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Design Life of Proposed Pavement Improvements:

The LOTCIP is funded with 20-year State bonds. Therefore, projects funded under the LOTCIP must be designed to provide an approximate 20-year design life (see exceptions below) for the proposed improvements commensurate with the duration of the bonds.

Pavement improvements can generally be categorized in four treatment categories:
1) Preservation,
2) Minor Rehabilitation,
3) Major Rehabilitation, and
4) Full Depth Reconstruction.

The treatment category must be selected based on existing field conditions by an engineer with pavement experience. Choosing the correct category helps to determine the appropriate level of investigative sampling required later. **The adequacy of a specific treatment type or repair strategy (mill and overlay, reclamation, full depth reconstruction, etc.) within these categories cannot be confirmed without proper investigation of the existing pavement layer depths and subsurface material composition.** For all treatments, the required investigation should begin with review of as-built construction records. This must be followed by investigative sampling (cores, borings, test pits, split spoon samples, sieve analysis) for the specific treatment category chosen, to accurately determine existing conditions and perform the required pavement design.

For projects that involve pavement improvements, this process will include providing a pavement design that meets the design life requirements for the respective treatment category chosen. Adherence to pavement design life requirements is determined by projecting construction-end-year traffic volumes over the design period, calculating cumulative Equivalent Single Axle Loads (ESALs), and then evaluating whether the provided structural number is greater than the required structural number per the 1993 AASHTO Guide for Design of Pavement Structures.

Exceptions to Design Life:

Pavement **major rehabilitation** and **full depth reconstruction** projects are required to meet the 20-year structural design life without exception.

Pavement **minor rehabilitation** projects must also meet a 20-year structural design life; however, mill and overlay resurfacing treatments that result in a minimum 15-year design life will be accepted. It should be noted that shortened design life periods are not necessarily more cost effective when considering life cycle costs over the long term. It is still encouraged to meet a 20-year design life for mill and overlay treatments if possible.

Pavement **preservation** projects, which should be limited to structurally sound pavements only (determined by an engineer with pavement experience), are exempt from all structural design life requirements, as these treatments are not intended to provide a structural improvement but simply preserve the existing structure. However, treatments should be selected that extend the service life as much as possible.

Simplified tools and guidance for following the AASHTO procedure are available on the Department's Pavement Design Unit web page under "Pavement Design Resources" at the following link:

https://portal.ct.gov/DOT/Engineering/Pavement-Design/Pavement-Design-Unit

Further discussion of individual treatment types is included in the pavement guidance provided by the Department's Pavement Design Unit in the following pages:

PAVEMENT INVESTIGATION FOR LOCAL ROAD PROJECTS

Introduction

This document outlines the required investigation for Local Roads (LOTCIP) projects that include pavement improvements. The guidance is broken out by categories of pavement improvement in order to identify the particular considerations, information, and investigative sampling required. This document considers only pavement with asphalt wearing surfaces and does not address concrete pavement wearing surfaces. The categories below attempt to capture some of the more common treatment strategies but do not seek to identify all pavement repair strategies.

Please contact the Pavement Design Unit at 860-594-3287 if you have any questions.

Category 1: Pavement Preservation

Surface Treatments (Bonded Overlay, Thin Overlay, Chip Seal, Microsurfacing, etc.):

A surface treatment project may be recommended for asphalt surfaced pavements with little or no areas of structural failure. Structural failures such as alligator fatigue cracking, potholes, and deformations generally indicate that the existing roadway structure, including asphalt and granular materials, are inadequate for some combination of the existing traffic, subgrade, and drainage conditions. In order to determine whether a surface treatment is appropriate, the roadway condition should first be surveyed to determine if the distresses are functional or structural in nature. Functional distresses are related to age and environmental impacts and may include transverse cracking, longitudinal cracking (non-wheelpath), block cracking, and raveling. For surface treatments, these functional distresses should be limited, covering some but not all of the area of the pavement surface, and should generally be low severity to moderate severity at worst.

Collecting the following minimum information is required for this effort:

- Perform a detailed distress survey to identify and estimate distress types, severities, and quantities using the linked documents as a reference to ensure the pavement is in good structural condition and can support a surface treatment.
    - FHWA - Distress Identification Manual
    - Pavement Interactive - Pavement Distresses
- Determine whether surface preparation will be required prior to treatment such as crack sealing and partial depth patching.
- Identify the latest traffic volumes which may be available here:
    - https://portal.ct.gov/DOT/PP_SysInfo/Traffic-Monitoring
        - AADT Reporting Tool
- Identify the functional classification which may be available here:
    - https://portal.ct.gov/DOT/PP_Bureau/Documents/Maps
        - Miscellaneous Maps → View/Download FC Maps
- Determine the pavement surface age from existing records.
    - Surface treatments have generally been found to be of the most benefit when the pavement surface age is roughly between 6 and 10 years.

Category 2: Minor Rehabilitation

Mill and Overlay, Hot-in-Place Recycling, Cold-in-Place Recycling, etc.:

A mill and overlay resurfacing treatment or in-place pavement recycling treatment may be recommended for asphalt surfaced pavements without extensive structural failure. Extensive structural failures such as alligator fatigue cracking, potholes, and deformations generally indicate that the existing roadway structure, including asphalt and granular materials, are inadequate for some combination of the existing traffic, subgrade, and drainage conditions. In order to determine whether a treatment of this type is appropriate, the roadway condition should first be surveyed to determine if the distresses are functional or structural in nature. Functional distresses are related to age and environmental impacts and may include transverse cracking, longitudinal cracking (non-wheelpath), block cracking, and raveling. A mill and overlay resurfacing treatment or in-place pavement recycling treatment is well suited for roadways that are experiencing primarily functional distresses to varying extents and severity. This treatment may also be appropriate if some minimal amount of structural failures are present but isolated; however, all areas of structural failure should be identified and repaired with full depth patching in combination with the resurfacing. When performing full depth patching, replacement of the existing granular base/subbase may be warranted if it is determined that those materials are in some way contributing to the poor performance of the asphalt pavement.

The next step is to determine the existing pavement depth and layer configuration, granular base and/or subbase depth, and subgrade type. The following minimum sampling is required for this effort:

- Take representative pavement cores along the roadway at 500-foot increments. Cores should be measured for total depth and depth between layers. Milling depths/recycling depths should be chosen to remove or recycle deteriorated layers and provide a layer for placing the new material that is sound. When milling, this is generally accomplished by avoiding the interface between existing pavement layers with the selected mill depth – staying slightly above an interface by approximately 1 inch, or slightly below an interface by approximately 1/2 inch. The targeted milling depth should also avoid exposing existing granular material by staying a minimum of 2 inches above the granular base or subbase. Consideration should also be given to the minimum pavement thickness that traffic will be traveling on after the initial mill. For instance, selecting a mill depth that results in the remaining pavement being 2 inches thick may be adequate to avoid subbase exposure while being inadequate to support heavy truck loads even for short term use.
- Check existing records to determine whether a granular base or subbase exists below the pavement. If no records on the existing roadway are available, take 1 split spoon sample (possibly in an existing core hole), or 1 test pit, every 1/2 mile to determine total base/subbase depth (engineered granular material) and depth to subgrade (existing or native material). A general identification of the base/subbase is recommended to distinguish whether the material is composed primarily of sand, gravel, or both (fine graded, coarse graded, or well graded). This assessment may also identify whether the material is silty or contains other contaminations.
- Identify the subgrade type for the area utilizing surficial mapping or other resources. Soil information can be accessed here:
    - Surficial Materials - CT DEEP GIS Open Data Website
        - Surficial Materials Map
    - ArcGIS - My Map
        - Additional Surficial Materials Map

- Identify the latest traffic volumes which may be available here:
    - https://portal.ct.gov/DOT/PP_SysInfo/Traffic-Monitoring
        - AADT Reporting Tool
- Identify the functional classification which may be available here:
    - https://portal.ct.gov/DOT/PP_Bureau/Documents/Maps
        - Miscellaneous Maps → View/Download FC Maps
- Perform a pavement design following the 1993 AASHTO Pavement Design Guide. Resources to assist in the calculation of ESALs, design structural number, and required structural number are available here:
    - https://portal.ct.gov/DOT/Engineering/Pavement-Design/Design-Guidance

Note: In-place recycling treatments should be covered with an overlay (either a dense graded HMA layer or preservation surface treatment) to achieve the best performance, and this layer should be accounted for in the design evaluation if applicable. It is not recommended to use the recycled pavement layers as a final wearing surface for the roadway. To maintain the existing roadway elevation, existing pavement material may need to be removed through partial milling before recycling occurs to accommodate placing the new asphalt pavement.

Category 3: Major Rehabilitation

Removal and Replacement of Asphalt ("Peel and Pave"), Full Depth Reclamation (FDR):

A peel and pave treatment or FDR treatment may be recommended for full depth asphalt pavements without extensive structural failures that would indicate a poor base/subbase condition or drainage issues. Extensive structural failures such as alligator fatigue cracking, potholes, and deformations generally indicate that the existing roadway structure, including asphalt and granular materials, are inadequate for some combination of the existing traffic, subgrade, and drainage conditions. In order to determine whether a treatment of this type is appropriate, the roadway condition should first be surveyed to determine if the distresses indicate that an extensive structural failure is present. Peel and pave or FDR treatments are each well suited for roadways with a high quantity and severity of functional distresses related to age and environmental impacts, which may include transverse cracking, longitudinal cracking (non-wheelpath), block cracking and raveling. These treatments are also appropriate if some structural failures are present but isolated, and mostly related to an inadequate initial pavement design thickness or indicative of a pavement that has reached terminal serviceability from repeated traffic loadings.

The next step is to determine the existing pavement depth, granular base and/or subbase depth, and subgrade type. The following minimum sampling is required for this effort:

- Take representative test pits along the roadway at 1000-foot increments to a depth of 36 inches each. Determine pavement thickness, total base/subbase depth (engineered granular material), and depth to subgrade (existing or native material). Test pits should be of an appropriate size and area in order to properly collect base/subbase samples which may be used in performing a sieve analysis based on the treatment selected.
    - For FDR projects, particle size distribution must be determined for the retrieved base/subbase samples. The material gradation should be determined in accordance with AASHTO T 27 and AASHTO T 11 standard test methods and identify sieves corresponding to CTDOT Form 818 Section M.02.06 Grading B requirements. See below for additional considerations.

    - For peel and pave projects, the collected base/subbase samples can be characterized visually. A general identification is recommended to distinguish whether the material is composed primarily of sand, gravel, or both (fine graded, coarse graded, or well graded). This assessment may also identify whether the material is silty or contains other contaminations.
- Take representative pavement cores along the roadway at 1000-foot increments between each test pit. Cores should be measured for total pavement depth.
- Identify the subgrade type for the area utilizing surficial mapping or other resources (visual identification should be used if encountered at 36-inch test pit depth in conjunction with mapping). Soil information can be accessed here:
    - Surficial Materials - CT DEEP GIS Open Data Website
        - Surficial Materials Map
    - ArcGIS - My Map
        - Additional Surficial Materials Map
- Identify the latest traffic volumes which may be available here:
    - https://portal.ct.gov/DOT/PP_SysInfo/Traffic-Monitoring
        - AADT Reporting Tool
- Identify the functional classification which may be available here:
    - https://portal.ct.gov/DOT/PP_Bureau/Documents/Maps
        - Miscellaneous Maps → View/Download FC Maps
- Perform a pavement design following the 1993 AASHTO Pavement Design Guide. Resources to assist in the calculation of ESALs, design structural number, and required structural number are available here:
    - https://portal.ct.gov/DOT/Engineering/Pavement-Design/Design-Guidance

Special Considerations for Full Depth Reclamation (FDR):

When considering an FDR treatment, it is important to keep in mind that in order to maintain the existing roadway elevation, base material will have to be removed after reclamation is performed, and before placing the new asphalt pavement. Note that there is also an approximate 15% bulking or "fluff" factor associated with this treatment to consider as well. Once a reclamation depth is chosen, and a new asphalt pavement thickness is determined through design evaluation, consideration should be given to the depth of reclaimed base material that will be left in place. Ultimately, this may not be the most effective treatment if less than 8 -10 inches of reclaimed base will be left in place.

Select a reclamation depth that will provide a blend of asphalt and granular base/subbase material meeting Section M.02.06 Grading B requirements. It is generally recommended that this blend not consist of more than 50% asphalt pavement, and typically would include an approximate 40% ratio of asphalt and 60% ratio of granular material. Blending subgrade material into the new reclaimed base should be avoided since this will typically blend in fine material (passing #200 sieve) that will increase the frost susceptibility of the reclaimed base.

Blended Material Example:

Sieve #	Assumed RAP Gradation (9" Depth)	Existing Subbase Gradation (11" Sandy Gravel)	Blend: RAP Gradation * (9/20) + Subbase Gradation * (11/20) =	M.02.06 Grading B Requirements	Check
5 inch	100	100	100	100	OK
3.5 inch	100	100	100	90 to100	OK
1.5 inch (37.5 mm)	80	80.8	80.4	55 to 95	OK
0.75 inch (19mm)	65	69.3	67.4		NA
0.25 inch (6.3mm)	35	58.7	48.0	25 to 60	OK
No.10 (2.0mm)	20	46.6	34.6	15 to 45	OK
No. 40 (425 µm)	9	26.8	18.8	5 to 25	OK
No. 100 (150 µm)	5	10.1	7.8	0 to 10	OK
No. 200 (75 µm)	2	4.2	3.2	0 to 5	OK

Note: In some instances, there may be both a granular base and granular subbase course between the bottom of the asphalt pavement and the subgrade; in this case, the additional layer may be blended in depending on the reclamation depth chosen. It should be noted that this base material would also require sampling and sieve analysis to consider the overall blend.

Category 4: Full Depth Reconstruction

A full depth reconstruction project may be recommended for asphalt pavements with extensive structural failures that would indicate a poorly designed asphalt pavement thickness, poor base/subbase condition, or drainage issues. Extensive structural failures such as alligator fatigue cracking, potholes, and deformations generally indicate that the existing roadway structure, including asphalt and granular materials, are inadequate for some combination of the existing traffic, subgrade, and drainage conditions. In order to determine whether a full depth reconstruction project is appropriate, the roadway condition should first be surveyed to determine if the distresses indicate that an extensive structural failure is present, warranting this treatment strategy.

Collecting the following minimum information is required for performing a full depth pavement design.

- Identify the latest traffic volumes which may be available here:
  - https://portal.ct.gov/DOT/PP_SysInfo/Traffic-Monitoring
    - AADT Reporting Tool
- Identify the functional classification which may be available here:
  - https://portal.ct.gov/DOT/PP_Bureau/Documents/Maps
    - Miscellaneous Maps → View/Download FC Maps
- Identify the subgrade type for the area utilizing surficial mapping or other resources. Soil information can be accessed here:
  - Surficial Materials - CT DEEP GIS Open Data Website
    - Surficial Materials Map
  - ArcGIS - My Map
    - Additional Surficial Materials Map
- Perform a pavement design following the 1993 AASHTO Pavement Design Guide. Resources to assist in the calculation of ESALs, design structural number, and required structural number are available here:
  - https://portal.ct.gov/DOT/Engineering/Pavement-Design/Design-Guidance