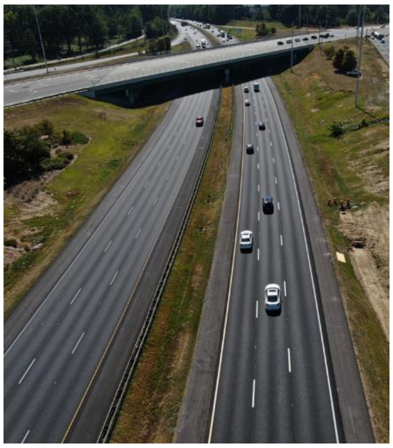
Pavement Evaluation Manual



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This document was developed as part of the continuing effort to provide guidance within the Georgia Department of Transportation in fulfilling its mission to provide a safe, efficient, and sustainable transportation system through dedicated teamwork and responsible leadership supporting economic development, environmental sensitivity and improved quality of life. This document is not intended to establish policy within the Department, but to provide guidance in adhering to the policies of the Department.

Your comments, suggestions, and ideas for improvements are welcomed.

Please send comments to:

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Revision History

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List of Effective Chapters

Document	Revision Number	Revision Date
List of Effective Chapters	1.0	3/26/24
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Definitions & Terminology	1.0	3/26/24
Chapter 1. Pavement Evaluation Policies	1.0	3/26/24
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Acronyms and Definitions

Acronyms

AADT – Average Annual Daily Traffic

AASHTO – American Association of State Highway and Transportation Officials (http://www.transportation.org)

AC – Asphaltic Concrete

CIR – Cold In-Place Recycling

COA-B – Concrete on Asphalt-Bonded

COA-U – Concrete on Asphalt-Unbonded

COC-B – Concrete on Concrete-Bonded

COC-U – Concrete on Concrete-Unbonded

CRB – California Bearing Ratio

CRCP – Continuously Reinforced Concrete Pavement

CSRB – Cement Stabilized Reclaimed Base

ESAL – Equivalent Single Axle Load

FDR – Full Depth Reconstruction

FHWA – Federal Highway Administration (http://www.fhwa.dot.gov/)

FWD – Falling Weight Deflectometer

GAB – Graded Aggregate Base

GDOT – Georgia Department of Transportation (http://www.dot.ga.gov)

GPR- Ground Penetrating Radar

HMA – Hot Mix Asphalt

HWTD – Hamburg Wheel Tracking Device

HPMS – Highway Performance Measuring System

IPES – Initial Pavement Evaluation Summary

JPCP – Jointed Portland Cement Concrete Pavement

LTE – Load Transfer Efficiency

LTPP - Long Term Pavement Performance Program

MRD – Materials Related Distress

MU – Multiple Unit

NCHRP – National Cooperative Highway Research Program

NHS – National Highway System

OGFC – Open Graded Friction Course

OGI – Open Graded Interlayer

OMAT – Office of Materials and Testing

OTD – Office of Transportation Data

PCC – Portland Cement Concrete

PES – Pavement Evaluation Summary

RAP – Recycled Asphalt Pavement

SMA – Stone Matrix Asphalt

SN – Structural Number

SSS – Soil Survey Summary

SSV – Soil Support Values

SU – Single Unit

SY – Square Yard

TSI – Terminal Serviceability Index

Definition of Terms

Aggregate – Granular material, such as sand, gravel, crushed stone, crushed hydraulic cement concrete, or iron blast.

Alligator Cracking – A series of interconnecting cracks in an asphalt pavement surface forming a pattern that resembles an alligator's hide or chicken wire. In its early stages, alligator cracking may be characterized by a single longitudinal crack in the wheelpath. The cracks indicate fatigue failure of the surface layer generally caused by repeated traffic loadings. Hence, the term fatigue cracking is also used.

Asphalt – A brown to black bituminous substance that is chiefly obtained as a residue of petroleum refining and that consists mostly of hydrocarbons.

Asphalt Pavement – A pavement comprising an upper layer or layers of aggregate mixed with a bituminous binder, such as asphalt, coal tars, and natural tars for purposes of this terminology; surface treatments such as chip seals, slurry seals, sand seals, and cape seals are also included.

Asphalt Concrete Base – A base type that utilizes hot mix asphalt concrete placed directly on subgrades of high soil support values. This is a common base in South Georgia.

Average Annual Daily Traffic (AADT) – The average 24-hour traffic volume at a given location over a full 365-day year. This means the total of vehicles passing the site in a year divided by 365.

Average Daily Traffic (ADT) – The total volume during a given time period (in whole days), greater than one day and less than a year, divided by the number of days in that time period.

Base – A base is one or more layers of specified material of design thickness placed on the subgrade or subbase to support a surface course.

Bleeding – Excess asphalt binder occurring on the pavement surface. The bleeding may create a shiny, glass-like surface that may be tacky to the touch. Bleeding is usually found in the wheel paths.

Block Cracking – A rectangular pattern of cracking in asphalt pavements that is caused by hardening and shrinkage of the asphalt. Block cracking typically occurs at a uniformly spaced interval.

Blow-up – Buckling and shattering of PCC pavement resulting from thermal expansion and the resultant compressive forces exceeding the strength of the material.

Bond Breaker – A material used to prevent adhesion of newly placed concrete form other material, such as a substrate. Any material used to prevent bonding or to separate adjacent pavement layers. Thin bituminous layers are often used as bond breaker layers between a concrete pavement and an unbonded concrete overlay.

Bonded Concrete Overlay – Thin layer of new concrete (2-4 inches) placed onto slightly deteriorated existing concrete pavement with steps taken to prepare old surface to promote adherence of new concrete. Increase in the pavement structure of a concrete pavement by addition of concrete thickness in direct contact with and adhering to the existing concrete surface. This method is used to correct wither functional or structural deficiencies. This is not a standard GDOT rehabilitation method.

Chip Seal – A surface treatment in which the pavement is sprayed with asphalt (generally emulsified) and then immediately covered with aggregate and rolled. Chip Seals are used primarily to seal the surface of a pavement with non-load associated cracks and to improve surface friction, although the are commonly used as a wearing course on low volume roads.

Cohesion – The internal bond within a joint sealant material. Cohesion loss is seen as a noticeable tear along the surface and through the depth of the sealant.

Composite Pavement – A composite pavement has a structure that is comprised of 2 or more layers with different characteristics that act as one composite material. Generally, this is an asphalt overlay over a PCC pavement.

Compressive Strength – The measured resistance of a concrete or mortar specimen to axial loading; expressed as pounds per square inch (psi) of a cross-sectional area.

Concrete – A composite material that consists essentially of a binding medium in which is embedded particles or fragments of relatively inert material filler. In Portland Cement Concrete, the binder is a mixture of Portland Cement and water; the filer may be a wide variety of natural or artificial aggregates.

Concrete Pavement Restoration – A series of repair techniques used to preserve or improve the structural capacity or functional characteristics of a PCC pavement. These techniques each have a unique purpose to repair or replace a particular distress found in PCC pavement and to manage the rate of deterioration. These techniques include:

- Full-depth repair
- Partial-depth repair
- Diamond grinding
- Joint and crack resealing
- Slab stabilization
- Dowel bar retrofit
- Cross-stitching cracks or longitudinal joints
- Retrofitting concrete shoulders
- Retrofitting cross drains

Construction Joint – A joint constructed in a transverse direction in JPCP pavements to control cracking of the slab as it cures. Highway construction joints are created by sawing the concrete. GDOT’s typical joint spacing is 15 feet for Interstate highways, and 20 feet for non-interstates.

Continuously Reinforced Concrete Pavement – PCC pavement constructed with enough longitudinal steel reinforcement to control transverse crack spacings and opening in lieu of transverse contraction joints for accommodating concrete volume change and load transfer.

Contraction – Decrease in length or volume.

Corner Break – A portion of the slab separated by a crack that intersects the adjacent transverse or longitudinal joints at about a 45° angle with the direction of traffic. The length of the sides is usually from 0.3 meters to 1/2 of the slab length on each side of the crack.

Corrective Maintenance – Maintenance performed once a deficiency occurs in the pavement; for example, pothole filling or spall repair. Maintenance applied to restore a pavement to an acceptable level of service due to unforeseen conditions.

Crack – Fissure or discontinuity of the pavement surface not necessarily extending through the entire thickness of the pavement. Cracks generally develop after initial construction of the pavement and may be caused by thermal effects, excess loadings, or excess deflections.

Crack Filling – The placement of materials into non-working cracks to substantially reduce the intrusion of incompressibles and infiltration of water, while also reinforcing the adjacent pavement. Crack filling should be distinguished from crack sealing.

Crack Sealing – A maintenance procedure that involves placement of specialized materials into working cracks using unique configurations to reduce the intrusion of incompressibles into the crack and to prevent infiltration of water into the underlying pavement layers.

Cracking – The process of contraction or the reflection of stress in the pavement.

Cross Stitching – A repair method that involves the drilling of holes diagonally across a crack in PCC pavement into which steel reinforcement bars are inserted and epoxied in place. The holes are alternated from side to side of the crack on a pre-determined spacing. This technique is generally used for longitudinal cracks that are still in no worse than fair condition. Cross-stitching increases slab integrity by adding steel reinforcement to hold the crack together.

Dense-Graded Asphalt Pavement – An overlay or surface course consisting of a mixture of asphalt binder and a well-graded (also called dense-graded) aggregate. A well-graded aggregate is uniformly distributed throughout a full range of sieve sizes.

Deterioration – 1) A physical manifestation of failure (for example: cracking, delamination, flaking, pitting, scaling, spalling, staining) caused by environmental or internal autogenous influences on rock and hardened concrete as well as other materials; 2) decomposition of material during either testing or exposure to service.

Diamond Grinding – A process that uses a series of diamond-tipped saw blades mounted on a shaft or arbor to shave the upper surface of a pavement to remove bumps, restore pavement rideability, and improve surface friction.

Distress – Physical manifestation of deterioration and distortion in a concrete structure as a result of stress, chemical action, and/or physical action.

Drainage – The interception and removal of water from, on , or under an area of roadway; the process of removing surplus ground or surface water artificially; a general term for gravity flow of liquids in conduits.

Expansion – Increase in length or volume.

Equivalent Single Axle Loads (ESAL) – Summation of equivalent 18,000-pound single axle loads used to combine mixed traffic to design traffic for the design period.

Faulting – Differential vertical displacement of a slab or other member adjacent to a joint or crack. Faulting commonly occurs at traverse joints of PCC pavements that do not have adequate load transfer.

Flexible Pavement – A pavement structure that maintains contact and distributes loads to the subgrade and depends on aggregate interlock, particle friction, and cohesion for stability.

Flexural Strength – A property of a material or structural member that indicates its ability to resist failure in bending.

Fog Seal – A light application of slow setting asphalt emulsion diluted with water and without the addition of any aggregate applied to the surface of an asphalt pavement. Fog seals are used to renew aged asphalt surfaces, seal small cracks and surface voids, or adjust the quality of binder in newly applied chip seals.

Full Depth Patching – 1) Removing and replacing at least a portion of a concrete slab to the bottom of the concrete, in order to restore areas of deterioration. 2) Removal and replacement of a segment of a flexible pavement to the level of the subgrade in order to restore areas of deterioration.

GDOT Policy – A guideline adopted by the Georgia Department of Transportation that must be followed.

Graded Aggregate Base (GAB) – A type of base that utilizes processed crushed stone or graded aggregate exclusively.

Hot Mix Asphalt (HMA) – A controlled mixture of asphalt binder and well-graded, high quality aggregate compacted into a uniform dense mass. HMA pavements may also contain additives such as anti-stripping agents and polymers.

Inlay – 1) A form of reconstruction where new concrete is placed into an area of removed pavement, removal may be an individual lane, all lanes between the shoulders or only partly through a slab. 2) A form of reconstruction where new asphalt pavement is placed into an area of milled pavement. The removal may be in an individual lane, all lanes between the shoulders or only partly through a full-depth asphalt pavement.

International Roughness Index (IRI) – A measure of a pavement's longitudinal surface profile as measured in the wheel path by a vehicle traveling at typical operating speeds. It is calculated as the ratio of the accumulated suspension motion to the distance traveled obtained from a mathematical model of a standard quarter car traversing a measured profile at a speed of 50 mph (80 km/hr). The IRI is expressed in units of inches per mile (meters per kilometer) and is a representation of pavement roughness.

Joint – 1) A pavement discontinuity made necessary by design or by interruption of a paving operation. 2) A plane of weakness to control contraction cracking in concrete pavements.

Joint Filler – Compressible material used to fill a joint to prevent the infiltration of debris.

Joint Seal Deterioration – Breakdown of a joint or crack sealant, such as by adhesion or cohesion which contributes to the failure of the sealant system. Joint seal deterioration permits incompressible materials or water to infiltrate into the pavement system.

Joint Sealer – Compressible material used to minimize water and solid debris infiltration into the sealant reservoir and joint.

Jointed Plain Concrete Pavement (JPCP) – PCC pavement constructed with regularly spaced transverse joints to control all-natural cracks expected in the concrete. Dowel bars may be used to enhance load transfer at transverse contraction joints.

Lane Distribution Factor (LDF) – A percentage of traffic thought to be in most heavily trafficked lane.

Life Extension – The extension of the performance period of the pavement through the application of preventative pavement treatments.

Load Transfer Efficiency – A measure of the ability of a joint or crack to transfer a portion of a load applied on one side of a joint or crack to the other side of the joint or crack.

Longitudinal Crack – A crack or discontinuity in a pavement that runs generally parallel to the pavement centerline. Longitudinal cracks may occur as a result of poorly constructed paving lane joints, thermal shrinkage, inadequate support, reflection from underlying layers, or as a precursor to fatigue cracking. (Note: Longitudinal cracking that occurs in the wheel path is generally indicative of alligator cracking.)

Longitudinal Joint – A constructed joint in a pavement layer that is oriented parallel to the pavement centerline.

Materials Related Distress – Concrete failures that are a result of the material properties reacting to the environment. These distresses can be a physical reaction, such as freeze-thaw deterioration, or a chemical reaction, such as alkali-aggregate reactivity.

Micro-surfacing – A mixture of polymer modified asphalt emulsion, mineral aggregate, mineral filler, water, and other additives, that is properly proportioned, mixed, and spread on a paved surface. Micro-surfacing differs from slurry seal in that it can be used on high volume roadways to correct wheel path rutting and provide a skid resistant pavement surface.

Milling – A process of removing pavement material from the surface of the pavement either to prepare the surface to receive overlays (by removing rutting, and surface irregularities) or to restore pavement cross slopes and profile. Also used to remove oxidized asphalt concrete.

Modified Asphalt Chip Seal – A variation on conventional chip seals in which the asphalt binder is modified with a blend of ground tire or latex rubber or polymer modifiers to enhance the elasticity and adhesion characteristics of the binder.

Modulus of Rupture – A measure of the ultimate load-carrying capacity of a beam, sometimes referred to s “rupture modulus” or “rupture strength.” It is calculated for apparent tensile stress in the extreme fiber of a transverse test specimen under the load that produces rupture.

Multiple Unit Trucks (MU) – Trucks with three or more axles. According to the FHWA Classification scheme, this comprises of vehicles from Class 6 through Class 13.

Off-System Roads – Roads that are not owned or maintained by GDOT. Local Roads such as county roads fall in this category.

Open Graded Friction Course – A thin HMA surface course consisting of a mix of an asphalt binder and open graded aggregate. An OGFC helps to eliminate standing water on a pavement surface, which reduces tire spray and hydroplaning potential. It has no structural value in pavement design computations.

Overlay – The addition of a new material layer onto an existing pavement surface.

Partial Depth Patching – Repairs of localized areas of surface deterioration of PCC pavements, usually for compression spalling problems, severe scaling, or other surface problems that are within the upper third of the slab depth.

Patch – Placement of a repair material to replace a localized defect in the pavement surface.

Pavement Preservation – The sum of all activities undertaken to provide and maintain serviceable roadways. This includes corrective maintenance and minor rehabilitation projects.

Pavement Preventative Maintenance – Planned strategy of cost-effective treatments to an existing roadway system and its appurtenances that preserves the system, retards future deterioration, and maintains or improves the functional condition of the system without increasing the structural capacity.

Pavement Reconstruction – Replacement of an existing pavement structure by the placement of the equivalent of a new pavement structure. Reconstruction usually involves complete removal and replacement of the existing pavement structure and may include new and/or recycled materials.

Pavement Rehabilitation – Structural enhancements that extend the service life of an existing pavement and/or improve its load carrying capability. Rehabilitation techniques include restoration treatments and structural overlays.

Performance Period – The period of time that an initially constructed or rehabilitated pavement structure will perform before reaching its terminal serviceability.

Potholes – Loss of surface material in an HMA pavement to the extent that a patch is needed to restore pavement rideability.

Pumping – Ejection of fine-grained material and water from beneath the pavement through the joints, cracks, or the pavement edge, caused by the deflection of the pavement under traffic loadings.

Raveling – Wearing away of the surface caused by the dislodging of aggregate particles and loss of asphalt binder.

Reflection Cracking – Cracking that appears on the surface of a pavement above joints and cracks in the underlying pavement layer due to horizontal and vertical movement of these joints and cracks.

Regional Factor - Region specific. Deals with drainage characteristics and terrain of area in question.

Rigid Pavement – Pavement that will provide high bending resistance and distribute loads to the foundation over a comparatively large area.

Routine Maintenance – Maintenance work that is planned and performed on a routine basis in order to maintain and preserve the condition of the highway system, and to respond to specific conditions and events that restore the highway system to an adequate level of service. Examples include crack sealing, fog sealing, and repair of localized failed areas of pavement.

Rutting – Longitudinal surface depressions in the wheel path of an HMA pavement, caused by plastic movement of the HMA mix, inadequate compaction, or abrasion from studded tires (such abrasion can be observed on PCC pavements).

Sandblasting – A procedure in which sand particles are blown with compressed air at a pavement surface to abrade and clean the surface. Sandblasting is a construction step in partial-depth patching and joint resealing.

Sealant – A material that has adhesive and cohesive properties to seal joints, cracks, or other various openings against the entrance or passage of water or other debris in pavements (generally less than 3 inches (76 mm) in width.

Sealing – The process of placing sealant material in prepared joints or cracks to minimize the intrusion of water and incompressible materials. This term is also used to describe the application of pavement surface treatments.

Segregation – Separation of aggregate component of asphaltic or Portland cement by particle size during placement.

Service Life – The period of time during which a treatment application remains effective.

Settlement – A depression at the pavement surface that is caused by the settling or erosion of one or more underlying layers.

Shoving – Localized displacement of an HMA pavement surface. Shoving is often caused by braking or accelerating vehicles.

Single Unit Trucks (SU) – Trucks with two axles. According to the FHWA Classification scheme, this comprises of vehicles from Class 1 through Class 5.

Slab Stabilization – Process of injecting grout or bituminous materials beneath PCC pavements to fill voids without raising the pavement.

Slippage Cracking – Cracking associated with the horizontal displacement of a localized area of an HMA pavement surface.

Slurry Seal – A mixture of slow setting emulsified asphalt, well-graded fine aggregate, mineral filler, and water. It is used to fill cracks and seal areas of old pavements to restore a uniform surface texture, to seal the surface to prevent moisture and air intrusion into the pavement, and to improve skid resistance.

Soil Cement – A construction material, a mix of pulverized natural soil with a small amount of Portland Cement and water and compacted to a high density.

Soil Support Value – An index of subgrade strength. It is region specific, ranges from 2.0 to 4.5, and is based upon the California Bearing Ratio.

Soil Survey – A geotechnical exploration for roadways.

Spalling – Cracking, breaking, chipping, or fraying of slab edges.

Stone Matrix Asphalt (SMA) – A mixture of asphalt binder, stabilizer material, mineral filler, and gap-graded aggregate. SMA pavements are used as a rut resistant wearing course.

Structural Layer Coefficient – A measure of the relative ability of a unit thickness of a given material to function as a structural component of the pavement.

Subbase – The layer of aggregate material laid on the subgrade on which the base course is laid. Subbase is often the main load-bearing layer of the pavement and is used to spread the load evenly over the subgrade.

Subgrade – The native materials underneath a constructed pavement. It is the foundation of the pavement structure, on which the subbase is laid.

Surface Treatment – Any application applied to an asphalt pavement surface to restore or protect the surface characteristics. Surface treatments include a spray application of asphalt (cement, cutback, or emulsion) and may or may not include the application of aggregate cover. Surface treatments are typically less than 1 inch (25 mm) thick. They may also be referred to as surface seals, or seal coats, or chip seals.

Swell – A hump in the pavement surface that may occur over a small area or as a longer, gradual wave; both types of swell can be accompanied by surface cracking.

Terminal Serviceability (TSI) – The lowest acceptable serviceability rating before resurfacing or reconstruction becomes necessary.

Thin Overlay – An HMA overlay with one lift of surface course generally with a thickness of 1.5 inches (38 mm) or less.

Transverse Crack – A discontinuity in a pavement surface that runs generally perpendicular to the pavement centerline. In HMA pavements, transverse cracks often form as a result of thermal movements of the pavement or reflection from underlying layers. In PCC pavements, transverse cracks may be caused by fatigue, loss of support, or thermal movements.

Ultra-thin Overlay – A HMA overlay over an existing HMA or PCC pavement, generally less than 1 inch (25 mm) in thickness.

Unbonded Overlay – Increase in the pavement structure of an existing concrete or composite pavement by addition of jointed plain, or continuously reinforced concrete pavement placed on a separator layer (usually asphalt) designed to prevent bonding to the existing pavement.

Weathering – Changes in color, texture, strength, chemical composition or other properties of a natural or artificial material due to the action of the weather.

Working Crack – A crack in the pavement that undergoes significant deflection and thermal opening and closing movements greater than 2 mm (1/16 in), typically oriented transverse to the pavement centerline.

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Chapter 1. Pavement Evaluation Policies

1.1 Introduction

A Pavement Evaluation Summary (PES) documents the condition of the existing pavement and proposes pavement designs to provide acceptable performance over the design life. Considerations are project specific and should be evaluated on a case-by-case basis. PES designs should follow the policies set forth in the Pavement Design Manual and Chapter 10 of the Design Policy Manual.

1.2 Purpose

1.2.1 Pavement Evaluation Summary

A full PES is performed when the project is in the Preliminary Design Phase. These reports are extensive studies that incorporate project data, historical information, lab testing, and field testing into pavement design recommendations. The PES will give recommendations for full depth, mill and inlay/overlay, and temporary pavement designs.

1.2.2 Initial Pavement Evaluation Summary

An Initial Pavement Evaluation Summary (IPES) is performed when the project is in the Concept Design Phase and provides a preliminary assessment of whether an existing pavement is suitable for retention and incorporation into the preliminary design. IPES reports include a visual field reconnaissance and review of readily available information, such as: project data, as-built construction plans, records of subsequent maintenance, and pavement condition data from the Office of Transportation Data's (OTD) Highway Performance Monitoring System (HPMS) Data Collection. The IPES report will discuss the suitability of the pavement for potential rehabilitation. However, IPES reports include only full depth pavement designs. Since coring is not within the scope of an IPES, neither Cement Stabilized Reclaimed Base (CSRB) nor inlay/overlay designs can be provided.

1.3 Policy

When a project proposes to retain existing pavement, the pavement condition should be evaluated to ensure its suitability for incorporation into the permanent pavement structure. The requirements for an IPES or PES report are based on the type of project, amount of pavement retained, and length of the proposed overlay. For additional guidance on requesting IPES/PES reports, refer to the Plan Development Process Sections 5.9 and 6.3.4 and the Pavement Design and Approval Process workflow.

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Chapter 2. Preliminary Investigation

2.1 Introduction

Preliminary investigation information includes all data needed to evaluate the pavement structure. The three primary focus areas of the preliminary investigation are: historic information, pavement distress data, and a field survey. The information derived from this data can identify possible issues that should be investigated.

2.2 Project Description

The project description should give a summary of the project's parameters and the extent of construction. The parameters would include the project type, functional classification, and project purpose. The extent of construction would be a paragraph describing the length of the project, the work that will be done, and any other relevant project information.

2.3 Historic Information

The first step in a preliminary investigation is collection of all available data on the history of the pavement structure and future intended use of the project. Construction and Maintenance history are essential in developing a field investigation strategy, determining existing material types and depths, and provide an indication of the pavement's past performance. Historic information can identify potential areas of historically problematic materials (such as natural sand, B-modified asphalt, etc.). Historically problematic materials must be evaluated prior to any rehabilitation method. However, the primary use of historic information will be to help determine the possible logical breaks between the differing base types, pavement treatments, or construction joints. These logical breaks may need different designs, different rehabilitation methods, or different sampling/testing plans. The historic information can be used in addition to (or in lieu of, in the case of an IPES) nondestructive testing and cores to estimate the existing pavement structure, i.e., layer types and thicknesses.

Historic plans can be found in GeoPI. Requests for past Maintenance activity records should be directed to the Area Maintenance Engineer or the District Maintenance Engineer. Historic plans should be included in the appendices of the IPES and PES and summarized in the body of the report. Useful information includes the Maintenance Project Contracts and Construction plan sheets such as, Cover Sheet, Typical Sections, Pavement Details, and other plan sheets, as necessary.

2.4 Pavement Distress Data

Proper distress identification aids the Pavement Engineer in determining modes of failure, such as: load related failures, environmental degradation, inadequate structural support, poor construction, etc. A distress survey should identify the types, levels, and extents of distresses.

GDOT currently utilizes automated pavement condition survey data from OTD's HPMS data collections. The GDOT Maintenance Office replaced their previous manual pavement surveys in 2017 with the automated pavement condition survey data. Automated pavement condition surveys are performed by specifically designed vehicles that obtain images and profile data in a single pass of the roadway. Surface distresses are then identified by type and severity in accordance with the HPMS Field Manual. Historic distress data can be requested from Pavement Management.

2.5 Field Survey

The field survey should evaluate the project conditions and sampling constraints to help determine the types of investigative procedures needed, as well as to determine the testing and sampling locations and frequencies. A Pavement Distress Survey should be performed for all lanes. Pavement Management uses the Distress Identification Manual for the Long Term Pavement Performance Program (LTPP) to identify distresses and severity levels. The survey should not give an overall score of the roadway and instead should give type, severity, and extent (as percentage) of each distress throughout the project. Areas of localized failures should also be noted if present.

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Chapter 3. Testing Procedures

3.1 Introduction

A review of the Concept documents and/or Construction plans, and a field survey are the first steps in developing the field-testing plan. Traffic control is often required for field testing and must be conducted in accordance with the Manual on Uniform Traffic Control Devices.

3.2 Non-destructive testing

Non-destructive testing may be used to obtain detailed structural information and performance data There are many forms of non-destructive testing; however, this manual will focus on the tests most often used by GDOT for pavement evaluation purposes.

3.2.1 Falling Weight Deflectometer

The Falling Weight Deflectometer (FWD) measures deflections of the pavement structure in accordance with AASHTO T256-01 Standard Method of Test for Pavement Deflection Measurements. High deflections often correlate to areas of voids, high distresses, potential base failures, or inadequate sections. Pavement deflection testing should be conducted only on existing pavement identified for retention when recommended by OMAT. This data may be used to:

- Determine statistically different pavement sections and sub-sections to refine destructive sampling plans
- Determine the soil and subgrade strength
- Assess the structural capacity of the pavement structure
- Estimate the material properties of the individual pavement layers
- Estimate load transfer ability of joints in jointed rigid and composite pavements

Additional information on FWD testing can be found in the Long-Term Pavement Performance Program Manual for Falling Weight Deflectometer measurements. FWD testing of asphaltic concrete pavement differs from testing of Portland Cement Concrete (PCC) pavement.

3.2.1.1 Flexible Pavement Testing

FWD testing on asphaltic concrete pavements measures the pavement deflections in response to an applied load. These deflections can be used to calculate additional information about the pavement such as: structural number (SN), dynamic modulus, and resilient modulus.

FWD tests are normally conducted in the wheel path of the outside lane. However, if the historical data shows significant differences in thickness between the lanes the testing locations may be modified. In multi-lane sections, deflections should be measured in both directions. The number of tests needed will determine the test spacing. Generally, a minimum of 20 locations per lane mile should be tested. Test location and temperature can affect FWD measurements and should be accounted for when calibrating the equipment. FWD test data should be normalized for temperature and load.

3.2.1.2 Rigid Pavement Testing

FWD testing requirements for Portland Cement Concrete (PCC) pavements differ from asphaltic concrete pavements and depend on the type of pavement: Continuously Reinforced Concrete

Pavement (CRCP) or Jointed Plain Concrete Pavement (JPCP). Deflection measurements on PCC pavements are used to determine overall stiffness, material properties, load transfer across the joints, and void detection. Because temperature affects the behavior of concrete slabs, testing should be conducted when the PCC surface temperature is between 50 and 80° F, generally prior to 11 AM, or if cloudy conditions exist such that surface temperatures are not excessive due to sunlight. The testing frequency should provide a representative sample of the load transfer on the section and the percentage of slabs with voids.

3.2.1.2.1 Continuously Reinforced Concrete Pavement

FWD testing of CRCP pavements should be conducted in mid-lane, between the wheel paths. The testing frequency should be adequate to provide a statistical representation of the response properties along the project. Testing at transverse cracks to determine load transfer should be considered for cracks that are spalled or faulted. However, placing the load plate on the crack should be avoided. Transverse cracks are a natural occurrence in CRCP pavements and may be spaced as close as 3.5 feet from each other. Badly spalled, highly faulted transverse cracks and punchouts should not be tested.

3.2.1.2.2 Jointed Plain Concrete Pavement

For JPCP pavements, deflection measurements can determine material properties, load transfer at the joints, and void detection. For the determination of material properties, testing should be conducted mid-slab. A testing frequency adequate to provide a statistical representation of the material properties along the project is required with no less than 20 tests per lane mile. Load transfer and void detection testing should be conducted on jointed pavements with noticeable faulting, evident pumping, or as directed. Void detection can be performed in accordance with MoDOT TM-64: Void Detection and Undersealing Verification Testing of Concrete Pavement with a Falling Weight Deflectometer or other methods approved by OMAT.

3.2.1.3 Reporting FWD data

3.2.1.3.1 Flexible Pavement Deflection Analysis Reports

Deflection testing and data analysis should contain the following elements:

- Plot of normalized maximum and normalized minimum (60-inch offset) deflection vs location
- Plot of cumulative sum of maximum deflection vs location
- Tabular summaries of:
  - Pavement and base layer thicknesses
  - AASHTO SN effective and uncorrected subgrade resilient modulus
  - Dynamic modulus, base course resilient modulus, and subgrade resilient modulus from back calculation. OMAT needs to be contacted to determine which back calculation program should be used.
  - Asphalt modulus corrected to 68º F mid-depth temperature of asphaltic concrete
  - Deflection data: distance (ft), load (lbf), deflections, surface temperature, time, comments

3.2.1.3.2 Rigid Pavement Deflection Analysis Reports

Deflection testing and data analysis should contain the following elements:

- Plots of normalized maximum Basin deflection vs location
- Plot of cumulative sum of maximum Basin deflection vs location
- Plot of Load-Transfer Efficiency (LTE) vs location
- Tabular summaries of (only if thickness information is available)
    - Pavement and base layer thicknesses
    - AASHTO PCC elastic modulus, Sc' (AREA method)
    - AASHTO modulus of subgrade reaction (AREA method)
    - Deflection data: distance (ft), load (lbf), deflections, surface temperature, time, comments, slab bending factor (B), LTE, void intercept

3.2.2 Ground Penetrating Radar

Ground Penetrating Radar (GPR) is an electromagnetic sounding method where a transducer is passed over the pavement surface. The transducer operates by transmitting short pulses of electromagnetic energy into the pavement from an antenna. It measures the changes in dielectric properties of pavement layers and the velocity of wave propagation within those layers. More information on GPR testing practices can be found in AASHTO R37-04(2022) Standard Practice for Application of Ground Penetrating Radar (GPR) to Highways. Common applications for GPR include:

- measuring pavement depth and consistency
- detecting voids
- locating moisture

Vehicle mounted GPR testing is conducted at highway speeds with little impact to the traveling public and provides thousands of data points vs coring alone. While GPR does not replace the need for coring, it can significantly reduce the number of cores needed. Cores are required to calibrate GPR field data.

3.2.2.1 Reporting GPR data

GPR data should be reported as a graph for each wheelpath presenting the cross-sectional view of the roadway where the horizontal axis represents horizontal travel distance, and the vertical axis represents depth. Anomalies in the GPR data usually coincide with voids or locations of high moisture. Anomalies can be reported in a separate table with columns for: roadway name, stationing/milepost, direction, lane number, wheelpath, GPR depth, and length in feet.

3.3 Destructive Testing

Destructive field testing is a basic component of a pavement evaluation.

3.3.1 Coring

Pavement depths are determined by cutting and retrieving cores from the pavement. Cores should be of sufficient length and diameter to determine the condition of the pavement layers and crack depths; or can be based on the requirements of the anticipated laboratory testing. Existing pavement layer types, condition, and thicknesses are required for all projects where pavement is being retained. Refer to the NCHRP Report 747: Guide for Conduction of Forensic Investigation of Highway Pavements, AASHTO R 67: Standard Practice for Sampling Asphalt Mixtures after Compaction, or AASHTO T24M/T 24: Standard Method of Test for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete for more information on core sampling.

3.3.1.1 Coring parameters

The general rule for core spacing is one per lane mile for each travel lane or shoulder on the project. Cores should be staggered such that the distance between the coring areas is +/- ½ mile. The engineer should use judgment in determining final locations.

3.3.1.2 Reporting Core Information

Each core must be recorded in a table with the following information:

- Core number
- Location (State Route Number or Latitude/Longitude)
- Direction of Travel
- Lane Number
- Milepost
- Length of the core in inches
- Core Condition
- Base Material

Core data can be presented in a variety of charts. The most basic chart will show the pavement and base thickness for each core, along with distinguishing features such as milepost, direction, and core number. Core photos should be included in the Appendix of the PES. The photos should show the core beside a measuring device and be labelled with the milepost, direction, and core number.

3.4 Laboratory Testing

3.4.1 Hamburg Testing

The Hamburg Wheel Tracking Device (HWTD) AASHTO T324 is the primary testing method used by GDOT to assess the rutting and stripping potential of existing asphaltic cement pavement. The HWTD measures the combined effects of rutting and moisture damage by rolling a steel wheel across the surface of a sample submerged in water at 50°C for 20,000 cycles or until 12.5mm of deformation occurs. Cores are paired and cut to conform to a testing mold that is 60mm in depth. After the drainage course is removed, Layer 1 is the first 60 mm slice to be cut and layer 2 is the subsequent 60 mm slice. Paired cores should consist of similar layers obtained from two adjacent cores to represent the same mix lots.

3.4.1.1 Reporting Hamburg Information

Hamburg results should be presented in a table with the milepost, core number, stripping index, and the depth of failure for each individual layer. The number of passing layers, failing layers, and percent passing can be added to the bottom of the chart.

3.4.2 Dynamic Modulus

Dynamic modulus is a linear viscoelastic material property that describes the stiffness of asphalt mixtures at different frequencies and temperatures. The dynamic modulus is a performance related property that can be used for mixture evaluation and characterizing the stiffness of asphalt mixtures. When dynamic modulus testing is requested by OMAT, any of the following methods may be performed:

3.4.2.1 AASHTO R62-13 and AASHTO T342-22

More information on Dynamic Modulus testing can be found in AASHTO R62-13: Developing Dynamic Modulus Master Curves for Asphalt Mixtures and AASHTO T342-22: Determining Dynamic Modulus of Hot Mix Asphalt (HMA). AASHTO T342-22 is performed on laboratory prepared samples with nominal aggregate sizes up to 37.5 mm.

3.4.2.2 AASHTO R84-17and AASHTO TP132-19

More information on Dynamic modulus testing using the Asphalt Mixture Performance Tester can be found in R84-17: Developing Dynamic Modulus Master Curves for Asphalt Mixtures Using the AMPT and T378-22 Determining the Dynamic Modulus and Flow Number for Asphalt Mixtures Using the AMPT. AMPT testing can be performed on laboratory prepared samples of dense- and gap-graded asphalt mixtures with nominal aggregate sizes up to 37.5 mm. strains are measured as a function of time and used to calculate the dynamic modulus and phase angle.

For small samples, testing should be performed in accordance with TP132-19: Determining the Dynamic Modulus for Asphalt Mixtures using small specimens in the AMPT. AASHTO TP132-19 is performed on dense-graded asphalt mixtures with nominal aggregate sizes up to 19mm. Cylindrical specimens can be cored and sawed from a Superpave Gyratory sample or field sample.

3.4.2.3 AASHTO PP96-18 and AASHTO TP131-18

More information on determining Dynamic Modulus using indirect tensile testing can be found in PP96-18: Proposed Standard Practice for Developing Dynamic Modulus Master Curves for Asphalt Mixtures Using the Indirect Tension Testing Method, and TP131-18: Determining the Dynamic Modulus of Asphalt Mixtures Using the Indirect Tension Test. Indirect Tensile Testing can be performed on both field samples and fabricated cores of dense- and gap-graded aggregate mixtures with nominal aggregate sizes up to 25 mm.

3.4.3 Resilient Modulus

The resilient modulus test provides a basic relationship between stress and deformation of pavement materials for the structural analysis of layered pavement systems. Resilient modulus values are a measure of the elastic modulus of the untreated base and subbase material. These values can be used to calculate the structural response to wheel loads for subgrade soils. More information on resilient modulus testing procedures can be found in AASHTO T307-99.

3.4.4 Soil Classification

GDOT Soil Classification is based on sieve analysis (GDT-4), volume change (GDT-6), and maximum dry density (GDT-7). Soil Classification should follow the guidance set forth in Section 810 Roadway Materials of the GDOT Standard Specifications.

3.4.5 California Bearing Ratio

The California Bearing Ratio (CBR) test evaluates the load bearing capacity of soils under normal conditions (ASTM D 1883 or AASHTO T-193.) The CBR value can be correlated to a Soil Support Value (SSV) using the Soil Support Correlation Chart in the Geotechnical Manual. All CBR tests should be performed using soaked conditions.

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Chapter 4. Pavement Repair Methods

4.1 Flexible Pavement Repairs

The type of rehabilitation method needed for a project is determined from the investigation's findings. The types of rehabilitation methods GDOT uses are:

- Full depth rehabilitation
- Mill and Inlay
- Overlay

4.1.1 Full Depth Reconstruction

Full depth reconstruction is the complete removal and replacement of the existing pavement structure.

4.1.2 Flexible Pavement Rehabilitation

4.1.2.1 Cement Stabilized Reclaimed Base

Cement Stabilized Reclaimed Base (CSRB) is a rehabilitation technique in which a predetermined portion of the flexible pavement and the underlying materials are uniformly crushed, blended with a stabilizing agent, and then compacted to form a stabilized base course. CSRB can produce a durable base for a new overlay that is strong, uniform, and more moisture resistant than the existing material. When recommending a CSRB base, the soil base material should follow the guidelines set forth in Section 814.2.02 Soil Cement Material in the GDOT Standard Specifications.

4.1.2.1.1 CSRB design

CSRB should be constructed as per Section 315 of the GDOT Supplemental Specifications not published in the 2021 edit. CSRB bases are dependent on the existing asphaltic concrete pavement depth and the type of soil underneath. Soil base material should meet the requirements of Subsection 810.2.01 for Classes IA1, IA2, IA3, and IIB1 following the restrictions in Section 814.2.02 Soil Cement Material in the GDOT Standard Specifications. It is preferable that the existing asphaltic concrete pavement comprise at least half of the CSRB thickness. For example, a 8-inch CSRB base should use 4 inches (or more) of the existing asphaltic concrete pavement available. If only 5 inches of existing asphaltic concrete pavement is present on the project, the thickest CSRB would be 10 inches.

4.1.2.1.2 Reporting CSRB

When a CSRB design is recommended in the PES, the quantity of cement needed should be included for preliminary cost estimations. The quantity of cement should be given in tons. The percent cement used for estimating is 8%. The spread rate of cement will change with the depth of the CSRB. The equation to calculate the tons of cement needed is:

$$T = \frac{\rho * \frac{(m * 5280) * (l * w)}{9}}{2000}$$

where:

T = tons of cement needed (tons)

ρ = cement spread rates (lb/ft)

m = number of miles (miles)

l = number of affected lanes (number)

w = lane widths (feet)

Common spread rates for cement are included in the table below.

Table 1: Cement Spread Rates based on CSRB Thickness

CSRB Thickness (inches)	Cement Spread Rate (lb/ft)
6	44
8	58
10	72

4.1.2.2 Cold In Place Recycling

Cold In-Place Recycling (CIR) is a rehabilitation technique that recycles the existing asphaltic concrete pavement to create a new pavement structure. The process involves milling the existing pavement, crushing the milled materials to form Recycled Asphalt Pavement (RAP), and remixing the RAP in-place without the application of heat. Additional aggregate and a binding agent are added, and everything is mixed to a uniform consistency before being placed and compacted to create the new layer. CIR can be used to correct surface distresses such as top-down cracking, wheel ruts, potholes, and raveling, as well as to correct cross-slope.

4.1.2.2.1 Reporting CIR

The asphalt concrete (AC) content is calculated as part of the CIR design process for use in preliminary cost estimates. The AC content should be given in tons. The percent AC used for estimating purposes is 3%. There are 2 equations needed to calculate the AC content.

Equation 1 calculates the total tons of CIR material:

$$C = \frac{(d * 110) * (l * w) * (m * 5280)}{2000 * 9}$$

where:

C = CIR material (tons)

d = depth of CIR in inches (inches)

m = number of miles (miles)

l = number of affected lanes (number)

w = lane widths (feet)

Equation 2 calculates tons of AC needed to produce the tons of CIR material from Equation 1. GDOT assumes an AC content of 3% by weight of CIR material.

$$\eta = C * 3\%$$

where:

C = CIR material (tons)

η = AC content (tons)

4.1.2.3 Milling

Milling is the process of removing the pavement surface to a predetermined depth. Milling can be used to eliminate major and minor rutting, cracks, or deterioration of the pavement surface. Milling can remove entire pavement layers without disturbing the underlying material. This can be helpful to remove stripping. The milling depth is influenced by analysis of the pavement cores. For pavements with only surface distresses, the most common milling technique is to remove the surface layer. A pavement with cores showing top-down cracks or stripping would need to mill to the layers below the bottom of these distresses. If the depth of the distresses changes throughout the length of the project, variable depth milling should be considered. The pay item number for variable depth milling is 432-5010. Milling and Micro-milling should follow the standards set in Section 432 Mill Asphaltic Concrete Pavement in the GDOT Standard Specifications.

4.1.2.3.1 Micro-Milling

Micro-milling is primarily used to remove a deteriorated drainage course layer, while leaving the underlying asphaltic concrete layers intact. This technique is beneficial on roadways in good condition where the main pavement distress is raveling. Milling and Micro-milling should follow the standards set in Section 432 Mill Asphaltic Concrete Pavement in the GDOT Standard Specifications.

4.1.2.4 Flexible Pavement Overlays

An existing pavement may become an overlay candidate when the following conditions exist:

- The existing structure is insufficient
- Pavement rehabilitation is required to extend the treatment of an existing pavement
- An adjacent lane (such as a passing or turning lane) is being added and the existing lane only needs a new surface course
- To correct surface distresses or grade of the existing pavement.

4.1.2.4.1 Functional Overlays

These are typically minor resurfacings that correct surface deficiencies, extend the service life, and restore the pavement riding surface to an acceptable standard. A functional overlay will generally only consist of a surface course and potentially levelling.

4.1.2.4.2 Structural Overlays

These are used when the existing pavement structure is insufficient for the design period of the pavement. Structural overlays can be as simple as adding a surface layer or may be more involved depending on the severity of insufficient structure. Milling the existing pavement to a certain depth is sometimes required prior to adding any new layers to the pavement to remove underlying deficiencies/issues in the existing pavement structure. Deficiencies that may need to be removed prior to overlay include but are not limited to: delamination, stripped asphaltic concrete, or voids under the pavement. Use the following guidelines when considering structural overlays:

For widening projects, determine the length of each individual segment being retained and their function in the pavement structure. A general rule of thumb is that the retained section should be greater than 1,000 feet to be feasible for constructability. Shoulders or turn lanes that will be a future travel lane should be the same material and structure as the existing travel lanes. Engineers and project designers should take care when planning overlays so that the final pavement is not a patchwork of new and overlaid sections. If a high percentage of the pavement requires overlays, reconstruction may be a more suitable option.

4.2 Concrete Pavement Repairs

4.2.1 Slab Replacement

Slab Replacement is a concrete rehabilitation technique that replaces the full depth of a severely distressed concrete slab. The full depth replacement slab is cast in-place to the depth of the adjacent, existing concrete slabs. Slab replacement repairs localized distresses, restores rideability, increases structural integrity, and prevents further deterioration of the roadway. Slab replacement is suitable in areas with:

- Medium and high severity transverse cracks
- Medium and high severity longitudinal cracks
- Medium and high severity spalling
- Medium and high severity D-cracking
- All severity levels corner breaks
- Blowups
- Punchouts
- Deteriorated previous repairs

4.2.2 Rigid Pavement Overlays

Concrete overlays can be placed on many types of pavements. Concrete overlays can address most pavement distresses while providing a durable, low maintenance pavement surface with a long service life. There are two types of concrete overlays, bonded and unbonded. Bonded PCC overlays become part of the underlying existing pavement and thus move as one singular structure. Unbonded PCC overlays use the existing pavement as a base and move independently from the underlying layer. This usually involves the use of an asphalt layer or fabric bond breaker. When determining the type of concrete overlay needed for a project, consider the following: the condition of the existing pavement, the traffic loading, the desired design life, and geometric constraints (such as curb and gutter, guardrails, shoulder widths, and vertical clearances). More information on concrete overlays can be found in the National Concrete Pavement Technology Center Guide to Concrete Overlays.

4.2.2.1 Concrete Overlays on Asphalt

Concrete overlays of existing asphalt encompasses both asphalt pavements and composite pavements.

4.2.2.1.1 Concrete on Asphalt-Unbonded

Unbonded Portland Cement Concrete overlays of existing Asphaltic concrete pavement may be used to address surface deterioration, inadequate base/sub-base support, or stripping of asphalt layers due to inadequate drainage. Areas of surface distress might include:

- Rutting
- Potholes
- Alligator cracking
- Subgrade/subbase issues
- Shoving

For composite pavements, can be appropriate in pavements exhibiting:

- Slow-reacting Materials Related Distresses (MRD)
- Significant cracking
- Underlying slabs that move or rock under traffic loading

An unbonded Concrete overlay of asphaltic concrete pavement generally does not require extensive repairs prior to applying a new overlay. The existing pavement should be free from wide cracks or unrepaired potholes. However, areas of significant surface deterioration or stripped asphalt layers must be removed before placing an overlay. It also may be desirable to mill the surface to eliminate minor surface distresses and reduce grade changes that would affect geometric issues - such as vertical clearances, curb and gutters, and guardrails.

The existing asphalt pavement is treated as the base. The thickness of the overlay is designed as a new concrete pavement with a stiff base. Overlay thicknesses range from 6-12 inches. The minimum thickness of existing asphalt remaining must be 4 inches to provide a stable base capable of supporting construction equipment and activities.

4.2.2.1.2 Concrete on Asphalt-Bonded

Bonded Concrete overlay of existing Asphalt pavements should only be considered for existing pavement in good structural condition. The overlay can be applied to roads and intersections in fair or better structural condition with minor rutting, minor alligator cracking, shoving, and thermal cracking. The bonded concrete overlay can be thinner than an unbonded overlay because the bonding of the asphalt and concrete layers increases the structural capacity of the roadway. The development and maintenance of the bond is critical to the performance of the overlay, as the loss of the bond will accelerate the development of pavement distresses and reduce the service life of the pavement.

Bonded Concrete Overlays should not be used in asphalt pavements with:

- Significant distresses
- Inadequate base/subbase support
- Stripping of asphalt layers

Or composite pavements with:

- Inadequate or uneven subbase support with an SSV of 2 or less
- Poor drainage conditions

- Stripping or delamination of the asphalt layers if these layers are removed
- Problems in underlying concrete due to MRD
- Indication of future durability issues

Bonded Concrete Overlays add structural capacity to existing asphalt pavements where traffic loads have increased or will increase. The design should assume that the bond between the overlay and the existing pavement creates a singular layer to reduce the stresses and deflections. Design thickness is generally 4-6 inches depending on the desired load carrying capacity and service life. Additional thickness may be required in transition sections to prevent movement of the panels adjacent to asphalt pavement to reduce the potential for cracking due to traffic impact loadings.

Direct overlay without milling can be used when rutting is less than 2 inches and there are no significant surface distresses. More information on direct concrete overlays can be found in the National Concrete Pavement Technology Center Guide to Concrete Overlays. Milling the asphalt surface will improve the bond between the overlay and the existing pavement but is not required. The main objectives of milling prior to the overlay are to

- Minimize changes in grade
- Remove significant surface distresses or deteriorated asphalt material that could result in inadequate bonding
- Remove high or low asphalt sections to ensure an even overlay
- Match elevations of curbs or other geometric issues

4.2.2.2 Concrete Overlays on Concrete Pavement

When a concrete pavement approaches the end of its service life, reconstruction often is not feasible or prudent. Concrete overlay of on existing concrete pavement might be an economical solution to restore the pavement surface and extend service life. Concrete on Concrete overlays can be used on both CRCP and JPCP pavements.

4.2.2.2.1 Concrete on Concrete -Unbonded

Unbonded Concrete overlay of existing concrete pavements are a cost-effective pavement rehabilitation technique typically used on poor or deteriorated concrete pavements. Even pavement experiencing MRD can provide a stable and uniform support for a concrete overlay. Concrete overlays consist of a new PCC surface placed over an existing concrete pavement. The two concrete layers are separated by an asphalt or geotextile separation layer designed to provide isolation, bedding, and drainage.

Unbonded Concrete overlays on existing concrete:

- Are designed as a new concrete pavement on a stable base course
- Can restore or enhance the pavements structural capacity
- Will improve the surface friction, noise, and smoothness of the pavement surface
- Have a service life comparable to new concrete pavement
- Will not get reflective cracks due to the use of an asphalt or geotextile separation layer
- Can be used to correct concrete distresses including cracks, spalls, faults, and joint repairs

The overlay should be designed as a new concrete pavement on a stable base layer. Overlays less than 6 inches in thickness should be constructed as 6-foot square panels. Overlays between 6 and

8 inches thick can be built either in smaller panels, or as full lane width panels in areas of low volume traffic. Overlays greater than 8 inches thick are typically constructed with full 12-foot lane widths in lengths ranging from 12 to 15 feet.

A separation layer of asphalt with a minimum thickness of 2 inch or a geotextile fabric is required to isolate the overlay from the existing pavement to prevent reflective cracking. The asphalt separation layer should be a dense graded asphalt layer to prevent stripping of the asphalt layer.

The PES should identify two key characteristics of the pavement: uniformity of support and the presence of faults. Uniformity of support for the unbonded concrete overlay is necessary to determine whether the existing concrete pavement and subbase can provide reasonably uniform support and whether any corrective treatments are needed. The existing pavement should provide stable support without significant differential movement, drainage issues, erosion, or subgrade stability issues. Transverse joints should be evaluated to determine potential movement, which would lead to cracking in the new overlay.

Faulting can usually be attributed to a combination of reduced load transfer and reduced subgrade/subbase support. During a pavement evaluation consider joint milling or grinding if (1) a geotextile fabric is used, and faulting is greater than ¼ of an inch or (2) an asphalt separation layer is used, and faulting is greater than 3/8 of an inch. The limits are recommended to prevent faulted joints reflecting through the separation layers into the overlay. When the depths are exceeded, corrective measures like surface grinding or increasing the thickness of the asphalt separation layer will be necessary.

When designing the unbonded concrete overlay, the existing concrete pavement is treated as a single layer of composite material. The design assumes an unbonded condition between the new concrete overlay and the existing pavement. The minimum thickness of existing concrete as a base is 4 inches. Consider full depth repairs only where structural integrity needs to be restored to provide uniform support or to eliminate rocking or moving slabs. If distressed areas are not moving and the subgrade is stable, repairs are not typically needed.

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Chapter 5. Design Procedure

5.1 Introduction

When the data collection, field work, and laboratory testing has been completed, a pavement design should be prepared for the project. The pavement design should be based on project requirements, existing pavement conditions, cores, and field and laboratory test results. For more information on creating a Pavement Design or using the Pavement Design Program, refer to Chapter 4 of the Pavement Design Manual.

5.2 Design Program Pavement Structure

5.2.1 Overlay Design Process

For an overlay design, the new pavement layers will be input into the overlay rows while the existing asphalt and base will be input into the existing rows. When recommending an overlay design, the engineer should review the typical sections to determine whether an increase in the grade would affect the geometric parameters (i.e., guardrails, curb, and gutter) of the roadway. Other considerations for overlays on interstates include underdrains and overhead structures, like bridges or signs.

5.2.2 Mill and Inlay Design Process

The mill and inlay design process will differ based on the amount of milling required. The milling depth should be entered on the "Traffic and Miscellaneous Data" page. Also, when inputting the existing asphaltic concrete, the milling depth should be taken into consideration as the program does not reduce the existing based on milling depth input. Therefore, the thickness input into the program for existing asphaltic concrete should be the existing asphalt thickness minus the milling depth.

5.2.3 CIR Design Process

Cold In-Place Recycling designs have the same design process as a regular mill and inlay. However, the milling depth of CIR will be the CIR thickness. Then the thickness input into the program for existing asphaltic concrete should be the existing asphalt thickness minus the CIR thickness. The CIR layer should be input into the overlay sections as a new layer.

5.2.4 CSRB Design Process

Cement Stabilized Reclaimed Base designs should be created as a new full depth flexible pavement. The first line should be the surface course. The second line should be the binder course. The third line will be the asphalt base (if needed). The last line will be the base course. The base course for CSRB in the Pavement Design programs is listed as Full Depth Reclamation and has a structural coefficient of 0.20. The structural coefficient for CSRB is 0.25 as listed in Appendix A of the Pavement Design Manual. After the design has been completed, the name and coefficient can be edited in a pdf viewer. However, changing the structural coefficient will mean that the structural value, proposed SN, and underdesign percentage will need to be recalculated manually.

5.2.5 Rigid Pavement Overlays

Concrete overlays are not included in the Pavement Design Program.

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Appendix A. Typical Value of Layer Coefficients

Material	Structural Coefficients
New Pavement Material:	
Asphaltic Concrete (top 4 ½")	0.44
Asphaltic concrete (>4 ½" from surface)	0.40
Cement Stabilized Reclaimed Base (CSRB)	0.22
Cold In-Place Recycling	0.22
Existing Pavement Material:	
Old Asphaltic Concrete	0.30
Old Portland Cement Concrete (Good)	0.40
Old Portland Cement Concrete (Fair)	0.30
Calcium Chloride Stabilized Limestone Base	0.18
Cement Stabilized Chert Base	0.20
Cement Stabilized Graded Aggregate	0.22
Graded Aggregate and Crushed Limestone (Compacted to Modified Density)	0.16
Graded Aggregate and Crushed Limestone (Compacted to 96% of Modified Density)	0.14
Limestone Base (Compacted to Modified Density)	0.16
Limerock Base (Compacted to 96% of Modified Density)	0.12
Sand Asphalt	0.18
Sand Bituminous Stabilized Base (6")	0.12
Soil Aggregate Base	0.12
Soil Cement	0.20
Sand Clay Base	0.10

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