide the asphalt surface into approximately rectangular pieces, typically one square foot or more in size.

**Blowup** - The result of localized upward movement of a PCC slab along a transverse joint or crack.

**Cement-Treated Permeable Base** - A coarse aggregate drainage layer stabilized with cement. (An ESAL-based design requires the use of a 100 mm layer of cement or asphalt-treated permeable base below the PCC pavement).

**Chipping** - Breaking or cutting off of small pieces from the hardened PCC surface.

**Cohesive Failure** - The loss of a material’s ability to bond to itself. Results in the material splitting or tearing apart from itself (e.g., joint sealant splitting).

**Composite Pavement** - A pavement structure composed of an asphalt concrete overlay over a Portland cement concrete slab.
**Construction Joint** - A joint made necessary by a prolonged interruption in placing PCC or HMA pavement.

**Contraction Joint** - A transverse joint placed at designated intervals in a rigid slab to control objectionable shrinkage cracks in the PCC slab.

**Corner Break** - A portion of a PCC pavement separated by a crack intersecting the transverse and longitudinal joints, which extends down through the slab, allowing the corner to move independently from the rest of the slab.

**Distortion** - Any deviation in the pavement surface from its original shape.

**Distress** - Any indication of poor or unfavorable pavement performance or signs of impending failure; any unsatisfactory performance of a pavement short of failure.

**Dowel** - A plain round steel bar which extends into two adjoining PCC slabs so as to transfer shear loads.

**Drainage Coefficients** - Factors used to modify layer coefficients in flexible pavements or stresses in rigid pavements as a function of how well the pavement structure can handle the adverse effect of water infiltration.

**Durability Cracking** - A series of fine, hairline crescent-shaped cracks in the concrete surface usually paralleling a joint or major crack and usually curving across slab corners. These are caused by freeze-thaw expansive pressures within certain aggregates. Also called “D” cracking.

**Edge Cracking** - Fracture and materials loss in pavements without paved shoulders which occurs at the edge of the pavement. This occurs due to soil movement beneath the pavement.

**Edgedrain** - An underdrain located beneath the pavement at the edge of pavement or shoulder.

**Embankment** - The portion of fill section situated between the embankment foundation and the subgrade surface.

**Equivalent Single Axle Load (ESAL)** - One pass of 80 kN single axle loading (dual tires).

**Expansion Joint** - A joint located to provide for expansion of a rigid slab, used to prevent development of lateral compression between adjacent slabs or to isolate pavement structures.

**Fatigue Cracking** - A series of small, jagged, interconnecting cracks caused by failure of the asphalt concrete surface under repeated traffic loading (also called alligator cracking).
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Fault - The difference in elevation between opposing sides of a PCC joint or crack.

Flexible Pavement - An HMA pavement structure that maintains intimate contact with, and distributes loads to, the subgrade, and depends on aggregate interlock, particle friction, and cohesion for stability.

Hairline Crack - Barely visible cracks in a random pattern in a PCC surface which do not extend to the full depth of the pavement. They are primarily due to shrinkage.

Joint Seal Damage - Any distress associated with the joint sealant, or lack of joint sealant.

Lane-to-Shoulder Separation - Widening of the joint between the traffic lane and the shoulder.

Lane-to-Shoulder Dropoff - The difference in elevation between the traffic lane and shoulder.

Layer Coefficient (a1, a2, a3) - The empirical relationship between structural number (SN) and layer thickness which expresses the relative ability of a material to function as a structural component of the pavement.

Leave Slab - The section of PCC pavement just past a joint, crack, or other significant roadway feature relative to the direction of traffic.

Load Transfer - The ability of a joint or crack to transfer a portion of a load applied on one side of the joint or crack to the other side of the joint or crack.

Longitudinal Joint - A joint parallel to the long dimension of a pavement.

Low Volume Road - A roadway generally subjected to low levels of traffic; in this manual, structural design is based on a range of 18-kip ESALs from 50,000 to 1,000,000 for flexible and rigid pavements, and from 10,000 to 100,000 for aggregate surface roads.

Maintenance - The preservation of the entire roadway, including surface, shoulders, roadsides, drainage, structures, and such traffic control devices as are necessary for its safe and efficient utilization.

Map Cracking - A series of interconnected hairline cracks in Portland cement concrete pavements that extend only into the upper surface of the concrete. Includes cracking typically associated with alkali-silica reactivity.

Modulus of Subgrade Reaction (k) - Westergaard’s modulus of subgrade reaction for use in rigid pavement design (the load in pounds per square inch on a loaded area of the roadbed soil or subbase divided by the deflection in inches of the roadbed soil or subbase, psi/in.).

Patch Deterioration - Distress occurring within a repaired area.

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Patch - An area where the pavement has been removed and replaced with a new material.

Pavement Design Life - As defined by AASHTO, this is the initial performance period of the pavement structure in years. The design life is the useful life of the pavement structure and drainage system after which time the road may need total reconstruction from the subbase up. See Section 4.5.1.1 for details.

Pavement Service Life - A period of time over which a pavement performs its design purpose based on past research and performance experience.

Pavement Structure - The combination of subbase, base course, and surface course placed on a subgrade to support the traffic load and distribute it to the roadbed.

Pavement Rehabilitation - Work undertaken to extend the service life of an existing pavement. This includes placement of additional surfacing material and/or other work necessary to return an existing roadway, including shoulders, to a condition of structural or functional adequacy. This could include the complete removal and replacement of the pavement structure.

Performance Index (PI) - The summary of present serviceability indexes over a time period.

Performance - A measure of the accumulated service provided by a pavement, i.e., the adequacy with which a pavement fulfills its purpose.

Polished Aggregate - The coarse aggregate in concrete exposed by the wearing away of surface mortar and texturing.

Popouts - Small pieces of PCC pavement broken loose from the surface as a result of localized expansive forces.

Pothole - A bowl-shaped depression in the pavement surface.

Present Serviceability Index (PSI) - Numerical index of the ability of a pavement in its present condition to serve traffic.

Pumping - The ejection of water and fine materials through cracks in the pavement under moving loads.

Raveling - The wearing away of an HMA pavement surface caused by the dislodging of aggregate particles.

Reflection Cracking - The fracture of asphalt concrete above joints in the underlying jointed concrete pavement layer(s).
Resilient Modulus - A measure of the modulus of elasticity of roadbed soil or other pavement material.

Rigid Pavement - A pavement structure that provides high bending resistance and distributes loads to the foundation over a comparatively large area.

Roadbed - The graded portion of a highway within top and side slopes, prepared as a foundation for the pavement structure and shoulder (also known as subgrade surfaces).

Roughness - Irregularities in the pavement surface that adversely affect the ride quality.

Rutting - Longitudinal surface depression in the wheel paths.

SAFETAP - Safety Appurtenance Program - An initiative designed to ensure that safety considerations are incorporated into the Department’s maintenance paving projects. It requires a project review of maintenance paving sites by a team of qualified Department staff for the purpose of deciding upon safety work to be implemented before, at the time of, or soon after, construction.

SAFE-TRAK - A quick, simple process that includes safety criteria to be used in assisting with the selection, scoping, and design of 100% state funded paving projects. It is intended to be used for preventive and corrective maintenance resurfacing projects that meet the SAFE-TRAK screening criteria.

Scaling - The deterioration of the upper 3 to 12 mm (0.125 to 0.5 in) of the concrete surface, resulting in the loss of surface mortar.

Select Material - Suitable native material obtained from roadway cuts or borrow areas or other similar material used for subbase, shoulder surfacing, slope cover, or other specific purposes.

Serviceability - Ability of a pavement to serve traffic with safety and comfort and with a minimum of detrimental effects to either vehicle or pavement.

SF Delivered - State Forces Delivered - Vendor delivers the material to a paving site. The paver can be a state owned and operated paver, a rented paver with State operators, or a paver rented with operators. The State pays for the material delivered to the site.

Shoving - Permanent, longitudinal displacement of a localized area of the HMA pavement surface caused by traffic pushing against the pavement (usually occurs at intersections).

Single Axle Load - The total load transmitted by all wheels of a single axle extending the full width of the vehicle.

Spalling - The cracking, breaking, chipping, or fraying of the concrete slab surface usually within 6/30/00
0.6 m (2 ft) of a joint or crack.

**Stabilization** - The modification of soils or aggregates by incorporating materials that will increase load bearing capacity, firmness, and resistance to weathering or displacement.

**Stripping** - The separation of bituminous films from aggregate particles in the presence of moisture.

**Structural Number (SN)** - An index number derived from an analysis of traffic, roadbed soil conditions, and environment. The SN is then converted to thickness of flexible pavement layers through the use of suitable layer coefficients related to the type of material being used in each layer of the pavement structure.

**Subbase** - The layer of specified granular material placed on subgrade to support a base course, typically 300 mm thick.

**Subgrade** - The top surface of a roadbed which consists of suitable material and on which the subbase or select granular subgrade materials are constructed. The subgrade area is that portion of embankment situated above either of the following: a) a line located 0.6 m below the subgrade surface and extended to the intersection with the embankment side slopes, or b) the embankment foundation, whichever is higher.

**Surface Course** - One or more layers of a pavement structure designed to accommodate the traffic load, the top layer of which resists skidding, traffic abrasion, and disintegrating effects of climate. The top layer of flexible pavements is sometimes called “wearing course.”

**Tack Coat** - A bituminous emulsion placed between asphalt lifts for adhesion.

**Tie Bar** - A deformed steel bar or connector embedded across a longitudinal joint in a PCC slab to prevent separation of abutting slabs.

**Transverse Joint** - A joint perpendicular to the long dimension of a pavement.

**Underdrain** - A drain located under the pavement, usually deeper than edgedrains and intended to lower the groundwater by means of gravity flow.

**Water Bleeding** - The self-generated flow of mixing water within, or its emergence from, freshly placed concrete or mortar.