

Pavement Design & Rehabilitation Manual
October 19, 2007 Update

This file contains the October 19, 2007 update to the Pavement Design & Rehabilitation Manual. The file is set up for double sided printing. For Sections 200, 300, and 400, the updated pages should replace the corresponding current pages. For Appendix A, the current appendix should be replaced in its entirety with the new appendix.

While users are free to maintain printed Manuals, the Ohio Department of Transportation no longer supplies hard copies. The online Manual is the official version.

200 Pavement Design Concepts

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201-1	January 1999	Serviceability & Reliability
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203-2	January 1999	Group Index Charts
203-3	January 1999	Subgrade Resilient Modulus

Serviceability & Reliability	201-1 January 1999
	Reference Section 201 & 204

SERVICEABILITY FACTORS		
	RIGID	FLEXIBLE
Initial Serviceability	4.2	4.5
Terminal Serviceability	2.5	2.5
Design Serviceability Loss	1.7	2.0

RELIABILITY LEVELS (%)		
FUNCTIONAL CLASSIFICATION	URBAN	RURAL
Interstate and Freeway	95	90
Principle Arterial, Minor Arterial	90	85
Collectors	90	85
Local	80	80

OVERALL STANDARD DEVIATION	
Flexible Pavement	0.49
Rigid Pavement	0.39

Traffic Factors	202-1 October 2007
	Reference Section 202

RATIO OF B:C COMMERCIAL VEHICLES	
FUNCTIONAL CLASSIFICATION	B:C RATIO
Rural Interstate (01)	7:1
Rural Principal Arterial (02)	5:1
All Other Rural (06, 07, 08, 09)	2:1
Urban Interstate (11)	4:1
Urban Freeway & Expressway (12)	3:1
Urban Principal Arterial (14)	2:1
All Other Urban (16, 17, 19)	1:1

ESAL CONVERSION FACTORS				
FUNCTIONAL CLASSIFICATION	RIGID		FLEXIBLE	
	B	C	B	C
Rural Interstate (01)	1.86	0.66	1.23	0.51
Rural Principal Arterial (02)	2.42	0.95	1.45	0.58
All Other Rural (06, 07, 08, 09)	1.55	1.40	0.89	0.75
Urban Interstate (11)	1.92	0.84	1.21	0.62
Urban Expressway & Freeway (12)	1.80	0.86	1.22	0.50
All Other Urban (14, 16, 17, 19)	1.72	0.80	1.03	0.55

LANE FACTORS		
Number of Lanes	% Trucks in Design Lane	Directional Distribution (%)
2 - Lane	100	50
4 - Lane	90	50
6 (or more) - Lane	80	50

300 Rigid Pavement Design Procedures & Considerations

List of Figures

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301-1	October 2007	Rigid Pavement Design Parameters
301-2	January 1999	Composite Modulus of Subgrade Reaction (k_c)
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302-3	January 1999	Rigid Pavement Design Chart Segment 2
303-1	January 1999	Bituminous Surface Treated Shoulder and Stabilized Aggregate Shoulder Typical Sections

* Design examples do not include changes to the design inputs made after June 1999.

Rigid Pavement Design Parameters	301-1 October 2007
	Reference Section 301

MATERIAL PROPERTIES	
Modulus of Rupture (S'_c)	700 psi
Modulus of Elasticity (E_c)	5,000,000 psi
Load Transfer Coefficient (J) - Doweled, Edge Support*	2.7
Load Transfer Coefficient (J) - Doweled, No Edge Support*	3.2

SUBBASE FACTORS			
ODOT Specification	Recommended Thickness (in.) (D_{SB})	Elastic Modulus (psi) (E_{SB})	Loss of Support (LS)
Item 301, 302 Asphalt Concrete Base	4"	300,000	0
Free Draining Base with Item 304**	10" (4" FDB / 6" 304)	30,000	0
Item 304 Aggregate Base	6"	30,000	1
Natural Subgrade ***			2

* Edge support includes tied concrete shoulders, integral curb, widened lane, etc. Widened lane refers to concrete slabs built 14 feet (4.2 m) wide or wider, but striped for a standard 12-foot (3.6 m) lane, leaving 2 feet (0.6 m) outside the traveled lane to provide edge support.

** **Free Draining Bases are not approved for use on ODOT projects. Never use Item 306 Cement Treated Free Draining Base or Item 307 Non-Stabilized Drainage Base, Type NJ with a rigid pavement.** The use of a free draining base requires a 6-inch (150 mm) layer of Item 304 Aggregate Base as a filter layer and is used to keep the subgrade from infiltrating and plugging the free draining base. The values in the table represent the combined effects of the 6-inch (150 mm) aggregate base filter layer, as well as the free draining base layer.

*** Not recommended for most applications. See Section 301.4

Composite Modulus of Subgrade Reaction (k_c)

301-2
January 1999
Ref. Section & Figure
301.4, 302-1 (step 4)

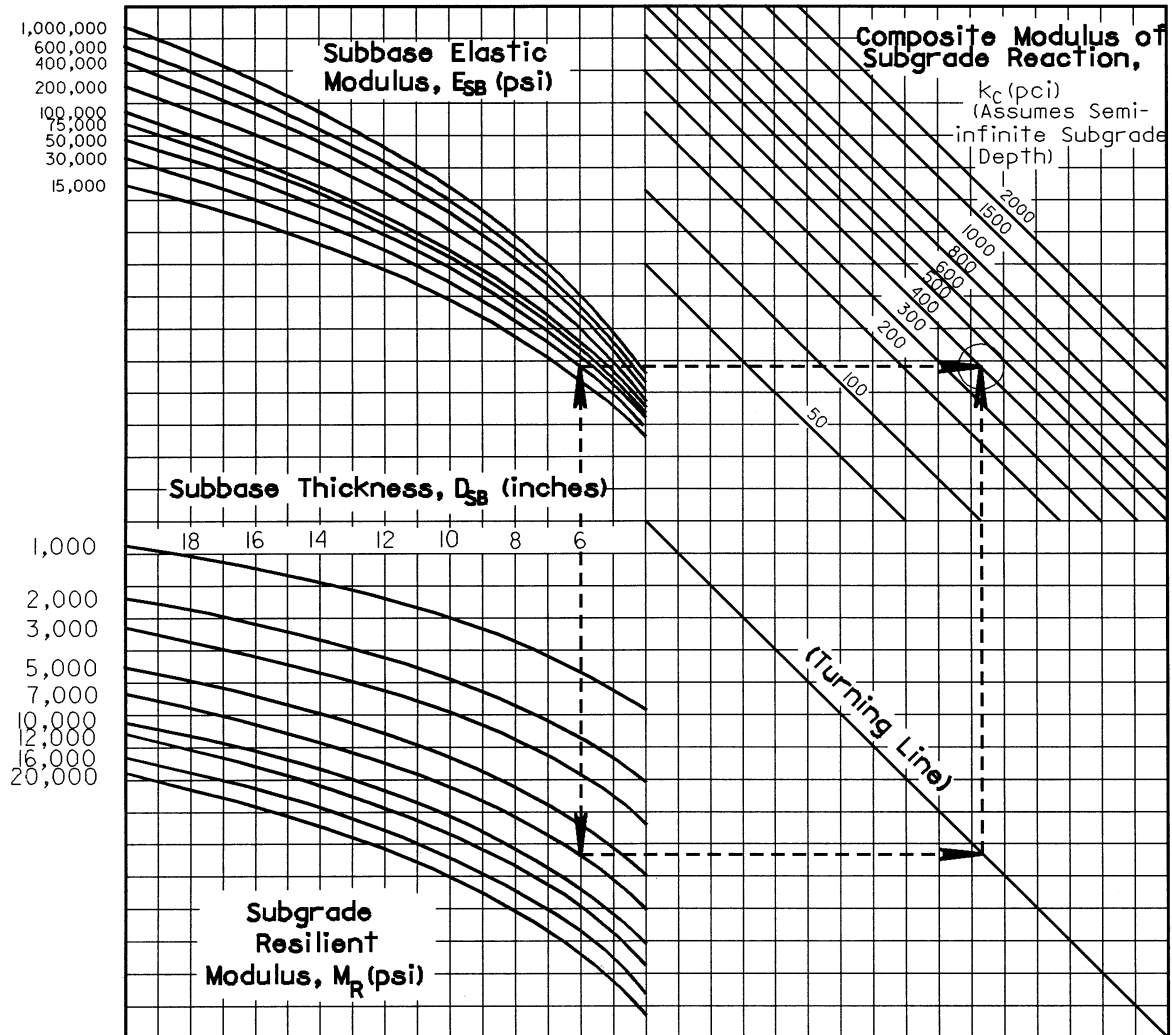
Example:

D_{SB} (Assumed) = 6 inches (150 mm)

E_{SB} = 30,000 psi (Figure 301-1)

M_R = 7,200 psi (Figure 203-1)

Solution: k_c = 400 pci



400 Flexible Pavement Design Procedures & Considerations

List of Figures

<u>Figure</u>	<u>Date</u>	<u>Subject</u>
401-1	October 2007	Flexible Pavement Structural Coefficients
402-1	January 1999*	Flexible Pavement Design Example
402-2	January 1999	Flexible Pavement Design Chart Segment 1
402-3	January 1999	Flexible Pavement Design Chart Segment 2
403-1	January 1999	Bituminous Surface Treated Shoulder and Stabilized Aggregate Shoulder Typical Sections

* Design examples do not include changes to the design inputs made after June 1999.

Flexible Pavement Structural Coefficients	401-1 October 2007
	Reference Section 401

ASPHALT CONCRETE STRUCTURAL COEFFICIENTS		
Material	English Coefficient	Metric Coefficient
Items 424, 442, 443, 446, 448, 826, 857, 859 - AC Surface Courses	0.43	0.0169
Items 442, 443, 446, 448, 826, 857 - AC Intermediate Courses	0.43	0.0169
Item 880 Warranty Asphalt - top 3" (75 mm)	0.43	0.0169
Items 301, 302 - Asphalt Concrete Base Courses	0.36	0.0142
Item 880 Warranty Asphalt - below top 3" (75 mm)	0.36	0.0142
Item 321 - Cracked & Seated Plain Concrete	0.27	0.0106
Existing Asphalt Concrete - old, oxidized, & weathered	0.23	0.0092
Item 304 - Aggregate Base	0.14	0.0055
Item 320 - Rubblized Concrete	0.14	0.0055
Items 306, 307, 308 - Free Draining Base Layers*	0.14	0.0055
Items 421, 881 - Microsurfacing	0.0	0.0
Item 803 Rubberized Open Graded Asphalt Friction Course	0.0	0.0
Items 822, 886 - Hot In Place Recycling	0.0	0.0

* Free Draining Bases are not approved for use on ODOT projects.

Asphalt Concrete Drainage Factor = 1.0

Flexible Pavement Design Example Page 1	402-1 January 1999
	Reference Section 402

Example - Flexible Pavement Design

Givens:

- Number of Lanes: 4
- Functional Classification: Rural Principal Arterial
- 1998 Traffic: 14,800 ADT
- 2018 Traffic: 23,360 ADT
- 24 hour truck % 10
- Year Completed: 2000
- Soil Classification: Liquid Limit = 45
Plasticity Index = 12
% Passing #200 sieve = 70

Problem: Solve for the Structural Number of the Flexible Buildup

Solution:

Step 1 - Determine the Group Index Number (G.I.) Using Figure 203-2.

In chart A, solve for the Partial Group Index using the 70 % Passing No. 200 Sieve and the Liquid Limit (L.L.) Of 45. G.I. from Chart A = 7.9. In Chart B, solve for the Partial Group Index using the 70 % (55 or more) Passing No. 200 Sieve and the Plasticity Index of 12. G.I. from Chart B = 0.8. The total G.I. is 7.9 plus 0.8 or 8.7 (Rounded to 9).

Step 2 - Determine the Subgrade Resilient Modulus (M_r) using Figure 203-3.

Using a G.I. of 9 from Figure 203-2 (Step 1), the California Bearing Ratio (CBR) is 6 (Rounded). The CBR is used in the following formula to determine the Resilient Modulus.

$$M_r = 1200 \times 6 = 7200 \text{ psi.}$$

Appendix A

Pavement Policies

Approved:



Gordon Proctor
Director

Policy Number: 20-006(P)
Effective: September 1, 2006
Responsible Division: Planning
Supersedes Policy: 515-002(P)
Dated: June 10, 1999

PAVEMENT TYPE SELECTION POLICY

POLICY STATEMENT:

The Ohio Department of Transportation (ODOT) must select paving materials when building and maintaining highways. This policy establishes a uniform procedure for selecting pavement type on projects categorized as new pavement, pavement replacement, or major rehabilitation that are in excess of four lane-miles of mainline pavement and/or collector-distributor lanes under ODOT jurisdiction.

Projects included in this policy will have the pavement thickness design and life-cycle cost analysis (LCCA) performed by the Office of Pavement Engineering. Subgrade recommendations for pavement design will be provided by the Office of Geotechnical Engineering. Unit price estimates for the LCCA will be provided by the Office of Estimating. Final pavement type selection will be made by the Pavement Selection Committee consisting of representatives of the district and Central Office, as appointed by the Director.

For projects included in this policy, the pavement thickness design, LCCA, and pavement type selection applies only to the mainline pavement and collector-distributor lanes and their adjoining shoulders. Pavement thickness and type selection for all other areas, including ramps, directional roadways, acceleration/deceleration lanes, cross-roads, side-roads, etc., and for all projects not included in this policy, are the responsibility of the districts and do not require a life-cycle cost analysis.

AUTHORITY:

Ohio Revised Code Sections 5501.02, 5501.03, 5501.11, 5501.14, 5501.31, and 5511.01.

REFERENCES:

Standard Procedure 520-001(SP)
Final Report, Neutral Third Party Ohio Pavement Selection Process Analysis prepared for
ODOT Pavement Selection Advisory Council, December 12, 2003
Pavement Design & Rehabilitation Manual
“Guide for Design of Pavement Structures” AASHTO, 1993

SCOPE:

This policy is applicable to all Districts, Divisions, and Offices of the Ohio Department of Transportation.

BACKGROUND AND PURPOSE:

In 1999, ODOT issued policy 515-002(P) which decentralized many of the responsibilities for pavement type selection. While the final selection rested with the Pavement Selection Committee, composed mainly of Central Office executive leadership, nearly all of the preparatory work was performed in the districts. Despite the guidance given in the policy and in the Pavement Design & Rehabilitation Manual, many inconsistencies were noted from district to district and sometimes project to project. Also, the policy did not establish a rigorous review process which may have precipitated errors.

In 2003, concerns about ODOT's pavement selection process were raised by outside entities to the Ohio General Assembly during committee hearings for the transportation budget. Due to these concerns, the following language was inserted in House Bill 87 of the 125th General Assembly:

Section 12 PAVEMENT-SELECTION PROCESS ANALYSIS

The Ohio Department of Transportation shall contract with a neutral third-party entity to conduct an analysis of the Department's pavement-selection process including but not limited to life cycle cost analysis; user delay; constructability and environment factors. The Department of Transportation shall hold the contract with the neutral third party entity, and the contract shall be subject to Controlling Board approval under division (C)(8) of section 5526.01 of the Revised Code. The entity shall be an individual or an academic, research, or professional association with an expertise in pavement-selection decisions and shall not be a research center for concrete or asphalt pavement. The analysis shall compare and contrast the Department's pavement-selection process with those of other states and with model selection processes as described by the American Association of State Highway and Transportation Officials and the Federal Highway Administration.

An advisory council shall be appointed to approve the scope of study and to select the neutral third-party entity. The advisory council shall consist of the following members:

- (1) The director of the Ohio Department of Transportation, who shall act as Chairman of the council;*
- (2) A member of the Ohio Society of Certified Public Accountants;*
- (3) A member of a statewide business organization representing major corporate entities from a list of three names submitted to and appointed by the Speaker of the House of Representatives;*
- (4) A member of the Ohio Society of Professional Engineers;*
- (5) A member of a business organization representing small or independent businesses from a list of three names submitted to and appointed by the President of the Senate;*
- (6) A representative of the Ohio Concrete Construction Association;*
- (7) A representative of Flexible Pavements Association of Ohio, Inc.*

Members of the advisory council representing the Ohio Society of Certified Public Accountants, the Ohio Society of Professional Engineers, the small or independent businesses and the major corporate entities shall have no conflict of interest with the position. For purposes of this section, "conflict of interest" means taking any action that violates any provision of Chapter 102. or 2921. of the Revised Code.

The advisory council shall be appointed no later than July 31, 2003. The council shall select the neutral third party entity and shall determine the scope of the study not later than September 1, 2003. Once appointed, the council shall meet, at a minimum, every thirty days to direct and monitor the work of the neutral third party entity, including responding to any questions raised by the neutral third party entity. The council shall publish a schedule of meetings and provide adequate public notice of these meetings. The meetings are also subject to the applicable public meeting requirements. The council shall allow a comment period of not less than thirty days before issuing its final report. The advisory council shall allow a comment period of not less than 30 days before a final report is issued. The report shall be issued on or before December 31, 2003. Upon issuing its final report, the council shall cease to exist.

The Department shall make changes to its pavement-selection process based on the recommendations included in the third-party entity's report.

The Department shall make the changes to its pavement-selection process based on the recommendations included in the neutral third-party entity's report.

The Pavement Selection Advisory Council, created by HB 87, was presented with and voted to accept the Neutral Third Party's (NTP) report on December 16, 2003. The final report and other

documents can be found on the Pavement Selection Advisory Council website at <http://www.ohiopavementselection.org>. Since the report was issued, ODOT has been implementing the recommendations to bring ODOT into general conformance with the practices of the other states studied. Multiple meetings over the following year with representatives from ODOT and the pavement industries illuminated issues raised by the NTP. Each issue raised was discussed, evaluated, researched, and concluded with a white paper generated by the Office of Pavement Engineering.

The purpose of this policy and related standard procedure is to formalize the pavement selection process currently followed and address the concerns of the outside entities that led to the NTP study.

DEFINITIONS:

Life-cycle cost analysis (LCCA): An economic analysis tool to quantify the differential costs of alternative pavement options by analyzing initial costs and discounted future costs over a defined period of time.

Major rehabilitation: Work performed on a pavement intended to restore structural and functional characteristics.

New Pavement: Pavement built on a new location where no pavement existed before, pavement replacing existing pavement that has been removed, and pavement built next to existing pavement to increase capacity (widening).

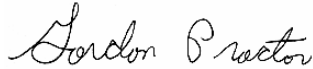
TRAINING:

There is no training mandated for the implementation of this policy. Questions concerning the pavement type selection process may be referred to the Office of Pavement Engineering.

FISCAL ANALYSIS:

It is expected this policy will save the Department money by standardizing the method by which the pavement type is selected for new pavements and major rehabilitations. By consistently analyzing life-cycle costs, the Department can be assured it is selecting the most cost effective pavement type, not only in the near-term but in the long-term as well.

Approved:



Gordon Proctor
Director

Policy Number: 20-007(P)
Effective: October 4, 2006
Responsible Division: Planning
Supersedes Policy: 515-002(P)
Dated: June 10, 1999

PAVEMENT DESIGN POLICY

POLICY STATEMENT:

The Ohio Department of Transportation (ODOT) must design roadway pavements to accommodate the current and predicted traffic needs in a safe, durable, and cost effective manner. This policy establishes the basic design parameters for pavement designs on Interstate, US, and State routes, and other Federal-aid routes.

AUTHORITY:

Ohio Revised Code Sections 5501.02, 5501.03, 5501.11, 5501.14, 5501.31, and 5511.01.

REFERENCES:

Pavement Design & Rehabilitation Manual

SCOPE:

This policy is applicable to all Districts, Divisions, and Offices of ODOT.

POLICY:

All pavements are to be designed in accordance with the Pavement Design & Rehabilitation Manual. The design period for various roadways and rehabilitation types is as follows:

Priority System	
New Pavement	20 years
Major Rehabilitation	20 years
Minor Rehabilitation	12 years
Preventive Maintenance (PM)	N/A (follow PM guidelines)
General System	
New Pavement	20 years
Major Rehabilitation	20 years

Minor Rehabilitation PM	N/A (follow General System guidelines) N/A (follow PM guidelines)
Urban System	
New Pavement	20 years
Major Rehabilitation	20 years
Minor Rehabilitation	N/A (local governing agency decision)
PM	N/A (local governing agency decision)

Other routes not on the priority, general, or urban systems should use the design period for the most similar roadway and rehabilitation type.

DEFINITIONS:

Design Period: The number of years used in traffic loading predictions to design the new or rehabilitated pavement structure.

Functional Characteristics: Those characteristics that affect the highway user but have little effect on the load carrying capacity of the pavement. Ride quality is the predominant functional characteristic. Others include skid resistance and surface oxidation.

Major Rehabilitation: Work performed on a pavement intended to restore structural and functional characteristics.

Minor Rehabilitation: Work performed on a pavement intended to restore functional characteristics and protect structural characteristics.

New Pavement: Pavement built on a new location where no pavement existed before, pavement replacing existing pavement that has been removed, and pavement built next to existing pavement to increase capacity (widening).

Preventive Maintenance (PM): Work performed on a structurally sound pavement, generally in the form of a surface treatment, intended to preserve the pavement, retard future deterioration, and maintain or improve the functional characteristics without substantially increasing the structural capacity.

Structural Characteristics: Those characteristics related to the load-carrying capacity of the pavement.

Policy Number: 20-007(P)
Effective: October 4, 2006
Page 3 of 3

TRAINING:

There is no training mandated for the implementation of this policy. Questions concerning pavement design may be referred to the Office of Pavement Engineering.

FISCAL ANALYSIS:

Pavements represent one of the largest investments in ODOT. As such, this policy has a major impact on the department. However, this policy does not change most current practices and therefore is not expected to have significant fiscal impact. Consistent design procedures throughout ODOT will lead to more consistent performance and improved budgeting.

Approved:

Standard Procedure No.: 520-001(SP)
Effective: September 1, 2006
Responsible Office: Pavement Engineering



Howard P. Wood
Deputy Director
Division of Planning

PAVEMENT TYPE SELECTION STANDARD PROCEDURE

PROCEDURAL STATEMENT:

This document details the procedure used by the Ohio Department of Transportation (ODOT) to select pavement in accordance with the Pavement Type Selection Policy 20-006(P). The procedures contained herein are the result of the Pavement Selection Advisory Council Final Report by the Neutral Third Party (NTP) and the facilitated meetings between ODOT and paving industry association representatives that followed.

This procedure provides a data-driven, objective, transparent, and repeatable process to determine pavement type for major projects and largely conforms to the pavement type selection processes of the majority states included in the NTP study.

AUTHORITY:

Ohio Revised Code Sections 5501.02, 5501.03, 5501.11, 5501.14, 5501.31, and 5511.01.

REFERENCES:

Policy 20-006(P)
Final Report, Neutral Third Party Ohio Pavement Selection Process Analysis prepared for
ODOT Pavement Selection Advisory Council, December 12, 2003
Pavement Design & Rehabilitation Manual
Project Development Process Manual

SCOPE:

This procedure is applicable to all Districts, Divisions, and Offices of the Ohio Department of Transportation.

DEFINITIONS:

Analysis Period: The number of years included in a Life-Cycle Cost Analysis.

Differential Costs: Costs which can be reasonably calculated, based on the information available at the time, that are different between the various alternatives in a life-cycle cost analysis.

Life-Cycle Cost Analysis (LCCA): An economic analysis tool to quantify the differential costs of alternative pavement options by analyzing initial costs and discounted future costs over a defined period of time.

PROCEDURE:

I. PAVEMENT ALTERNATIVE DETERMINATION

- A. At the outset of a project, “all” potential pavement types are considered. For pavement to be built on a new location, this includes both rigid and flexible pavement and may include composite pavement if there is a local or district preference to do so. For rehabilitation/replacement of an existing pavement, the alternatives initially considered depend in part on the existing pavement type. Potential pavement alternatives include: new flexible pavement, new rigid pavement, rubblize and roll, unbonded concrete overlay, crack and seat, and whitetopping.
- B. After the potential alternatives are identified, an engineering review and analysis of principal selection factors is conducted to determine the feasible alternatives. Below is a list of principal factors most often considered in the engineering review, however, other factors may be considered at any time. If only one pavement alternative is determined to be feasible, that alternative is automatically selected and an LCCA is not performed.

Principal Factors:

1. **Geotechnical Concerns** - The subgrade conditions may preclude the use of some alternatives.
2. **Amount of Replacement** - The amount of replacement required due to bridges, soil conditions, re-alignment, etc., may become so large as to make it preferable to replace the entire pavement.
3. **Amount of New Pavement** - On projects with lane additions or other widening, the amount of new pavement to be built may become so large as to make it preferable to replace the entire pavement.

4. **Research** - ODOT may wish to perform research on a specific pavement type or treatment including new innovations.
5. **Maintenance of Traffic** - The ability to maintain safe access for the traveling public, according to ODOT policies, may preclude the use of some alternatives.
6. **Adjacent Existing Sections** - When filling in a gap between two similar pavement types, it may be preferable to continue a similar pavement type rather than change from one, to another, then back to the first.
7. **Municipal Preference** - Local government agencies may have a preference for a particular pavement, particularly where they are the maintaining agency.

II. LIFE-CYCLE COST ANALYSIS

- A. When more than one feasible alternative exists, an LCCA is prepared. The analysis period is 35 years. Future maintenance work is determined in accordance with the Pavement Design & Rehabilitation Manual.
- B. The unit prices used in the LCCA are provided by the Office of Estimating. Because the unit prices for the concrete pavement and asphalt pavement used in the initial construction have a significant impact on the LCCA, a data-driven, objective, transparent and repeatable process is used to determine warranty concrete and warranty asphalt prices. The concrete and asphalt prices are updated quarterly.
 1. All the criteria to determine if a unit price data point is to be included are based on individual project reference numbers. Projects with funding splits or a part 1 and a part 2, may have the same item with two or more reference numbers. Reference numbers are not combined at any point in the process. Data to be included is as follows:
 - a) For asphalt pavement, only 7-year warranty asphalt will be included (currently Item 880);
 - b) For concrete pavement, 7-year warranty concrete as well as non-warranty, non-reinforced concrete will be included. This includes but is not limited to Items 452, 884, 888, and 896;
 - c) The minimum time period for both pavements is 2 years;
 - d) It is desired to have a minimum of 15 data points for both pavements;

- e) If there are fewer than 15 data points in 2 years for either pavement, the time period will be expanded by quarter, up to 4 years maximum, until the 15 minimum is met or exceeded;
 - f) The maximum time period for both pavements is 4 years, even if this results in less than 15 data points;
 - g) Between 2 and 4 years, all the projects in the quarter that contains the 15th data point will be included which may result in excess of 15 data points;
 - h) For both pavements, the unit prices used in the analysis will be the average of the “low 3” bidders. “Low 3” are the three responsive and responsible bidders with lowest total bids, typically the awarded bidder and the next two bidders;
 - i) The minimum quantity for asphalt is 15,000 cubic yards; and
 - j) The minimum quantity for concrete is 50,000 square yards.
2. Once the asphalt data is identified, it is placed in a spreadsheet, graphed showing quantity vs. unit price, and a power curve trendline is generated. The equation of the trendline is used to determine the unit price for quantities in the LCCA.
 3. Once the concrete data is identified, all the unit prices of the various thicknesses are adjusted to a unit price for a normalized thickness. The adjustment method is a straight ratio of the normalized thickness divided by the actual thickness, multiplied by the unit price of the actual thickness. The normalized prices are graphed vs. square yard quantity and a power curve trendline is generated. The equation of the trendline is used to determine the normalized unit price for the quantities in the LCCA. The normalized price is then adjusted to the desired thickness, again using a straight ratio.
 4. If there is more than one thickness of concrete for a single alternative, the unit price is calculated using the actual quantity for all thicknesses with quantities 50,000 square yards and greater. For alternatives with thicknesses at quantities both greater than and less than 50,000 square yards, the smallest quantity greater than 50,000 square yards is used to determine the unit price for the thicknesses of quantities less than 50,000 square yards. For an alternative with all thicknesses at quantities less than 50,000 square yards, the largest quantity is used to calculate the price for all thicknesses.

5. All data points are manually filtered for applicability prior to inclusion. Non-applicable data includes ramp pavement when the mainline pavement is of a different type, even if the ramp pavement exceeds the quantity threshold.
- C. The completed, draft pavement selection package is sent to the district for review. At the same time, it is sent to representatives of the paving industries for their review. The purpose of the review is to identify any errors and provide comments when applicable. The Office of Pavement Engineering corrects any errors and submits the comments with the final pavement selection package to the Pavement Selection Committee. If corrections to the draft LCCA switch any alternative(s) from outside the 10 percent range, discussed below, to within 10 percent, the pavement selection package is redistributed to all parties for comment on the Secondary Factors.

III. FINAL PAVEMENT SELECTION

- A. Alternatives not within 10 percent of the life-cycle cost of the lowest cost alternative are eliminated from consideration. If no alternatives are within 10 percent, the lowest cost alternative is automatically selected.
- B. If the life-cycle cost of one or more alternatives is within 10 percent of the lowest cost alternative, the life-cycle cost is considered equal for all alternatives within the 10 percent range and the pavement selection is based on Secondary Factors. The Secondary Factors are listed below. A worksheet used to evaluate the Secondary Factors and a definition of each factor is included in Appendix 1.
 1. Transverse Uniformity of Cross-Section
 2. Longitudinal Uniformity of Cross-Section
 3. Drainage
 4. Recycleability/Re-useability
 5. Risk of Design
 6. Risk of Construction/Constructability
 7. Availability of Local Materials
 8. Stop and Go Trucks

9. User Delay Days
10. Noise
11. Stimulation of Competition
12. District/Local Concerns
13. Other Factors

IV. RECONSIDERATION OF PAVEMENT SELECTIONS

ODOT reserves the right to reconsider pavement selections at any time, however, it is not standard practice to do so. Minor errors and omissions are generally not cause for reconsideration. Changes to the process, such as the design procedures or the unit price determination, are generally not cause for reconsideration either. Significant changes in the project scope or schedule may be causes for reconsideration. Reconsideration of a pavement selection must be weighed against any increased cost and/or time delay required to make plan changes and therefore may not follow this standard procedure in its entirety.

TRAINING:

There is no training mandated for the implementation of this standard procedure. Questions concerning the pavement type selection process may be referred to the Office of Pavement Engineering.

FISCAL ANALYSIS:

It is expected this procedure will save the Department money by standardizing the method by which the pavement type is selected for new pavements and major rehabilitations. By consistently analyzing life-cycle costs, the Department can be assured it is selecting the most cost effective pavement type, not only in the near-term but in the long-term as well.

SECONDARY FACTORS WORKSHEET*

Project:		Selection Date:		PID No.:	
Length: miles		Sale Date:		Program Amount: \$	
	Flexible	Rigid	R/R	UBCO	Other
LCCA					
% Difference From Lowest					
Instructions: If LCCAs are > 10% of lowest, Stop , and select the lowest LCCA. Else, proceed with the LCCA alternatives that are within 10% of the lowest, and the Secondary Considerations that apply to each alternative.					

Secondary Considerations **

Secondary Factors	Significance (High, Med, Low, None)	Narrative (Project Specific Summaries)				
		Flexible	Rigid	R/R	UBCO	Other
Transverse Uniformity of Cross-Section						
Longitudinal Uniformity of Cross-Section						
Drainage						
Recycleability / Re-usability						
Risk of Design						
Risk of Construction / Constructability						
Availability of Local Material						
Stop and Go Trucks						
User Delay Days						
Noise						
Stimulation of Competition						
District/ Local Concerns						
Other Factors						
Pavement Type Selection: _____						

* To be used ONLY if the LCCAs are within 10%.

** If Secondary Considerations do not delineate a clear pavement alternative, the alternative the lowest Initial Cost will be selected.

Secondary Factors

Definitions:

1. **Transverse Uniformity of Cross-Section** refers to variations in the typical section across the width of the roadway. Non-uniform typical sections can result in differential pavement performance and condition across the width of the roadway. Consistent performance across the width of the roadway is preferred. The preferred uniformity is applicable to driving lanes only and not existing shoulders that will remain shoulders. Designs with uniform cross-section across the width of the roadway are preferred. Rubblize designs with near-uniform cross-section across the width of the roadway have a secondary preference.
2. **Longitudinal Uniformity of Cross-Section** refers to variations in the typical section along the length of the roadway and accounts for the possibility of differential performance, similar to Transverse Uniformity of Cross Section. Where the amount of replacement is very low, any differential performance would either affect nearly the entire pavement, or could be easily corrected with spot repairs. As the amount of replacement grows larger, the problems presented by any differential performance grow larger. At some point determining whether to treat the entire pavement or a significant portion thereof may be difficult and at least creates a higher level of uncertainty or risk. Therefore, designs with uniform cross-section along the length of the roadway are preferred.
3. **Drainage** is an important part of any pavement structure. A new pavement allows full access to properly locate and construct the drainage system. When the existing pavement is rehabilitated in place, construction of the drainage system may be more difficult and can undermine the existing pavement if the underdrain trench collapses. Also, the preferred location of the underdrains may have to be adjusted due to the presence of the existing pavement. Designs with new pavement and thus new drainage are preferred.
4. **Recycleability/Re-useability** accounts for the future opportunity to recycle and/or reuse the paving materials used in the initial construction. All paving materials have some ability to be reused or recycled but unbonded concrete overlays, due to the thickness of the pavement section and the “sandwich” effect of concrete-asphalt-concrete, have significantly less potential for recycle-ability. All new pavement and rubblize designs are determined to have greater recycle-ability on whole.
5. **Risk of Design** quantifies the accuracy of the design model and the likelihood of success. New pavements are designed according to AASHTO and have the highest level of accuracy. New pavement presents the greatest likelihood of success due to the opportunity to address all design and construction issues unhindered by constraints of the existing conditions, materials, etc. Rehabilitation designs, such as rubblize and unbonded

concrete overlays, all depend, to one extent or another, on the existing pavement, subgrade, etc. Also, the design model for unbonded concrete overlays depends on the ODOT-developed Dynaflect procedure and an equation from the Army Corps of Engineers and does not have the same level of accuracy as the AASHTO models. Thus, new pavement alternatives are preferred, and rubblize designs have a secondary preference.

6. **Risk of Construction/Constructability** – Risk of Construction accounts for the potential construction difficulties associated with each alternative. Constructability accounts for all other site conditions that may provide an advantage or disadvantage to some alternatives.
7. **Availability of Local Materials** accounts for the parts of the state where quality aggregates are not locally available.
8. **Stop and Go Trucks** cause the highest possibility of rutting and shoving in asphalt. While there are asphalt mixes that may reduce the chances of rutting and these may be included in the analysis, the chance of rutting is always higher with asphalt than concrete. For projects with heavy trucks operating under stop and go conditions, concrete designs are preferred. Ramps are not included in this definition, and neither would a ten-mile project with a single stop condition be included.
9. **User Delay Days** is a comparison of the theoretical time to construct and maintain each alternative based on predetermined production rates. It is not a measure of the actual time needed to construct each alternative as many factors exist which are not considered. Particularly for the initial construction, the pavement may not be the controlling factor.
10. **Noise** has a significant impact on quality of life and can be costly to mitigate after the fact. ODOT has committed to study noise issues and implement valid results. Until such time as we have identified methods to quiet concrete pavements, designs in urban and suburban areas with asphalt surfaces are preferred.
11. **Stimulation of Competition** - ODOT believes that two healthy pavement industries benefit the Ohio taxpayers. As used herein a “monopoly” would constitute one pavement type completely dominating pavement selections. ODOT desires to avoid this type of monopoly situation and believes improvement in products and methods is encouraged through healthy competition among industries involved in the production of paving materials. Where it is felt a near-monopoly situation exists and competition is needed, one paving material will receive a preference over the near-monopoly paving material. ODOT will evaluate each situation on its own merits and consider past pavement selections both locally and on a state-wide basis when determining the potential of a monopoly situation.

12. **District/Local Concerns** accounts for any other concerns of the ODOT District Office or the local municipality, when applicable, as to the use of a pavement type. These concerns should not duplicate other factors already listed.
13. **Other Factors** – Factors, not included above, that are currently unforeseen and/or project specific.

Pavement types and/or rehabilitation methods not detailed here will be considered on a case-by-case basis.