CHAPTER 680 – PAVEMENT DESIGN FOR WIDENING PROJECTS

Topic 681 – Pavement Widening Overview

Index 681.1 – Background

(1) Purpose - Pavement widening involves the construction of additional width to improve traffic flow and increase capacity on an existing highway facility or to improve existing features such as the inclusion of shoulders, turn lanes, and passing lanes. Pavement widening projects create unique issues for pavement engineers such as what is the best structure to build for the widening and how to tie or build next to existing pavement. This Chapter provides instructions and guidance for selecting pavement type, design standards, and details for pavement widening projects.

(2) Types of Pavement Widening Projects - Pavement widening may involve the following types of pavement projects:

- Adding travel lanes (including bus or bicycle lanes), auxiliary lanes, climbing or passing lanes, etc.,
- Adding shoulders, pullouts for maintenance/transit traffic; or
- Widening existing lanes, shoulders or pullouts.

When planning widening projects such as lane or shoulder additions, the existing adjacent pavement condition should be investigated to determine if the measures discussed in Index 682.3 are needed to combine rehabilitation or pavement preservation work with widening.

Topic 682 – Design Considerations

682.1 Standards

Besides pavement engineering discussed in Chapter 610, pavement widening presents additional challenges in pavement design. These include the following:

- A uniform foundation across the new and existing pavement structure to accommodate both pavement drainage and fatigue performance.
- Existing pavement is adequate to sustain traffic loads expected during the design life of the new pavement widening structure.
- Continuity of existing pavement structure drainage system.

Oftentimes, because existing pavements may have been designed decades earlier for lower traffic loads than are currently experienced, their thicknesses may not only be less than those of the new widened pavements but are often worn and in some cases exhibit
minor or major distress. These issues could considerably affect the service life and drainage of both the existing and new pavement structures. To ensure both drainage and design life standards are met, drainage conditions and structural capacity of both existing and new pavement structures should be evaluated and taken into account during the planning and scoping phases of a widening project.

682.2 Pre-Design Evaluation

Pavement widening requires a careful evaluation of the existing and proposed new widened pavement structures to ensure adequate performance under expected traffic loads, provide a consistent foundation across new and existing pavements, and perpetuate pavement drainage. The following pre-design evaluations are recommended to ensure that pavement widening projects are designed and constructed to meet these performance requirements.

- Review as-built records of the existing pavement structure such as the as-built material properties, mix designs, and layer thicknesses. In some instances, layer thicknesses from Ground Penetrating Radar (GPR) may also be available.
- Review the current pavement condition survey data.
- Conduct field evaluations including obtaining pavement cores and where applicable performing Falling Weight Deflectometer (FWD) survey to determine the following:
  1. Existing material properties and layer thicknesses
  2. Layer deflection and moduli (for use in asphalt pavement design)
  3. Soil properties including subgrade strength and subgrade moduli, and obtain samples for laboratory investigation if needed.
  4. Detection of moisture in the existing base

In instances where the existing pavement is in good condition and does not require rehabilitation, the most essential evaluations are the review of as-built records and current pavement condition survey data.

682.3 Pre-Design Considerations

The following pre-design considerations are recommended when designing a pavement widening project.

(1) **Consistent and Cost-effective Overall Pavement Structure.** The engineer needs to consider what characteristics are important for both the new and existing pavement in order to provide a consistent, cost-effective, and functioning structure for the overall pavement. This includes taking into account how the new pavement will perform as well as doing a life-cycle cost analysis of how and when the new and existing pavements will be maintained.

(2) **Rehabilitation or Pavement Preservation of Existing Pavement with the Widening Project.** It is not often cost-effective nor desirable to widen a highway without correcting ride quality and structural distress in adjacent pavement structure when that
work is needed. During planning and scoping of widening projects, it is necessary to thoroughly evaluate the existing adjacent pavement structure to determine if rehabilitation or pavement preservation is needed in conjunction with the widening. This involves a review of the current pavement condition survey data in conjunction with a field investigation of the existing roadway. The review should be done during the project initiation phase and updated during the design phase because the pavement condition may have deteriorated during the intervening time. If rehabilitation or pavement preservation is warranted, combining rehabilitation or pavement preservation work with widening is strongly encouraged.

(3) Future Traffic Delay and Long-Term Costs. Combining widening with rehabilitation or pavement preservation work on existing pavement can minimize future traffic delay and long-term costs. If the adjacent existing lane warrants rehabilitation, the lane should be rehabilitated in conjunction with the widening and brought up to the same life expectancy as the new widened portion of the roadway (see Index 612.3. In certain circumstances, the District may defer the pavement rehabilitation work and program it as a separate project, but this should be done in coordination with Headquarters Pavement Reviewers and the Project Delivery Coordinators (for non-delegated projects per the District Design delegation Agreement). If the adjacent lane does not need to be rehabilitated, an appropriate pavement preservation treatment should be applied to provide a uniform surface for maintenance of existing and widened sections.

Pavement preservation and rehabilitation work that should be included with widening projects for concrete and asphalt pavements are discussed in Index 682.4(1)(b) and 682.4(2)(c) respectively.

682.4 Scoping, Estimating, and Detailing

The following design criteria are provided to aid in scoping, estimating, and detailing pavement widening projects. As per Index 82.1(1), these requirements should be viewed as minimum criteria for determining how much work to do on existing pavements. Because each widening project has different pavement engineering and performance issues, early and frequent involvement of Headquarters Pavement Reviewers is recommended to appropriately address what features to include and how to ensure the following design criteria are met.

(1) Pavement Structure Requirements. The following minimum requirements should apply when designing pavement structures for widening projects.

(a) If a widening project causes the traffic lanes to lay partially on existing pavement and new pavement, then the engineer should ensure that the pavement type and structure are consistent across the lane. Avoid creating lanes that are partially asphalt, concrete or composite as this will wear at different rates and increase future maintenance costs and worker exposure on the lane.

(b) Remove the existing pavement up to the lane line of the existing adjacent truck permitted lane and replace it as part of the new widening pavement structure if:

(1) The traffic load capacity of the existing pavement measured in ESALs is more than 90 percent of the predicted need,
(2) The existing pavement is in good condition as identified in the pavement condition survey), and

(3) The new widening is adding less than 2 lanes and the width of widening the proposed lane is 9 feet or less.

In these situations, the proposed widened pavement structure may match the existing pavement and, where needed, a preservation treatment applied as discussed in Index 682.4(1)(b) and (2)(c). Otherwise, it is preferable to construct new lane(s) to new construction standards and remove existing pavement as needed to accommodate the predicted need.

(2) Widening of Concrete Roadways. The following design standards should apply when widening concrete roadways:

(a) Place longitudinal joints at location of proposed lane lines (or ultimate lane line if project is an interim stage of an ultimate project) except as noted below:

(1) Place the longitudinal construction joint between the existing pavement and the new widened section, 0.5 foot from the lane line for truck permitted lanes and from the edge of existing concrete for all other widening in traveled way except for auxiliary lanes next to truck permitted lanes where widening should match existing edge (See Figure 682.4A). Relocating the joint also allows for a clean joint by minimizing spalling and undulations in the existing joint. For truck permitted lanes, relocating the longitudinal joint 0.5 foot outside the lane will provide a uniform section of concrete to distribute truck loads and provide lateral support for the truck lane when longitudinal isolation joint is used. This will assure the performance of the pavement over its design life.

(2) Additional requirements and details for tying adjacent concrete slabs can be found in Index 622 and the Standard Plans.

(3) When existing longitudinal joints and proposed or ultimate lane lines do not line up, it is preferable to construct longitudinal pavement joints between new and existing concrete (particularly isolation joints) in non-truck permitted lanes.

(b) Do not place or leave slabs less than 8 feet wide in truck permitted lanes or joints within 2 feet of wheel paths. The reduced width of the slab will lead to early cracking of the pavement.

(c) When widening contiguous to concrete pavement in good condition, a pavement preservation strategy in conjunction with widening is recommended if warranted, including grinding the existing rigid pavement where warranted. This provides a smooth riding surface and can eliminate old striping and pavement markings. Grinding the lane next to the proposed widening is required when the existing International Roughness Index (IRI) exceeds 90 inches per mile in order to provide a smooth platform for the paving machine to construct the adjacent pavement structure. Pavement preservation strategies are discussed in Index 603.3 and in the Concrete Pavement Guide. Additional information on procedures for concrete pavement preservation can also be found in Topic 624.
Figure 682.4A

Typical Concrete Pavement Widening Median Lane and Outer Lane

NOTES:

(1) See Index 623.1 and Tables 623.1B – M for details on concrete pavement structure design.
(d) For concrete pavement that will require rehabilitation within ten years, the widening project should consider future compatibility of the proposed structure with the eventual concrete pavement rehabilitation strategy. Pavement rehabilitation strategies are discussed in Index 603.4 and procedures for concrete pavement rehabilitation can be found in Index 625.1.

(e) If the existing adjacent pavement to remain was a previously cracked, seated, and asphalt overlaid concrete roadway, then the new pavement structure for the widening project should match the structural layers of the existing pavement. This is done by placing asphalt concrete over a concrete base or lean concrete base thick enough to match the concrete layer in the existing pavement. Excluding any cement treated base, the thickness of the new concrete base should not be less than 0.35-feet. Where needed to match existing or add structural capacity, the new pavement structure should include an aggregate base or subbase. To provide a uniform surface for the widening and existing pavement, mill and replace 0.15 foot of the existing asphalt surface course or if the new asphalt concrete surface course required for the new pavement structure is thicker than the existing, the existing shall be overlaid a minimum of 0.15 feet to match the top surface of the new asphalt concrete layer. Figure 682.4B shows a typical pavement widening structure adjacent to existing previously cracked, seated and asphalt overlaid concrete pavement.

(3) Widening of Asphalt Roadways. The following design standards should apply when widening asphalt roadways:

(a) When widening asphalt pavement, continuity with the existing pavement should be provided whenever it is economically feasible. At a minimum, the design should use compatible materials and provide for adequate drainage underneath the existing pavement. This may require constructing the top of subgrade for the widening at the same or lower elevation than the existing subgrade, and extending underdrains from the edge of the existing pavement to an outlet beyond the new pavement structure.

(b) When widening adjacent to existing asphalt pavement that is in good condition, a pavement preservation strategy in conjunction with widening such as placing a non-structural wearing course over the widening and existing pavement should be done. This provides a surface with a uniform appearance, a surface course with equivalent future maintenance requirements, a clean surface for new striping configurations, as well as elimination of pavement joints which are susceptible to water intrusion and early fatigue failure.

If the new asphalt concrete surface course required for the new pavement structure is thicker than the existing, the existing shall be overlaid a minimum of 0.15 feet to match the top surface of the new asphalt concrete layer.
Figure 682.4B

Widening Previously Cracked, Seated, and HMA Overlay Concrete Pavement in Good Condition

NOTES:

(1) See Figures 682.4A for additional details.

(2) Match the structural layers of the existing pavement for situations described in section 682.4 (2) (e).

(3) Match thickness of adjacent concrete but not less than 0.35 feet.

(4) When needed to match existing treated base, granular base/sub base, or add structural capacity.
If the existing pavement exhibits oxidation, raveling, or minor cracking, it is recommended to mill 0.15 foot of the existing asphalt surface and overlay across the entire existing pavement and new section as shown in Figure 682.4C. The overlay joint should be offset 1.0 foot from the underlying vertical interface between existing and new pavement to improve the impermeability of the interface in the short-term. (The underlying vertical interface at the widening will eventually cause reflective cracking through to the surface.)

Pavement preservation strategies are discussed in Topic 634 and in the Maintenance Technical Advisory Guide (MTAG). Additional information on procedures for asphalt pavement preservation can also be found in Index 603.3.

(c) For asphalt pavement exhibiting major distress that need rehabilitation work, the widening project should include an appropriate pavement rehabilitation strategy for the existing pavement structure at least in the lane adjacent to the widening to obtain a smooth riding surface. In such cases, project scoping and other engineering decisions should take into account cost as well as other project considerations such as traffic safety to determine whether pavement rehabilitation of the existing roadway should be included with the pavement widening project. Pavement rehabilitation strategies are discussed in Topic 635 and procedures for asphalt pavement roadway rehabilitation can be found in Index 603.4.

(d) Widening of asphalt roadways with concrete should not be done except in the following cases:

1. Concrete pavement will be placed across all the truck permitted lanes.
2. The concrete pavement joint will be located at the proposed lane line (or ultimate lane line if project is just an interim stage of an ultimate project)
3. There is a funded project to replace the existing lanes with concrete within the next 10 years.

When an asphalt roadway is widened with concrete the existing asphalt pavement should be replaced with concrete and at the same time the entire pavement should be overlaid or, at a minimum, designed to be overlaid with concrete in the future.

(4) Drainage of Pavement Widening Structure. Perpetuate pavement drainage in accordance with Chapter 650. The pavement structure of the widening should be designed where feasible to provide a path for subsurface water drainage to the edge of pavement. If it is not feasible to accomplish this, then consult with Headquarters Pavement Reviewers for other options.

682.5 Other Considerations

In addition to the foregoing design considerations, the following measures should be taken into account when constructing a pavement widening project.
Figure 682.4C

Widening Asphalt Pavement in Good Condition

NOTES:

(1) Offset overlay joint by 1.0 feet from the underlying vertical interface between existing and new pavement.
(1) **Crack Sealing.** An aggressive crack sealing program will limit the amount of precipitation runoff from entering into the structure. Consideration should be given to using geosynthetic pavement interlayers over the joint between new and existing pavement prior to applying the full-width overlay to delay reflective cracking.

(2) **Treatment of the Subgrade.** Treatment of the subgrade under the widened section is recommended as an effective strategy to reduce moisture fluctuations at the new pavement edge which in turn should reduce the potential for longitudinal edge cracking. An alternative to treatment of the subgrade may be to use a subgrade enhancement at the subgrade/base interface. Treatment should be accomplished below the level of the old asphalt base.

(3) **Selection of the Base Material.** Selection of the new base material should be based on laboratory evaluation of both new and existing materials to compare the moisture susceptibility of each. Preferably, the moisture susceptibility of the existing and new base materials should be about the same. A material that is more highly moisture susceptible may draw moisture from both the original section and from outside the structure. A material that is less moisture susceptible may send moisture into the original base, particularly during the original curing process. It should also be noted that premature problems can be experienced when pavements with asphalt bases are widened with different base material, especially cement treated base. Cracks form at the longitudinal joint and moisture ingress often leads to rapid deterioration of the existing section.

(4) **Treated Base Sections.** Other considerations will closely parallel those discussed in Index 662.2 for treated base materials. There are cases where it may be desirable to use full-depth HMA for the widening to expedite construction, even though the base for the existing pavement was cement-treated material. This strategy should not cause subsurface moisture flow problems (“bath tub” effect) provided that the cement treated base is not moisture susceptible. Laboratory evaluation of core samples will determine the degree of moisture susceptibility of the existing base.

### 682.6 Life-Cycle Cost Analysis for Widening Projects

In addition to selecting the type of pavement for the widening project, as discussed in Topic 619, life-cycle cost analysis is a key component in determining how best to maintain both new and existing pavements over time and whether it is better to design the widening to match the life of the existing pavement or plan for the upgrading of the existing pavement to match the new pavement. When doing a life-cycle cost analysis for pavement widening, it is often best to perform the life-cycle cost analysis on how best to maintain the existing pavement first since the type and condition of the existing pavement will often influence the engineering of the new pavement. Life-cycle cost analysis is discussed further in Topic 619 and the Life-Cycle Cost Analysis Procedures Manual.