WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
DESIGN DIRECTIVE

DD-641
PAVEMENT DESIGN SELECTION GUIDE

August 1, 2003

A pavement type selection and design will be performed/prepared on all projects requiring pavement in accordance with the Division of Highways' Pavement Design Selection Guide. A copy of said document is attached.

Attachment

PAVEMENT DESIGN SELECTION GUIDE

A. INTRODUCTION

Pavement type selection is a combination of engineering and economic analysis that provides data to assist the engineer or manager in choosing a cost-effective pavement. The engineering analysis consists of a pavement structural design procedure with consideration of other factors that may influence the selection of a pavement. Pavement type selection has not evolved to an exact science and there will not exist an absolute or indisputable mathematical solution for all selections. The 1993 AASHTO *Guide for the Design of Pavement Structures* allows for "other factors", both principal and secondary, that need to be considered along with the engineering and economic data to select the pavement type that best fits the needs and conditions of the project. The principal factors have a major influence on the pavement type selection process and can dictate the type of pavement selected. The secondary factors will be used when a clear choice is not indicated by the principal factors.

This Guide outlines the process for pavement type selection for new or reconstructed pavement structures and rehabilitation projects. It provides guidance in the design approach for the cost comparison, life cycle cost, the use of design parameters and discusses principal and secondary factors to be utilized in making a selection. This Guide is provided in compliance with Title 23 Code of Federal Regulations. The West Virginia Division of Highways Pavement Design Manual is to be used to obtain technical data needed in the analysis.

B. APPLICATION

This selection process applies to all projects. On projects where pavement replacement, reconstruction, or rehabilitation is less than 1,000 feet on a single roadway segment or less than 500 feet, of each bridge approach roadway, the selection process can be based on engineering judgment. The project manager shall give due consideration to in-kind replacement, adjacent pavement type and future improvements when exercising judgment during the selection process. A flowchart showing the pavement selection process is attached to this Design Directive for reference.

C. TIME FRAME

The pavement type selection will be performed for all projects upon receipt of soils, existing pavement cores, and traffic data required. On corridor type projects it will not be necessary to perform a new selection for each project when the design parameters remain relatively constant. This decision will be made by the Deputy State Highway Engineer- Development.

D. RESPONSIBILITIES AND SELECTION PROCEDURES

Pavement type analysis will be the responsibility of the project manager. The project manager will perform the design analysis and life cycle cost analysis utilizing appropriate software for both the flexible and rigid type pavement alternates. The analysis period shall be the same for each type of pavement with a pavement strategy developed to give an equivalent performance. The project manager will document the principal and secondary factors as they relate or apply to the project. Weighing the factors and any related costs along with the costs of alternates from the life cycle

analysis, a pavement type selection will be submitted to the Deputy State Highway Engineer-Development for approval.

When the project manager's selection represents a change from normal practices, the Deputy State Highway Engineer-Development will consider budgetary and system wide consequences prior to giving final approval.

E. SAFETY

All projects, whether new construction, reconstruction or rehabilitation, will have skid resistant properties suitable for the needs of traffic. See Design Directive 644 for criteria.

F. GENERAL TYPES

The following types of pavement alternates are to be considered:

1. Rigid

The pavement will be jointed Portland Cement Concrete (PCC) as required by design parameters and/or current design policy. Joint spacing shall be set forth in the Standard Details.

2. Flexible

The pavement will be Hot-Mix Asphalt (HMA). Applications or type of mixes shall be as set forth in Design Directive 644.

3. Base Courses

Base course(s) will be specified as per Design Directive 643.

4. Shoulders

Type and thickness of paved shoulders shall match mainline pavement section for (1) urban arterials, (2) projects with an ADT of 6,000 and truck traffic of 15% or greater, or (3) ADT greater than 15,000. Joint spacing on PCC shoulders shall match the mainline.

G. PERFORMANCE PERIOD - NEW PAVEMENTS

Performance periods will be selected based on past design practices, experiences and a review of pavement data. For new construction projects, an analysis period of forty (40) years will be used for the life cycle cost analysis. The designer will develop, based on past performances, reasonable design strategies for each alternative; that is, an initial pavement structure followed by a series of overlays to cover the performance period. The analysis period will be the same for each alternative considered. Unless data exists showing an alternative strategy, the designer shall use an initial period of ten (10) years followed by a series of three (3), ten (10) year, rehabilitation periods

for newly constructed flexible pavements. Rigid pavement alternatives shall be based on an initial period of twenty (20) years followed by series of two (2), ten (10) year, rehabilitations.

H. PERFORMANCE PERIOD - REHABILITATION

Rehabilitation projects shall be based on performance periods of at least 8 years.

I. TRAFFIC SELECTION

Traffic factors for growth rates, equivalent single axle loads, and directional distribution percentage are to be obtained from the Transportation Planning Division.

J. ROADBED SWELLING AND FROST HEAVE

Recommended values from the Pavement Design Manual are to be used.

K. SERVICEABILITY

Recommended values from the Pavement Design Manual are to be used.

L. MATERIALS PROPERTIES

1. Effective roadbed soil resilient modulus data to be obtained from Materials Control, Soil and Testing Division.

2. Recommended values for pavement layer characteristics to be obtained from the Pavement Design Manual.

M. PAVEMENT STRUCTURAL CHARACTERISTICS

Values recommended in the Pavement Design Manual shall be used. One modification is required for the load transfer value utilized with shoulders. A value of 2.7 will be used for tied shoulders utilized with concrete pavements.

N. UNIT COSTS

The unit cost used in the life cycle cost analysis and other economic analyses shall be obtained from the latest Statewide Average Unit Bid Prices. These prices can be modified based on the project manager's knowledge of the project, past experience and local conditions not reflected in the statewide averages with modifications to be reflected in the documentation.

The following maintenance costs will be used in the initial evaluation of pavement cost. All costs are in $/lane mile/year.

TIME FRAME (YEARS)	HMA	PCC
4-20	$700	$1,000
21-30	$425	$425
31-40	$425	$425

O. PAVEMENT THICKNESS

The final pavement thickness will be based on the structural analysis. The minimum layer thickness will be consistent with standard construction methods and/or material requirements. Refer to DD-644 for information on pavement layer thickness criteria.

P. REHABILITATION PROJECTS

The Division recognizes that there are a variety of rehabilitation methods and strategies available to restore pavements. As all factors that influence pavement performance and life expectancy have not been quantified, it is felt that the latest information should be considered in the selection type and process outlined herein.

Although alternate rehabilitation methods may be considered, HMA overlays are primarily chosen for pavement rehabilitation projects. This choice is based on the past success of this rehabilitation method, availability of local contractors to perform this type of rehabilitation, traffic control considerations, and the relatively low cost per mile.

The HMA overlay thickness for this type of project will be based on a pavement design performed in accordance with the Pavement Design Manual or a field review of the existing pavement and the past performance of HMA overlays on similar projects.

In situations where the use of an HMA overlay as the rehabilitation method is questionable, the following process can be used to select the rehabilitation method best suited to the project:

1. Project Evaluation

The type of pavement rehabilitation to be considered begins with an evaluation of pavement distress, smoothness or ride ability and consideration of general conditions within the proposed project area. For asphalt pavement, distress evaluations are based on the amount of rutting, longitudinal cracks, transverse cracks, alligator cracks, and smoothness. For concrete pavements, the distress will be measured on the basis of the amount of faulting, longitudinal cracking, transverse cracking, pumping, joint deterioration and smoothness. Smoothness is measured by either the GM-Profilometer or the Mays Meter. This information will normally be available from pavement management inventories collected by the Transportation Planning

Division. Project conditions will be gathered based on a field review by the project manager.

2. Project Analysis

Upon completion of evaluations, alternative solutions will be considered for the project. The alternates considered may vary with the type of pavement being overlaid, the amount of distress and smoothness values. The alternates will be analyzed as to their constructability, performance period, initial and life cycle costs. Constructability will consider the vertical clearances, traffic control, and construction conflicts.

The strategies, use and performance anticipated of alternates that will be considered are as follows:

a. PCC Pavements

(1) First Phase of Rehabilitation

(a) Pavements with moderate amounts of distress and roughness with a Present Serviceability Rating (PSR) of 3.5±.

Concrete Pavement Restoration (12-year performance).

(b) Pavements with moderate amounts of distress and roughness with a Present Serviceability Rating (PSR) of 3.0±.

Conventional asphalt overlay (8-year performance).

PCC overlay (20-year performance).

(c) Pavements with heavy amounts of distress and roughness with a PSR of 2.6±.

Break and seat with asphalt overlay - thickness related to expected performance (8-year performance).

Rubblize with asphalt overlay - thickness related to expected performance (8-year performance).

Unbonded PCC overlay (20-year performance).

Recycling PCC pavements (20-year performance).

Reconstruction (20-year performance).

Asphalt overlay with saw and seal (8-year performance).

(2) Second Phase of Rehabilitation

(a) Pavements with moderate amounts of distress or roughness with PSR of 3.0± (Overlay strategies can include various techniques, such as saw and seal.)

Previously crack or break and seat — overlay with or without milling (8-year performance).

Previously overlaid only — overlay with or without milling (8-year performance).

(b) Pavements with heavy amounts of distress or roughness with PSR of 2.6±.

Previously crack or break and seat — reconstruct (20 year performance)

Previously overlaid only — mill, break and seat (8 year performance)

Previously overlaid only — mill, rubblize (8 year performance)

Previously overlaid only — reconstruction (20 year performance)

b. Asphalt Pavements

Note: Full and partial depth patching are normally considered maintenance and occur prior to rehabilitation.

(1) Moderate amounts of distress and roughness with PSR of 3.0±.

Asphalt overlay - minimum thickness based on design requirements (8-year performance).

(2) Heavy amounts of distress and roughness with PSR of 2.6± and/or vertical constraints.

Asphalt overlay with milling and recycling (8-year performance).

(3) Severely deteriorated pavements with PSR of 2.5 or less.

Reconstruction (20-year performance).

(4) Project Design

The design strategy will be to bring the PSR up to near the initial value of 4.5. The design of overlays will be in accordance with methods previously outlined.

(5) Project Implementation

Rehabilitation projects will be initiated on an annual program in accordance with pavement management data and budget.

Q. PRINCIPAL FACTORS

Principal factors are those which can have a major influence on the selection and may dictate the pavement type on some projects. Some of these factors are also included in the basic design procedures as they influence the structural requirements of the pavement design or subgrade, or the embankment treatments. In such cases, they are assigned an economic value for comparative purposes. The following discussion documents Division policies and practices for principal factors not considered in basic design procedures.

1. Traffic

Shifts occur in the economic activity of manufacturing and service industries throughout the state. These activities should be considered as factors affecting the proposed alternative and required method for construction of the selection. In urban areas or on roadways with heavy traffic, the need to minimize disruptions may be a major consideration.

2. Soils Characteristics

The design is to give full consideration to any unusual soils characteristics. Subsurface exploration is an essential part of the design process. It includes investigation, sampling and testing, identification of materials types and the distribution of soils materials throughout the project. Based on past experience, the characteristics of the roadbed soils have been found to have a major influence on pavement performance.

3. Recycling

It is the Division's policy to promote recycling of existing roadway materials. Standard Specifications allow recycled materials to be incorporated in the pavement section.

4. Cost Comparison

The pavement type selection should be made on the best fit solution for the criteria. All costs are to be considered, including the life cycle costs, differences in

maintenance of traffic costs, added features required, corridor typicals and other known factors.

R. SECONDARY FACTORS

These factors generally have a lesser influence on pavement type selection and will only be considered when there are no overriding characteristics or one alternate is not clearly superior.

1. Performance of Similar Pavements

Recommendations of personnel concerning pavement performance in the field under similar traffic conditions.

2. Adjacent Existing Pavements

Benefits can be gained by long sections of similar pavement as maintenance operations can be assembled for one pavement type.

3. Conservation of Materials

Shortage of materials usually is reflected in increased costs; however, there may be instances where this has not been reflected in costs or there is a special need to conserve or use one type of material.

4. Availability of Local Materials and Contractors

Every effort is made to use local materials and contractors.

5. Traffic Safety

Traffic safety is a consideration on all projects.

6. Incorporation of Technology

If the Division desires to field test a new material, concept or other technology, a work plan will be developed and the project evaluated over a performance period.

7. Stimulation of Competition

The Division recognizes the benefits of encouraging competition among industries involved in the production of paving materials. The engineer will consider acceptable additives and alternate materials within the pavement structure.

PAVEMENT DESIGN PROCESS FLOWCHART

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