

**PAVEMENT TYPE SELECTION PROCEDURES**

**IN**

**VIRGINIA**

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Pavement Design and Evaluation  
Designing Today for Tomorrow's Strains



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## **Introduction**

This document outlines VDOT's Pavement Type Selection Procedures (PTSP) used in selecting the most functional and economical pavement type. These procedures are the results of the cooperation among various groups/divisions of VDOT and both asphalt and concrete industries. These PTSP are to be used with conventional Design Bid Build, Design Build, and Alternate Bidding contracts.

The procedures are aimed to provide the following:

1. Consistency
2. Conciseness
3. Transparency
4. Enhanced competition
5. Identical selection of pavement type by all qualified users upon following these procedures

## **Pavement Type Selection**

The PTSP are a set of steps that lead to the determination of alternate structures using a variety of materials, pavement design, construction methodologies, and Life Cycle Cost Analysis (LCCA). Therefore, it is possible that more than one type of pavement (typically, asphalt and concrete) could be designed which is capable of accommodating the design traffic under the same environmental condition. However, the differing pavement types will have different cost and maintenance components as well as differing constructability issues. The pavement designer needs to select the type that best satisfies the interest of the Department and the traveling public by thoroughly assessing all the pertinent factors. Such process is called pavement type selection.

## **Pavement Types**

Pavement types are broadly categorized into the following:

- Flexible pavement
  - Asphalt pavement
- Rigid pavements
  - Jointed Plain Concrete Pavement (JPCP)
  - Jointed Reinforced Concrete Pavement (JRCP)

- Continuously Reinforced Concrete Pavement (CRCP)
- Composite pavements (asphalt over concrete surface is typical in VA)

**Pavement Design:**

Pavement design is the process of selecting a practical and economical combination of materials of known strength and adequate thicknesses to support anticipated traffic under the prevailing environmental conditions. VDOT uses two different methods for pavement design. The 1993 AASHTO Guide for Design of Pavement Structures is used for interstate and primary roads. A separate indigenous design method described in VDOT's "Pavement Design Guide for Subdivision and Secondary Roads in Virginia" is followed for secondary roads. High volume secondary roads, as defined in the referenced secondary pavement design document, are also recommended to be designed following the 1993 AASHTO method. In order to ensure consistency, the pavement type selection process shall be applied only for pavements that are designed following the AASHTO method (i.e., interstate, primary and high volume secondary roads). The 1993 AASHTO design process is outlined in Chapter VI of Materials Division's Manual of Instructions.

**Pavement Type Selection Procedures (PTSP)**

Typically, the following factors influence the selection of pavement types:

- Cost (both initial and future maintenance/rehabilitation)
- Geometry of the pavement to be built (if applicable)
- Geometry of the adjacent pavement (if applicable)
- Existing appurtenant features (median barriers, drainage structures, curb & gutters, lateral & overhead clearances, structures limiting the new or rehabilitated pavement structure)
- Maintenance of traffic
- Availability of local materials
- Maintaining or changing grade profile
- Corridor continuity
- Local experience

The pavement type selection process is not an exact science as it involves not only engineering analysis but also subjective and complex consideration to project constraints

which may or may not be agreed upon by all concerned. This is very important since it significantly impacts the Department's budgetary and resource need. For typical projects, PTSP initiate at the project scope which determines if the project will be a candidate for considering multiple pavement types. The process then involves the following components: design of alternatives, performing life cycle cost analysis, selection of pavement type, development of typical pavement section, signing/sealing of the selected pavement section, forwarding the typical section to the project manager and project advertisement. In general, the following four steps should be followed when selecting a pavement type for typical projects (alternate bid projects follow a slightly different process which is explained in Alternate Bidding Section of this document):

Step 1: Decide if multiple pavement types need to be considered

Step 2: Design different types of pavement

Step 3: Perform Life Cycle Cost Analysis (LCCA) on competing pavement types

Step 4: Select the pavement type

These steps are discussed in detail in the following sections.

### **Step 1: Decide if multiple pavement types need to be considered**

Two major categories are encountered in this step, namely: new alignment/reconstruction and rehabilitation projects. New alignment or reconstruction projects are generated from the six year plan, while the rehabilitation projects are initiated from the Maintenance Division's pavement management process. While new alignment/reconstruction projects are prevailing examples, multiple pavement types could be considered for major rehabilitation projects as well. A general guideline for the criteria when multiple pavement types should be considered is provided below.

#### New Construction

New construction type projects could be sub-divided into the following two categories:

##### 1. New Alignment:

Typically, brand new alignment projects are most suitable for considering multiple types of pavements. However, length and structure of the pavement are to be considered in deciding whether multiple pavement types provide realistic solutions.

For example, pavement type for a new section that is too short could be simply decided by the pavement it is joining to. At the same time, multiple pavement types may not be realistic if the pavement structure is too thin. If the length of the project is at least 4 centerline miles or at least 16 lane miles and the design Structural Number (SN) for AC pavement is at least 5 or design concrete pavement thickness is at least 8 inches then multiple pavement types should be considered for new alignment projects. This means if the designer starts with asphalt section and the section meets the above length criteria and the design SN is at least 5 then an equivalent concrete section needs will be considered and the steps described in this document will be followed to select the final pavement type. At the same time, if the designer starts with concrete section and the section meets the above length criteria and the design PCC thickness is at least 8 inches then an equivalent asphalt section will be considered. The steps described in this document will then be followed to select the final pavement type.

## 2. Reconstruction:

Reconstruction projects could involve either the same footprint or widening of an existing road and the following criteria are applied for selecting PTSP candidates.

- a. For reconstruction along the same footprint projects, if the length of the project is at least 4 directional miles or at least 8 lane miles and the design Structural Number (SN) for AC pavement is at least 5 or design concrete pavement thickness is at least 8 inches then multiple pavement types should be considered. The directional mile is used since reconstruction may often involve only one direction of a divided roadway.
- b. For widening projects, if the length of the section is at least 4 miles and the design SN of the existing pavement (if AC) is at least 5 or the thickness of the existing pavement (if PCC) is at least 8 inches, multiple pavement types should be considered.

## Major Rehabilitation

Certain types of major rehab projects may qualify for considering multiple pavement types. At a minimum, the rehabilitation solution should provide a design life of 20 years. In addition, if the length is at least 4 directional miles or at least 8 lane miles and the new design SN (for AC pavement) is at least 5 or the new design pavement thickness (for PCC pavement) is at least 8 inches, multiple pavement types should be considered.

The criteria and process described above are shown in Figure 1 with a detailed flowchart.

Situations where the above conditions are not met, pavement type is usually governed by adjacent or existing pavement or special needs. As a general guideline, following are some typical examples (not all inclusive) where multiple pavement types need not be considered:

1. Turning lane
2. Functional maintenance projects (for example, single lift Asphalt resurfacing projects)
3. Pavement preservation projects (for example, surface treatment, slurry seals etc.)

### **Step 2: Design different types of pavements**

Once it is decided to consider multiple pavement types for the project and the possible alternate pavement types are identified, the appropriate pavements shall be designed following Chapter VI of Materials Division's Manual of Instruction (MOI) which utilizes the 1993 AASHTO method of pavement design. As noted earlier, high volume secondary roads are recommended to be designed following the 1993 AASHTO method.

### **Step 3: Perform Life Cycle Cost Analysis (LCCA)**

After designing the possible alternate pavement sections, Life Cycle Cost Analysis (LCCA) is to be performed to assess the economic worth of the alternate pavement sections. This consists of the initial cost estimate of the paving materials and the future maintenance activities necessary to maintain the road at an acceptable serviceability level to the traveling public. These activities include maintaining the pavement quality, namely smoothness and safety in terms of non-skidding, and the structural capacity, namely the elimination of cracks, faulting, potholes, and rutting. The present worth (PW)

approach is generally used to represent the translation of specified amounts of costs or benefits occurring in different time periods into a single amount at present instant. However, Equivalent Uniform Annual Cost (EUAC) approach is used for certain major rehab projects where the design life between the competing options are not the same.

In PW approach, LCCA converts the initial and all expected maintenance/rehabilitation costs of the differing pavement types into present worth values. In EUAC approach, the calculated PW is evenly distributed over the analysis period. For details on VDOT's LCCA approach, please see the document titled "Guidelines for Life Cycle Cost Analysis" or Section 607 of Materials Division's Manual of Instruction (Chapter VI).

#### **Step 4: Select the final pavement type**

If the present worth (or EUAC for certain major rehab projects) values in the LCCA for the competing pavement type solutions differ more than 10%, the pavement type with the lowest present worth (or EUAC for certain major rehab projects) shall be recommended for final selection. When the net present worth (or EUAC for certain major rehab projects) for competing types of pavements is within 10%, other factors are examined as outlined in VDOT's LCCA process (for non alternate bid projects) or the project is selected for alternate bidding (see the section on Alternate Bidding below for alternate bidding project selection criteria). If the project is not an alternate bid candidate, other factors that are not considered in the LCCA computation should be considered in conjunction with LCCA results. These factors along with the LCCA results are considered to make the final decision. These factors could be, but are not limited to:

- Initial project constructability
- Constructability of future improvements
- Volume of traffic
- Maintenance of traffic
- Climate
- Recycling
- Adjacent existing pavement (if applicable)
- Traffic safety
- Incorporation of experimental features

- Participating local government preference

If any particular type of pavement is disregarded due to special circumstances despite the favorable LCCA result, appropriate justification shall be documented and approved by the State Materials Engineer or his designee. For projects that are selected for alternate bidding process, the final pavement type will be selected based on the outcome of the alternate bidding process.

### **Alternate Bidding**

Alternate bidding is the process where bids are solicited on two different pavement types for the same project. The final pavement type selection is based on the actual bid price of the project (not the pavement components only). Such practice, if applied to the right project, is expected to enhance competition within the contracting industry and potentially lead to lower costs for VDOT.

New construction and complete reconstruction projects meeting the criteria as described in Step 1 (and also outlined in Figure 1) are suitable candidates for the alternate bidding process. VDOT will perform LCCA on these projects based on the best estimates of the unit prices. If the difference between the PW for competing pavement types are within 10%, VDOT will pursue alternate bidding. Each alternate will be included in the bid package for solicitation. The final selection of the pavement type will be based on the least bid amount for the project. For Design Build projects, the final selection of the pavement type will follow the standard award process for Design Build projects.

It should be noted that alternate bidding may be considered for projects not meeting the above criteria but is deemed to provide opportunities for competition. Such decision should be made on case by case basis and approved by the State Materials Engineer or his designee.

### **How to use the procedures**

Pavement type selection procedures (PTSP) start at the scoping of any project. The scoping determines whether multiple pavement types are practical and the project is a candidate for PTSP. The procedures should involve the following:

1. Start with the project scope and use the decision flow chart in Figure 1 to select the proper category
2. Follow the applicable procedures

If a project is not a candidate for Pavement Type Selection Procedures (PTSP), the standard VDOT design process will be followed. This will involve detailed design of the selected pavement type, signing/sealing by the respective design engineer and forwarding the design to the respective project manager. On the other hand, if the project is a PTSP candidate, multiple pavement types will be considered and designed. Life Cycle Cost Analysis (LCCA) will be performed following VDOT's LCCA process to assist in the determination of the final pavement type. The selected pavement design is signed and sealed by the respective design engineer and is ultimately forwarded to the project manager. If a project is selected for alternate bidding, the design engineer will sign and seal both pavement types and forward these two pavement designs to the project manager. Bids will be solicited on both these sections and the selection of the pavement type will be determined based on the least bid price of the project or following the standard award process for Design Build projects.

The pavement type selection process shall be performed under the purview of the respective District Materials Engineer or his designee. If the project is a candidate for Central Office Materials (CO) review (interstate and primary routes for brand new alignments), the project details and pavement design recommendations shall be sent to CO Pavement Design and Evaluation section for review after an LCCA is performed. Interstate and Primary route candidates for rehabilitation may be sent to CO for review at the District Materials Engineer's discretion. The State Materials Engineer or his designee will review the project upon consultation with the district and issue a written letter of concurrence and/or noting any concern or issues. The District Materials Engineer or his designee will then finalize the pavement type, sign and seal the pavement design and forward it to the respective project manager for incorporation into the project plans and contract documents. The State Materials Engineer will have the final decision authority over any unresolved technical matters related to the project pavement type selection or pavement design. For projects where the alternate bid process is used, both alternates

with the applicable plan sheets and other pertinent contract documents shall be included in the bid package. The final selection of the pavement type will be made after receiving bids. A flowchart summary of the process is shown in Figure 1. Any deviation from the policies and procedures described herein must be documented by the project design staff and approved by the State Materials Engineer or his designee.

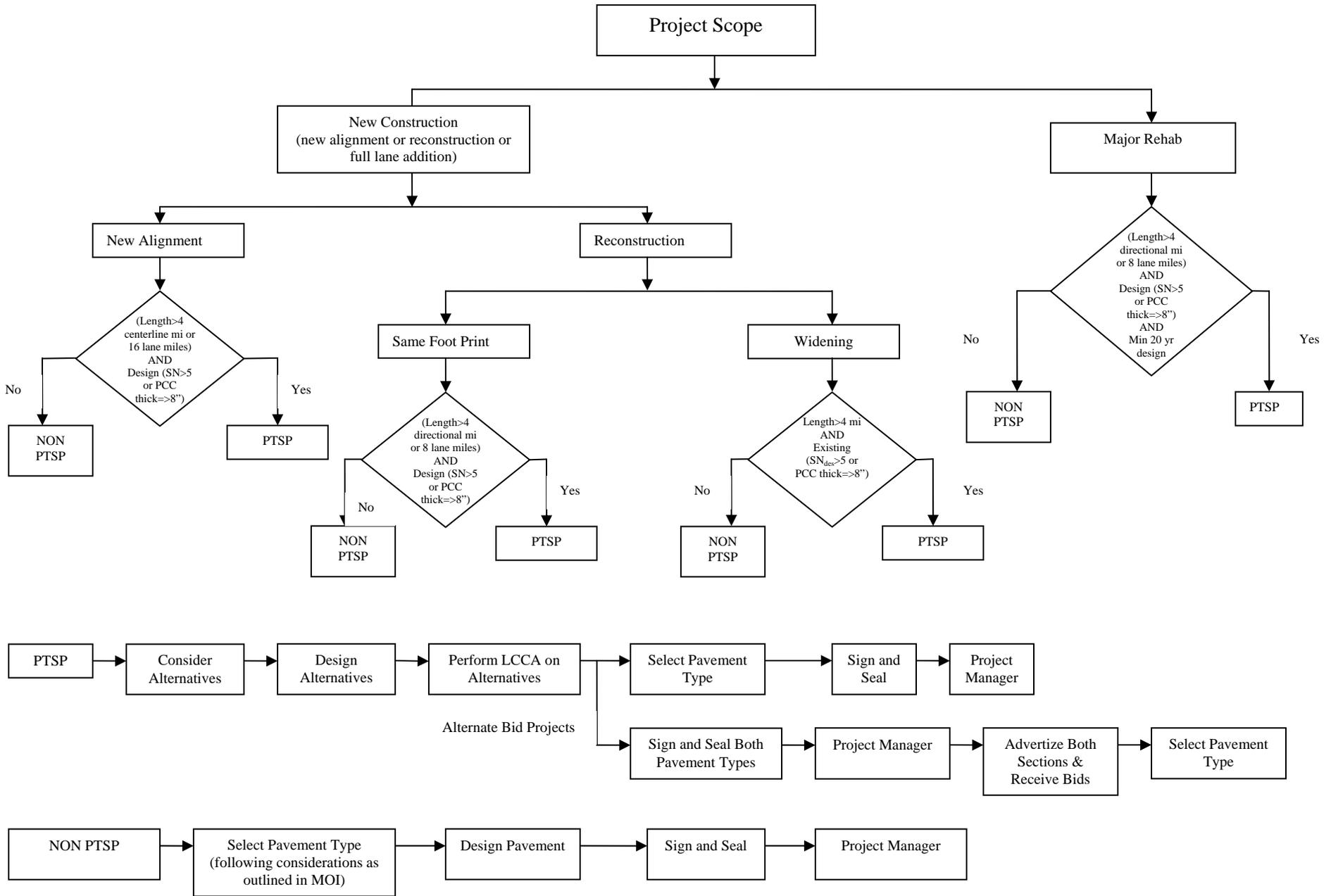


Figure 1: Pavement Type Selection Decision Work Flow