Recommendation #2f—Develop User Delay Costs Procedure

Four of the highway agencies that were interviewed are using (and three are developing) user delay models to include in their LCCA. It is recommended that ODOT undertake a research project develop a user delay cost procedure for incorporation in its LCCA. Since this research may take several years, in the interim, it is recommended that the current ODOT method of determining user delay days be used as a secondary factor in the pavement selection process.

As indicated in FHWA's Interim Technical Bulletin on LCCA [2] the decision to include or exclude user costs can significantly affect LCCA results. They describe several approaches for considering user costs, including consideration of the combined agency and user costs, as well as the separate evaluation of user costs. Development work for the user cost element of the LCCA process should include a state-of-the-art review of the various State practices for incorporation of these costs into the analysis process.

Implementation—This is a long-term effort expected to take 1 to 3 years for full implementation.

Benefit—Including user delay costs in the LCCA ensures that the impact on the highway user is considered during the pavement design process. With the advent of techniques such as just-in-time delivery, even minor impacts on traffic flow can have an adverse impact on the local economy.

Recommendation #3—Implement Alternative Bidding Trial Projects

Because of the issues raised relative to the lack of reliable unit costs for PCC pavements, we recommend that ODOT utilize FHWA Special Experimental Project 14 (SEP-14), Innovative Contracting Practices, to let (sell) a number of alternative pavement bidding projects over the next 2 years. It is recommended that 5 to 10 projects involving new or reconstructed pavements be selected for this effort. Projects selected should be those for which there are no significant engineering reasons for selecting a specific pavement type and the estimated life cycle costs, show a difference of less than 10 percent. Projects selected should be on Interstate routes or non-Interstate routes with greater than 35 million rigid ESAL's for the 20-year design period or average daily traffic (ADT) greater than 30,000 vehicles/day, based on the most recent Traffic Survey Report and be approximately 5 centerline miles or greater in length.

At least five States have utilized alternative pavement type bidding under SEP-14. Its use is recommended for Ohio as a means of addressing issues raised regarding the development of initial cost estimates in the life cycle cost analysis. Michigan, Missouri, and Louisiana have used the process on a number of projects and have documentation on specifications and procedures followed. The Province of Ontario is also using the alternative bid process. ODOT should consult with these highway agencies to assist in establishing the most appropriate alternative bid process for Ohio. The typical approach followed by each of the agencies is to develop a life cycle adjustment factor for each of the pavement alternatives to be bid. The life cycle adjustment factor is a fixed-dollar amount added to each bid and is based on the agencies' estimate of the net present value of future rehabilitation work to be performed over the analysis period for each alternative. Since a certain amount of consensus with industry will be required to accomplish this, facilitated meetings are recommended.

Because of the increased engineering costs involved in developing plans for alternative bidding and the ongoing controversy that will arise in applying future costs to the contract bids, the NTP is not recommending that the use of alternative bid be adopted as a routine practice or extend beyond a maximum of 10 projects.

Implementation—This recommendation is expected to be accomplished during calendar years 2004 and 2005.

Benefit—This recommendation will go a long way toward improving the cost competitiveness of the two pavement types in Ohio. Alternative bidding provides a means of insuring that Ohio gets the most cost-effective pavement on major projects. It will also address the issue of appropriate initial costs for use in LCCA.

Recommendation #4—Address Pavement-Tire Noise Issues

ODOT should undertake a review to determine which noise mitigation techniques will ensure that future pavements provide suitable noise levels to adjacent property owners and motorists. Further, test sections should be constructed to verify the suitability of the techniques.

Pavement-tire noise is an issue that ODOT should address. Based on experience in other highway agencies, the concerns raised by a number of citizens in Ohio are real. There are four methods currently being used by agencies to address pavement-tire noise. They are as follows:

- Overlaying with open-graded HMA.
- Performing longitudinal tining of the PCC surface.
- Using the random transverse spacing developed in Australia.
- Using a random-spaced tining pattern developed in Wisconsin.

According to the FHWA, there has been good success with the first three techniques and varied success with the Wisconsin random tining concept. Good results with the longitudinal tining concept have been reported by California, Michigan, Kansas, and Colorado. The tining spacing and size is critical in reducing noise on PCC-surfaced pavements. Diamond grinding has also been shown to reduce the tire pavement noise levels on existing pavements. FHWA is currently developing a Technical Advisory on this subject and may be able to provide additional guidance.

Implementation—The full study is expected to take approximately 2 years. In the interim, the most promising techniques, based on FHWA recommendations should be incorporated into noise sensitive projects.

Benefit—There are techniques available to address the pavement-tire noise issue at little or no additional first cost. Addressing the pavement-tire noise issue after the fact can lead to large expenditures by the highway agency to mitigate the problem.

Miscellaneous Issues

Table 6 contains a listing of a number issues raised by the industries during our review. The types of issues raised are of the type that we would normally expect States and industry to resolve in a fairly routine basis through effective communication. We have provided a recommendation for each item; however, we believe further communication between ODOT and the affected industry would be appropriate.

Table 6. Issues that should be resolved by ODOT and Industry on a routine basis.

Issue	Recommendation
1. Warranty asphalt unit price tables should be based on a trend line of average price. The price for warranty asphalt for quantities greater than 100,000 cubic yards does not agree with the source data that ODOT used to develop the tables.	It is recommended that the asphalt unit price tables should be based on a trend line of average prices and the apparent discrepancy for quantities greater than 100,000 cubic yards be resolved.
2. Flexible reconstruction projects should be treated the same as rigid pavement reconstruction projects in terms of construction traffic management (i.e., if traffic is diverted to one side for rigid pavements, it should be the same for flexible pavements).	Limited Concurrence. The evaluation of traffic management plans was felt to be outside the scope of the NTP's review. However, this is an area of continued disagreement and therefore, the NTP recommends that ODOT establish procedures for evaluating each flexible reconstruction project and determining the most advantageous traffic management plan from the standpoint of construction operations and user safety and convenience.
3. Suggest that Step 4 of the pavement selection process be modified to evaluate other factors such as bridge construction that could be the primary factor influencing traffic disruption.	We concur.
4. Revise layer coefficients Surface and intermediate layers -increase from 0.35 to 0.45. Bituminous base from 0.35 to 0.37 (these revisions would reduce the required layer thicknesses and, therefore, cost).	Layer coefficients should be increased in accordance with the study recently completed for ODOT by the University of Toledo and an AASHTO Bulletin Board survey. The increase is supported with data, generally conforms to the 1993 AASHTO Guide, and follows practices of other States.
5. Recycled asphalt ODOT should review the current limitations on use based on a study done for the ODOT completed by CTL Engineering.	We do not concur. While many States may appear more liberal, most require recycled mixes to meet the same specification as virgin mixes for surface courses on high volume routes. This is an area where further discussion between ODOT and industry appears warranted.

Table 6. Issues that should be resolved by ODOT and Industry on a routine basis (continued).

Issue	Recommendation
6. Break and seat ODOT should allow the use of break and seat rehabilitation based on a study completed by the University of Cincinnati.	Recommend further study. Break and seat has very limited use. This item is not in the scope of work of the NTP study.
7. The relationship used to convert CBR to resilient modulus may not be appropriate for use in Ohio.	We do not concur. The current method used to convert CBR to resilient modulus is within the range recommended in the AASHTO 93 Design Guide.
8. The improvement in the CBR value due to soils stabilization is questionable.	We do not concur. No data were presented that indicated that the long-term durability of soils stabilization is a problem in Ohio. The State indicates they currently do not increase CBR when soil stabilization is performed.
9. Since both pavement types are constructed to the same ride quality specifications, the same initial serviceability level should be used for both pavement types.	We do not concur. ODOT's selection of initial serviceability is based on measurement of completed pavement sections. We recommend that ODOT develop a process for continually monitoring the ride of newly constructed pavements and update the initial serviceability value annually based on this process.
10. Pavement type selection should be revisited if the projects have been delayed for any significant time, as the traffic data may be out of date.	We do not concur. It would be prudent to verify the pavement designs for substantial differences in traffic expected from the original design values. Generally, time constraints and designs costs would preclude repeating the pavement type selection.
11. The asphalt price adjustment provides an unfair advantage to the HMA.	NTP makes no recommendation on this issue. The current stability of asphalt prices makes this a minor issue at this time. Asphalt prices adjustments are used by half of the highway agencies interviewed.
12. PCC should be considered recyclable.	ODOT specifications relative to the use of recycled concrete generally conform to the practices of the States reviewed. FHWA is currently reviewing the use of PCC materials and may provide further guidance on this issue.
13. Method of payment for HMA and PCC should be the same (i.e., by the square yard for a specified thickness). Currently, HMA is paid by the cubic yard not to exceed planned quantity. PCC is currently paid by the square yard with a penalty for thickness less than the plan thickness, which results in PCC contractors increasing the quantity of concrete placed to ensure that they are not penalized for low thickness.	We do not concur. The method of payment used by ODOT is in general conformance with that used by other highway agencies.

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Appendix A

"Pavement Selection the ODOT Way"

The ODOT Way Pavement Selection Scoring System

Draft 4/17/03

Scoring Category	Wt.	Imp.	Rel	Spread Factors						Available Points
Life-Cycle Cost Initial Cost	40	8	5	Spread Points	0-3% 1	3.01-6% 0.8	6.01-10% 0.5	10.01-15% 0.3	>15% 0	1600
Future Maint. Cost	25	8	2	Spread Points	0-10% 1	10.01-20% 0.8	20.01-30% 0.5	30.01-40% 0.3	>40% 0	400
User Delay Initial Construction	30	3	3	Spread Points	0-25% 1	25.01-50% 0.8	50.01-75% 0.5	75.01-100% 0.3	>100% 0	270
Future Maintenance	30	6	2	Spread Points	0-25% 1	25.01-50% 0.8	50.01-75% 0.5	75.01-100% 0.3	>100% 0	360
Constructability Subgrade	20	7	3	Unbonded Concrete Overlay and Whitetopping = 1.0 New pavement and pavement replacement, all types = 0.7 Rubblize and Roll, and Crack and Seat = 0.6						420
Drainage	20	2	4	New pavement and pavement replacement, all types = 1.0 Unbonded Concrete Overlay, Whitetopping, Rubblize and Roll, and Crack and Seat 0.8						160
Uniformity of X-section	20	6	5	If no widening: All alternatives = 1.0 If widening (permanent lane addition): New pavement and pavement replacement, all types = 1.0 Rubblize and Roll = 0.8 Unbonded Concrete Overlay, Whitetopping, and Crack and Seat 0.6						600
Maintenance of Traffic	20	7	3	Alternatives with an advantage = 1.0 Alternatives with a disadvantage = 0.5 When no alternative has any advantage, all alternatives						420
Environment Recycle-ability	10	3	4	New Flexible and Flexible Replacement = 1.0 Rubblize and Roll = 0.9 Crack and Seat = 0.8 New Rigid, Rigid Replacement, and Whitetopping = 0.7 Unbonded Concrete Overlay = 0.3						120
Ride	10	5	3	All asphalt alternatives = 1.0 JAll concrete alternatives = 0.7						150

Wt. = Weight   Imp. = Importance   Rel. = Reliability   Total possible points = 4500

Pavement Selection the ODOT Way

4-17-03

The Purpose of Pavement Selection

The Pavement Selection Committee (PSC) is charged with selecting pavement type for new pavements and major rehabilitations. This authority is granted by the Pavement Design and Selection Process (Policy 515-002(P)). The selection of pavement type is not a simple one as the competing products both have advantages and disadvantages and both can provide excellent service for many years. This document describes the process the Ohio Department of Transportation (ODOT) uses to select pavement type.

There are many factors to be considered when selecting pavement type. Some factors relate to all projects, others may be project specific or may have varying importance on a project by project basis. Weighing the various factors requires a documented process for open, informed decision making. While any pavement type may be acceptable, this process provides fact-based reasoning for the pavement type selection.

Changes in the Pavement Selection Process

Several changes in the pavement selection process have been instituted to improve the process, provide more consistency, provide better documentation, and result in more fact-based decisions. Significant changes are as follows:

- Life-cycle cost analysis (LCCA) performed by Office of Pavement Engineering (OPE);
- Unit prices determined by Office of Estimating (OoE);
- Added engineering and administrative costs on future maintenance projects;
- Added maintenance of traffic costs on future maintenance projects;
- Included industry involvement prior to the final selection;
- Eliminated Discount Rate Sensitivity Analysis in favor of a single discount rate provided annually by the federal Office of Management and Budget; and
- Developed scoring system to select one alternative.

The New Pavement Selection Process

The new process provides a holistic approach to pavement type selection. This process depends on open and honest communication among various ODOT Divisions and Offices. To improve consistency, most of the work is performed by OPE. Increased attention to subgrade conditions is achieved by early involvement of the Office of Geotechnical Engineering (OGE) in the design process. The process includes industry involvement to allow time to identify any project specific concerns prior to the final decision.

In short, the process works as follows: the Office of Systems Analysis Planning (OSAP) identifies the projects, OGE provides subgrade recommendations, OPE designs the alternatives and prepares the LCCA and pavement selection package, OoE provides unit prices, District develops conceptual maintenance of traffic, OPE scores the alternatives and informs District and industries, and the PSC selects the approved alternative. The actual selection of the alternatives is based on a scoring system which encompasses many factors including construction and maintenance costs, user impact, constructability issues, and environmental factors.

Pavement Selection Steps

1. OSAP identifies projects as potential major rehabilitation candidates. Also, new pavement alignments identified.

2. OPE organizes a meeting with the District, Priority System Manager, and OGE to determine the critical path time line, date for delivery of soils recommendation and other issues as needed.

3. OPE schedules and performs Dynaflect testing and coring, and researches the pavement history.

4. OPE performs field review with the District and Priority System Manager to discuss potential alternatives, determine which alternatives are feasible, review the existing conditions, and determine the preliminary scope. At this time it may be determined that some projects do not require major rehabilitation and they will become minor rehabilitation.

5. Upon receipt of the soils recommendation, OPE designs the rehabilitation alternatives.

6. OPE calculates LCCA quantities and initial and future user delay. Alternatives such as rubblize or unbonded concrete overlay that require more than 40% removal and replacement due to bridge clearances, etc., will be eliminated from the analysis. The 40% figure was selected by the PSC as the amount beyond which alternatives will not be considered. Below that amount, economics and the scoring system will judge the worthiness of the alternative.

7. OoE provides unit prices. District provides documentation of any maintenance of traffic differences.

8. OPE calculates LCCA, prepares selection package and score, and distributes to District and industries.

9. OPE corrects any errors, submits LCCA package and scoring, and any District or industry comments to PSC.

10. PSC meets and selects the approved alternative. Pavement Selection the ODOT Way - 4-17-03 Page 3 of 10

11. OPE notifies District, FHWA, and industry of the approved alternative and maintains a file of the selection documents.

Roles and Responsibilities

OPE Coordinate with OSAP

Coordinate with District

Coordinate with OGE

Perform Dynaflect testing

Perform coring

Research pavement history and determine the existing buildup

Perform traffic loading predictions

Design pavement alternatives

Calculate LCCA initial construction quantities for all alternatives

Select future maintenance schedule for all alternatives

Calculate LCCA future maintenance quantities for all alternatives

Perform LCCA calculations

Calculate initial and future lane closure days

Score the alternatives

OSAP Supply list of potential major rehabilitation candidate projects

Revise list based on feedback or changes from OPE and District

OGE Coordinate with OPE

Coordinate with District

Perform subgrade investigation

Analyze subsurface investigation

Provide subgrade CBR recommendation

Provide stabilization and undercut recommendations

Determine feasibility of alternatives based on subgrade conditions

OoE Determine unit prices for all items

District Coordinate with OPE

Coordinate with OGE

Supply OPE with needed information

Develop conceptual maintenance of traffic for each alternative and define advantages or disadvantages to each

PSC Review the pavement selection scoring

Select approved alternative

Unit Price Determination

Unit prices will be estimated by the Office of Estimating in accordance with their business rules.

Future Maintenance Schedules

The new process has defined future maintenance schedules for the different pavement types. There are both advantages and disadvantages to this approach. The main advantage is that this removes another variable and a potential area for conflict. The disadvantages are that it does not account for local differences in performance and the schedules may not always be revised quickly to respond to changes in performance, materials, etc.

The schedules are divided by traffic levels. Interstate and other high traffic routes receive more maintenance than low traffic routes. On all future maintenance, once the pavement costs are calculated, they will be increased by an additional 7% to account for the Department's engineering and administrative costs. Also, the pavement costs will be increased by 10% to account for maintenance of traffic costs. The future maintenance schedules are as follows:

I. Interstates (all), Non-interstate routes with greater than 35 million rigid ESAL's in the 20- year design period **or** greater than 30,000 ADT in the most recent Traffic Survey Report from the Office of Technical Services.

A. Flexible, Rubblize, and Crack and Seat Pavements:

1. Year 12: 1.5" overlay with planing (full width of mainline and shoulders);

2. Year 22: 3.25" overlay with planing (full width of mainline and shoulders) and with 1% patching planed surface (percent of planed area); and

3. Year 34: 1.5" overlay with planing (full width of mainline and shoulders).

B. Rigid, Unbonded Concrete Overlay and Whitetopping Pavements:

1. Year 22: Diamond grinding (mainline plus one foot of shoulder), full depth repair 4% of mainline surface area; and

2. Year 32: 3.25" asphalt overlay, full depth repair 2% of mainline surface area.

II. Non-interstate routes with less than 35 million rigid ESAL's in the 20-year design period **and** less than 30,000 ADT in the most recent Traffic Survey Report from the Office of Technical Services.

A. Flexible, Rubblize, and Crack and Seat Pavements:

1. Year 14: 1.5" overlay with planing (mainline only); and

2. Year 25: 3.25" overlay with planing (full width of mainline and shoulders) and with 1% patching planed surface (percent of planed area).

B. Rigid, Unbonded Concrete Overlay and Whitetopping Pavements:

1. Year 25: Diamond grinding (mainline plus one foot of shoulder) and full depth repair 4% of mainline surface area.

Pavement Selection Scoring System

A scoring system was developed to weigh and combine all the factors important to pavement type selection. This approach is expected to provide for a more criteria-based pavement type selection.

The scoring system includes many factors. The four major categories are: Cost, User Delay, Constructability, and Environment. A weighting factor is applied to each of the scoring items to differentiate them from one another. This allows the importance factor, discussed later, to be judged independent of how it affects the final score. Initial Construction Cost receives a weight of 40, Future Maintenance Cost receives a weight of 25, all User Delay items receives a weight of 30, all Constructability items receives a weight of 20, and all Environment items receives a weight of 10. The four major categories are further broken down into individual sub-categories where the actual scores are applied.

There are four parts to the score for each factor. Part one is the weighting factor, 40, 25, 30, etc., discussed above. The second part is an importance factor. The importance factor is the relative importance of the item to ODOT. It is to be expected that other entities would assign different levels of importance but as the pavement selection decision belongs to ODOT, so does determining the importance factors. Importance factors vary between one and ten. The third part is a reliability factor. The reliability factor is the accuracy of or confidence in the data. For example, initial cost data is well established and has a high reliability factor but since future maintenance of traffic techniques are unknown, the reliability of future user delay is low. Reliability factors vary between one and five. The final part is a spread factor. The spread factor accounts for the differences between the alternatives. Spread factors vary between 0 and 1.0 depending on the difference between the alternatives. All of the factors, their weight, importance, and reliability are given below. Spread factors are detailed later.

1.. Cost

a. Initial Construction, Weight = 40, Importance (I) = 8, Reliability (R) = 5
b. Future Maintenance, Weight = 25, I = 8, R = 2

2. User Delay (Weight = 30)

a. Initial Construction, I = 3*, R = 3
b. Future Maintenance, I = 6, R = 2

3. Constructability (Weight = 20)

a. Subgrade, I = 7, R = 3
b. Drainage Concerns, I = 2, R = 4
c. Uniformity of Cross-Section, I = 6, R = 5
d. Maintenance of Traffic, I = 7, R = 3

4. Environment (Weight = 10)

a. Recycle-ability, I = 3, R = 4
b. Ride, I = 5, R = 3

* User Delay - Initial Construction is given a low importance rating because it is expected that the same number of lanes as currently exist will be maintained during the initial construction in accordance with ODOT policy 516-003(P). Since the number of lanes is not reduced, the importance is judged to be low.

Definitions

1.a. Cost - Initial Construction

Cost of initial construction for each alternative. Initial construction cost is not affected by discount rate. Lower initial cost is preferable.

1.b. Cost - Future Maintenance

Total cost to maintain the pavement for the entire 35-year analysis period, using the real discount rate for 30-year or greater programs published in the current revision of Circular A-94, Appendix C from the federal Office of Management and Budget. Lower future maintenance cost is preferable.

2.a. User Delay - Initial Construction

Time in lane closure days to complete initial construction of the pavement items. Less time is preferable, however, time to construct the pavement may not be the controlling factor. This factor will not be used for pavements built in new locations or when it is determined that bridge or other work is the controlling factor.

2.b. User Delay - Future Maintenance

Time in lane closure days to complete all of the future maintenance activities. Less time is preferable.

3.a. Constructability - Subgrade

Potential risk due to unanticipated subgrade problems during initial construction. Higher risk could result in higher costs for initial construction due to change orders or could result in reduced performance if problems are not identified and corrected. Various alternatives and their level of risk are as follows:

Unbonded Concrete Overlay No risk

Whitetopping No risk

Rubblize and Roll High risk

New Flexible Pavement Medium to high risk

New Concrete Pavement Medium to high risk

New Composite Pavement Medium to high risk

Lower risk is preferable.

3.b. Constructability - Drainage Concerns

This relates to the ability to provide drainage. When the existing pavement is removed, a new drainage system can be properly located and easily installed. If the existing pavement is left in place, retrofitting new underdrains or replacing outlets of the existing drains is more difficult, may not be properly located, can undermine the existing pavement if the underdrain trench collapses, and may not provide the same level of drainage a new system would. New drainage is preferable to retrofitting.

3.c. Constructability - Uniformity of Cross-Section

Alternatives that do not include removing the existing pavement usually result in a large elevation increase and may require pavement removal and undercutting to lower the elevation at bridges. The result is non-uniform typical section along the length of the project. Also, if a new lane is being added, there will be non-uniformity across the width unless the existing pavement is removed. Non-uniform sections can result in differential performance. The entire pavement may have to be treated because a part of it is distressed. Uniformity across the length and width of the project is preferable.

3.d. Constructability - Maintenance of Traffic

This relates to the cost and ability to maintain traffic during the initial construction. District must develop a conceptual maintenance of traffic plan for each alternative and define the differences between alternatives. Alternatives with cheaper and/or easier maintenance of traffic are preferable.

4.a. Environment - Recycle-ability

This concerns the future recycle-ability of the pavement to be constructed. There are environmental and performance concerns with using recycled concrete in many applications. Disposal of old concrete may be expensive if no locations exist within the right of way to bury it. Recycled asphalt has none of these concerns when used according to the specifications. The ability to recycle is preferable.

4.b. Environment - Ride

A smooth ride is one of the most noticeable and important factors affecting the traveling public. Pavements built smoother initially tend to maintain smoothness longer. Smoother pavement is preferable.

Spread Factor

The spread factor accounts for the differences between the alternatives. Spread factors vary between 0 and 1.0 depending on the difference between the alternatives.

Initial Construction Cost

Alternatives within the specified percentage of the alternative with the lowest initial cost are assigned the given spread factor. Lowest cost alternative always receives 1.0.

0-3%	3.01-6%	6.01-10%	10.01-15%	>15%
1.0	0.8	0.5	0.3	0

Future Maintenance Cost

Alternatives within the specified percentage of the alternative with the lowest future maintenance cost at the real discount rate for 30-year programs published in the most recent federal Office of Management and Budget Circular A-94

Appendix C (3.2% as of Jan. 2003) are assigned the given spread factor. Lowest cost alternative always receives 1.0.

0-10%	10.01-20%	20.01-30%	30.01-40%	>40%
1.0	0.8	0.5	0.3	0

User Delay - Initial Construction

Alternatives within the specified percentage of the alternative with the fewest number of days of lane closure for initial construction are assigned the given spread factor. Alternative with fewest days always receives 1.0.

0-25%	25.01-50%	50.01-75%	75.01-100%	>100%
1.0	0.8	0.5	0.3	0

User Delay - Future Maintenance

Alternatives within the specified percentage of the alternative with the fewest number of days of lane closure for future maintenance are assigned the given spread factor. Alternative with fewest days always receives 1.0.

0-25%	25.01-50%	50.01-75%	75.01-100%	>100%
1.0	0.8	0.5	0.3	0

Subgrade

Unbonded Concrete Overlay and Whitetopping = 1.0

New pavement and pavement replacement, all types = 0.7

Rubblize and Roll, and Crack and Seat = 0.6

Drainage Concerns

New pavement and pavement replacement, all types = 1.0

Unbonded Concrete Overlay, Whitetopping, Rubblize and Roll, and Crack and Seat = 0.8

Uniformity of Cross Section

If no widening (permanent lane addition), all alternatives = 1.0

If widening:

New pavement and pavement replacement, all types = 1.0

Rubblize and Roll = 0.8

Unbonded Concrete Overlay, Whitetopping, and Crack and Seat = 0.6

Maintenance of Traffic

Alternatives with an advantage = 1.0

Alternatives with a disadvantage = 0.5

When no alternative has any advantage, all alternatives = 1.0

Recycle-ability

New Flexible and Flexible Replacement = 1.0

Rubblize and Roll = 0.9

Crack and Seat = 0.8

New Rigid, Rigid Replacement, and Whitetopping = 0.7

Unbonded Concrete Overlay = 0.3

Ride

All asphalt alternatives = 1.0

All concrete alternatives = 0.7

The table below shows each factor, its weight, importance, reliability, and the possible spread values.

Factor	Weight	Importance	Reliability	Spread				
Initial Const. Cost	40	8	5	1	0.8	0.5	0.3	0
Future Maint. Cost	25	8	2	1	0.8	0.5	0.3	0
User Delay - Initial Construction	0	3	3	1	0.8	0.5	0.3	0
User Delay - Future Maintenance	30	6	2	1	0.8	0.5	0.3	0
Subgrade	20	7	3	1		0.7		0.6
Drainage	20	2	4	1				0.8
Uniformity of Cross Section	20	6	5	1		0.8		0.6
Maintenance of Traffic	20	7	3	1				0.5
Recycle-ability	10	3	4	1	0.9	0.8	0.7	0.3
Ride	10	5	3	1				0.7

Other factors considered for the scoring system include: force account work, snow and ice differences, late season paving, highway lighting, and pavement markings. These factors were discarded because of low importance, low reliability or both, lack of any defensible spread difference between alternatives, or current research in the area. For example, highway lighting is designed the same for all pavement types so there is no difference between alternatives.

The score for each factor is determined by multiplying the weight by the importance by the reliability by the spread. For example, the alternative with the lowest initial construction cost would get a score for initial construction cost of 40*8*5*1.0 = 1600. The total score for each alternative is the sum of the individual scores for each factor. The total number of points available is 4500.

Future Updates to the Pavement Selection Process

It is expected that this process will be revised and updated in the future. A documented process will be developed to consider and implement or reject any changes which will affect pavement type selection. This will include design changes, specification changes, changes to the future maintenance schedules, changes to the scoring system, and all supporting information such as rules for estimating unit prices, production rates for lane delay, etc.

Summary

The new process provides a more holistic approach to pavement selection. It is intended to account for all of the important differences between different pavement types and rehabilitation treatments. Each step in the process is clearly documented and the responsibilities are clearly defined. The process is not intended nor expected to make everyone happy. In a competitive environment between two industries, there will always be a winner and a loser on each project. This process will clearly show why one alternative was selected since decisions are made on technical criteria. The new process is an improvement and provides ODOT with a valuable tool to select the proper pavement type for a long-life, quality pavement.

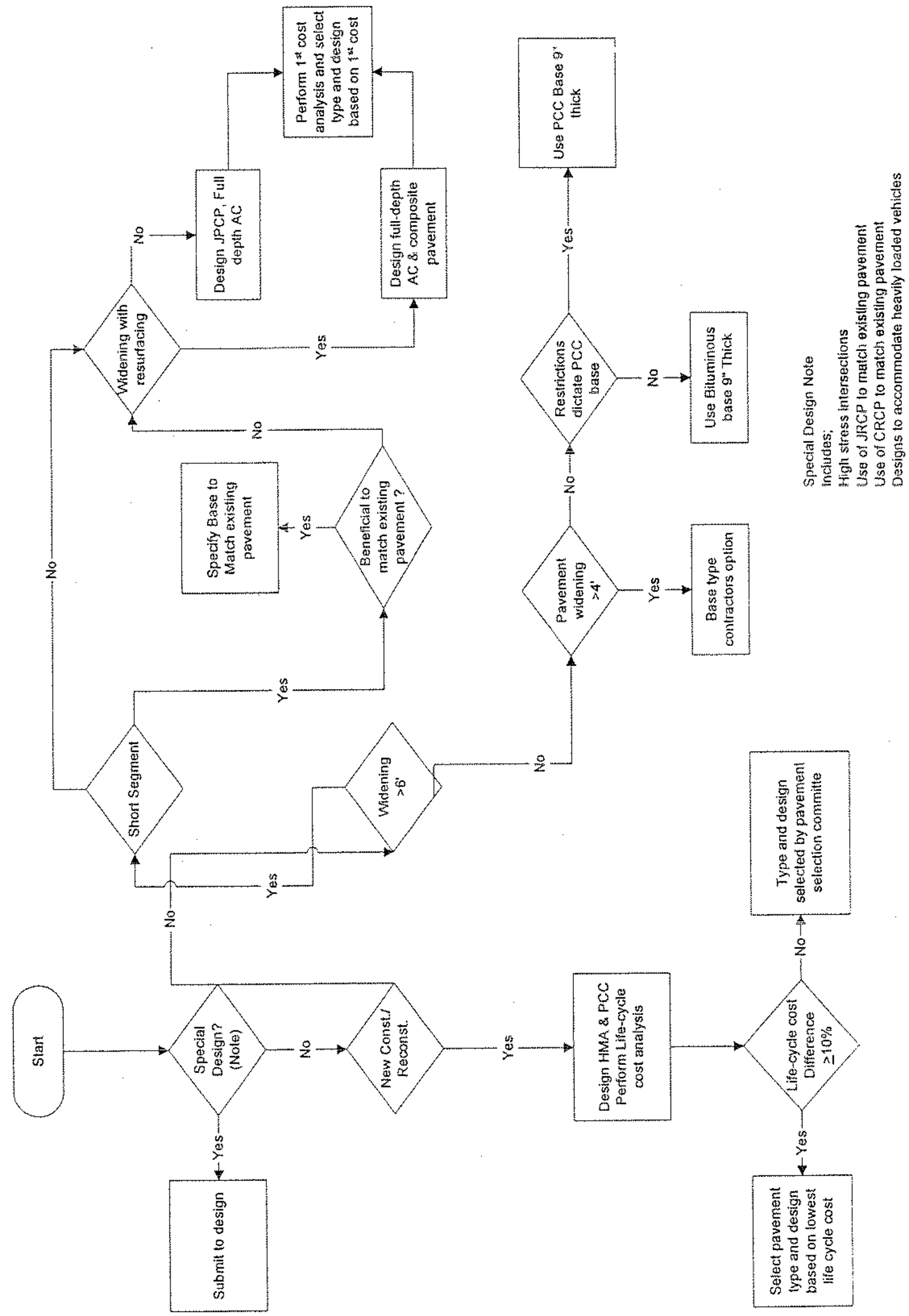
Appendix B

Pavement Type Selection Flow Charts

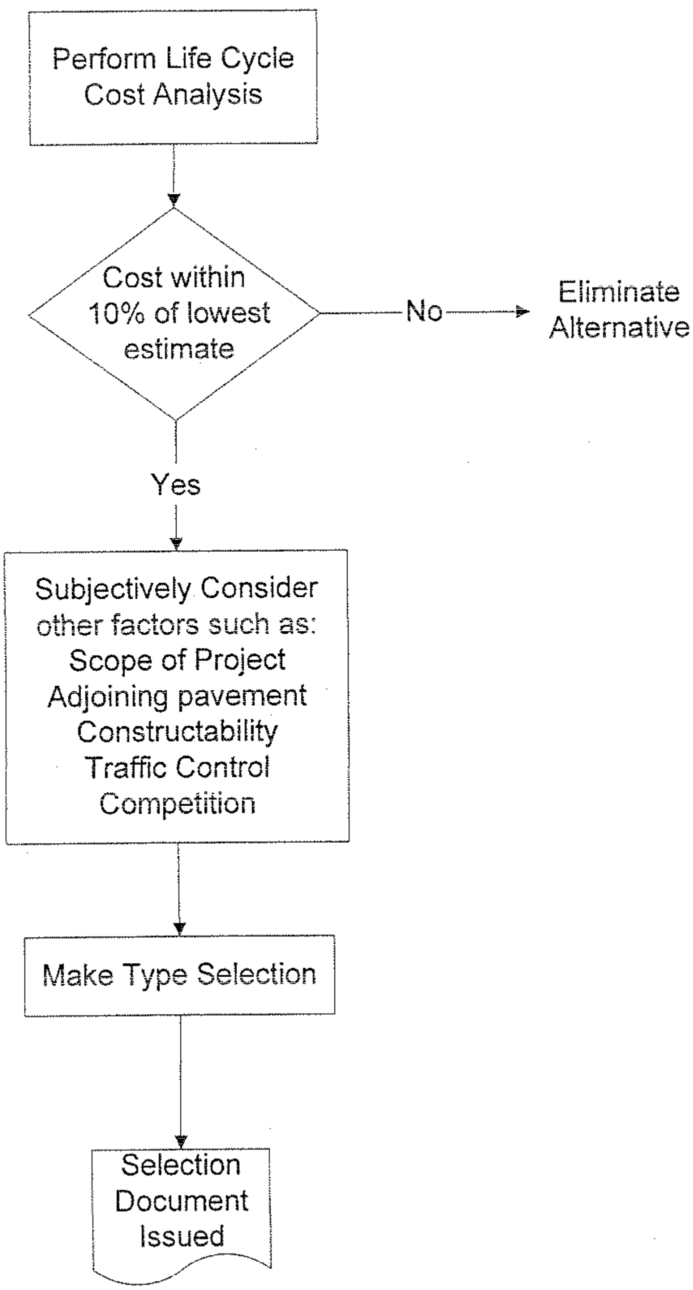
for

10 Comparison States

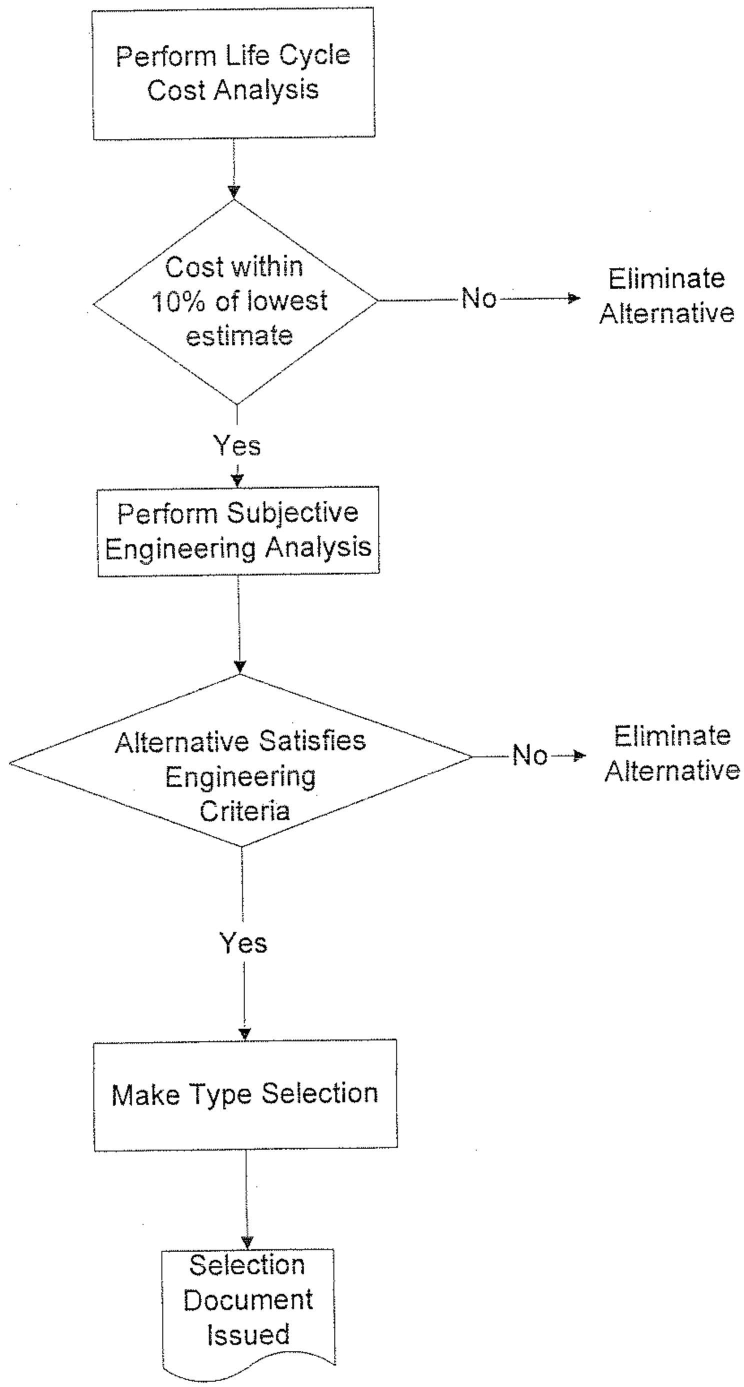
ILLINOIS DEPARTMENT OF TRANSPORTATION PAVEMENT TYPE SELECTION PROCESS



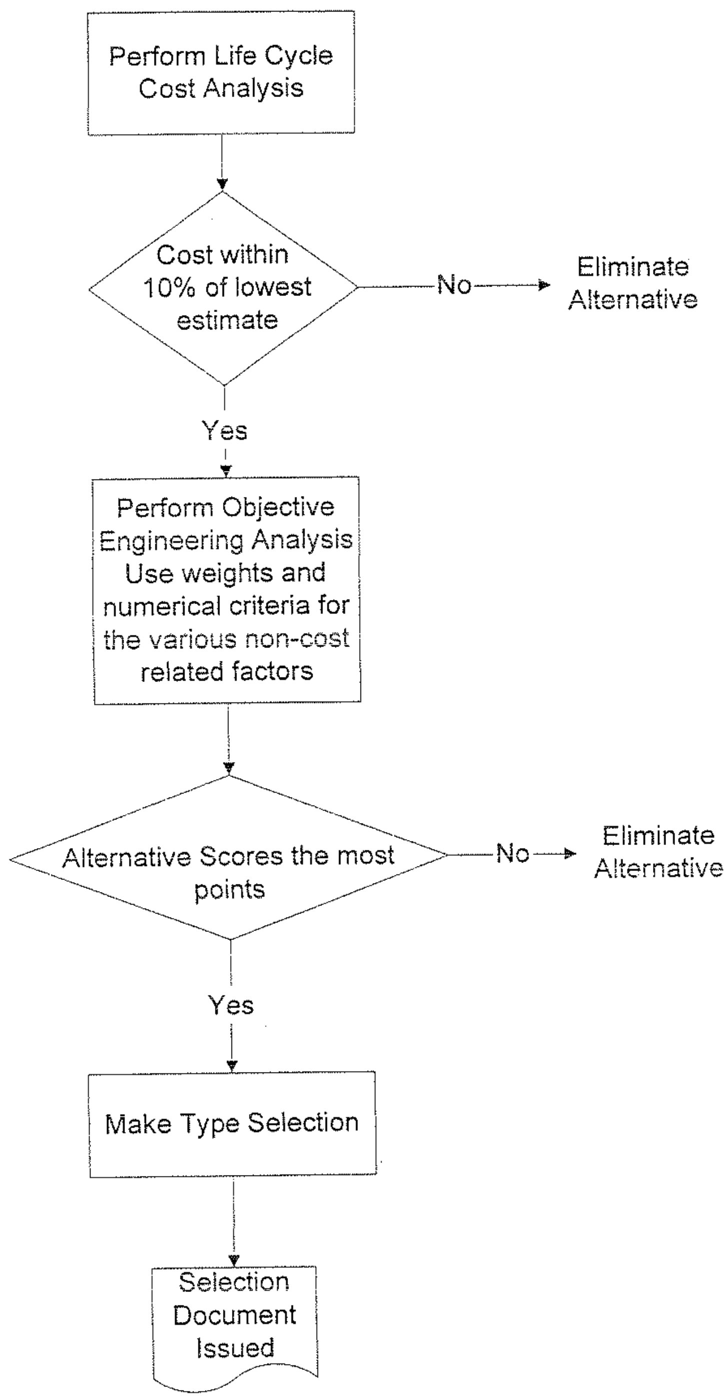
INDIANA DEPARTMENT OF TRANSPORTATION
TYPE SELECTION PROCESS
(Current)



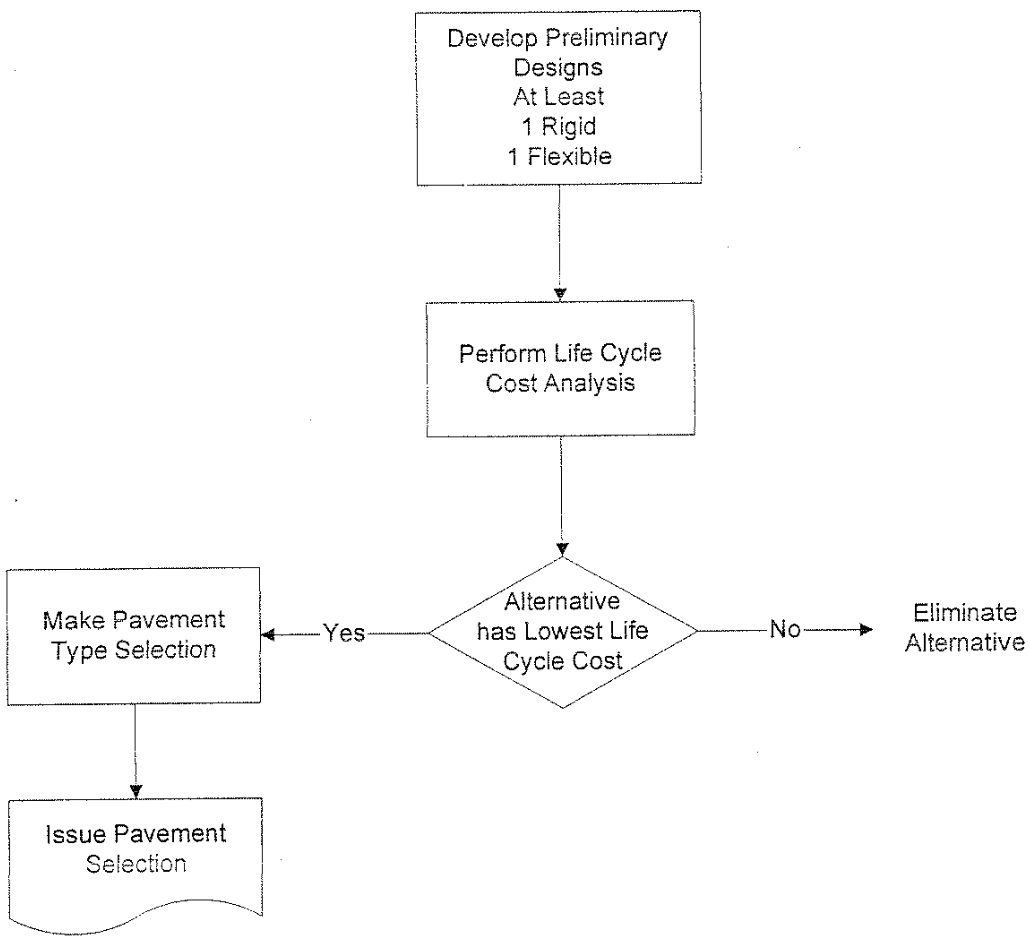
MARYLAND DEPARTMENT OF TRANSPORTATION
TYPE SELECTION PROCESS
(Existing)



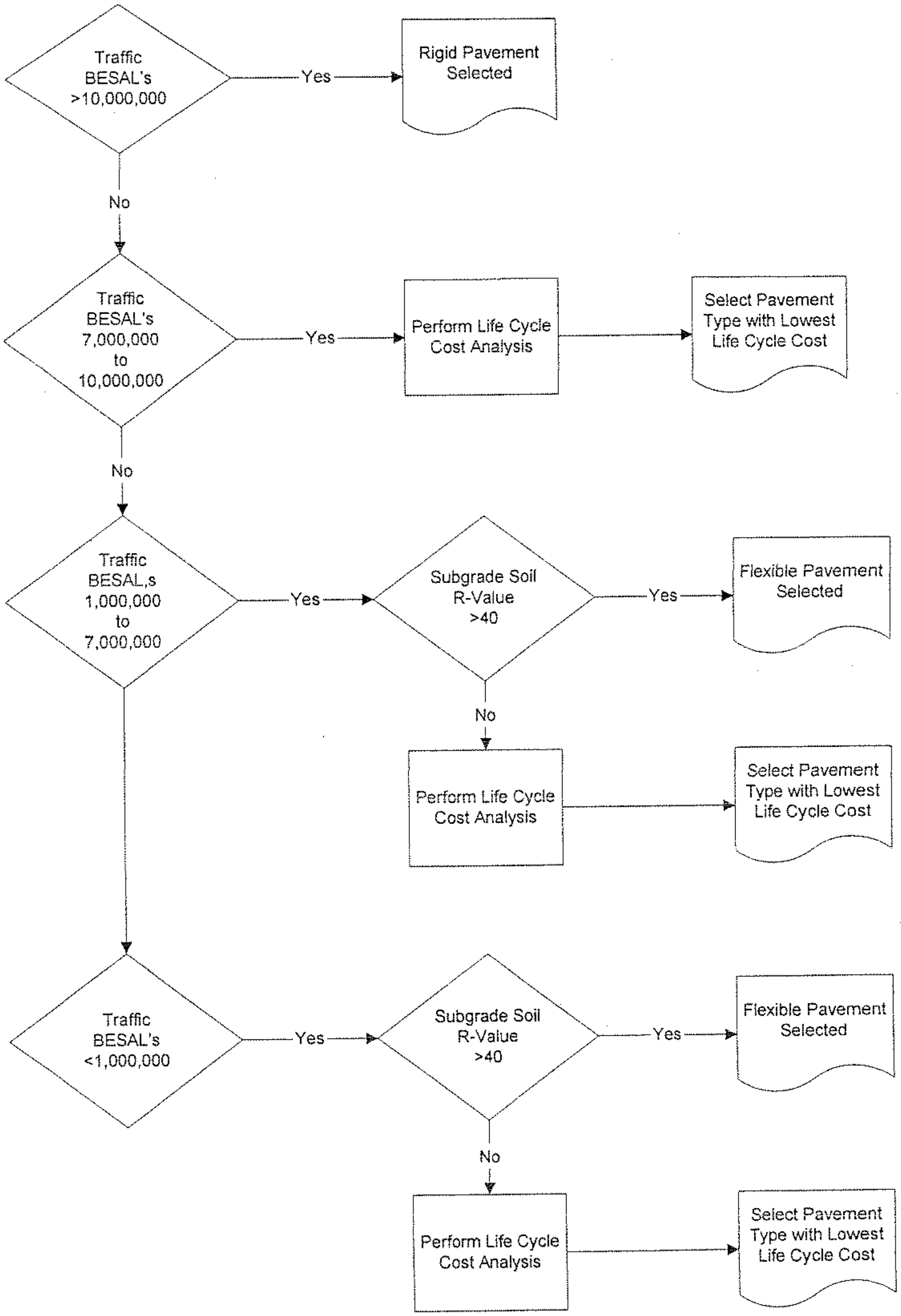
MARYLAND DEPARTMENT OF TRANSPORTATION
TYPE SELECTION PROCESS
(Future)



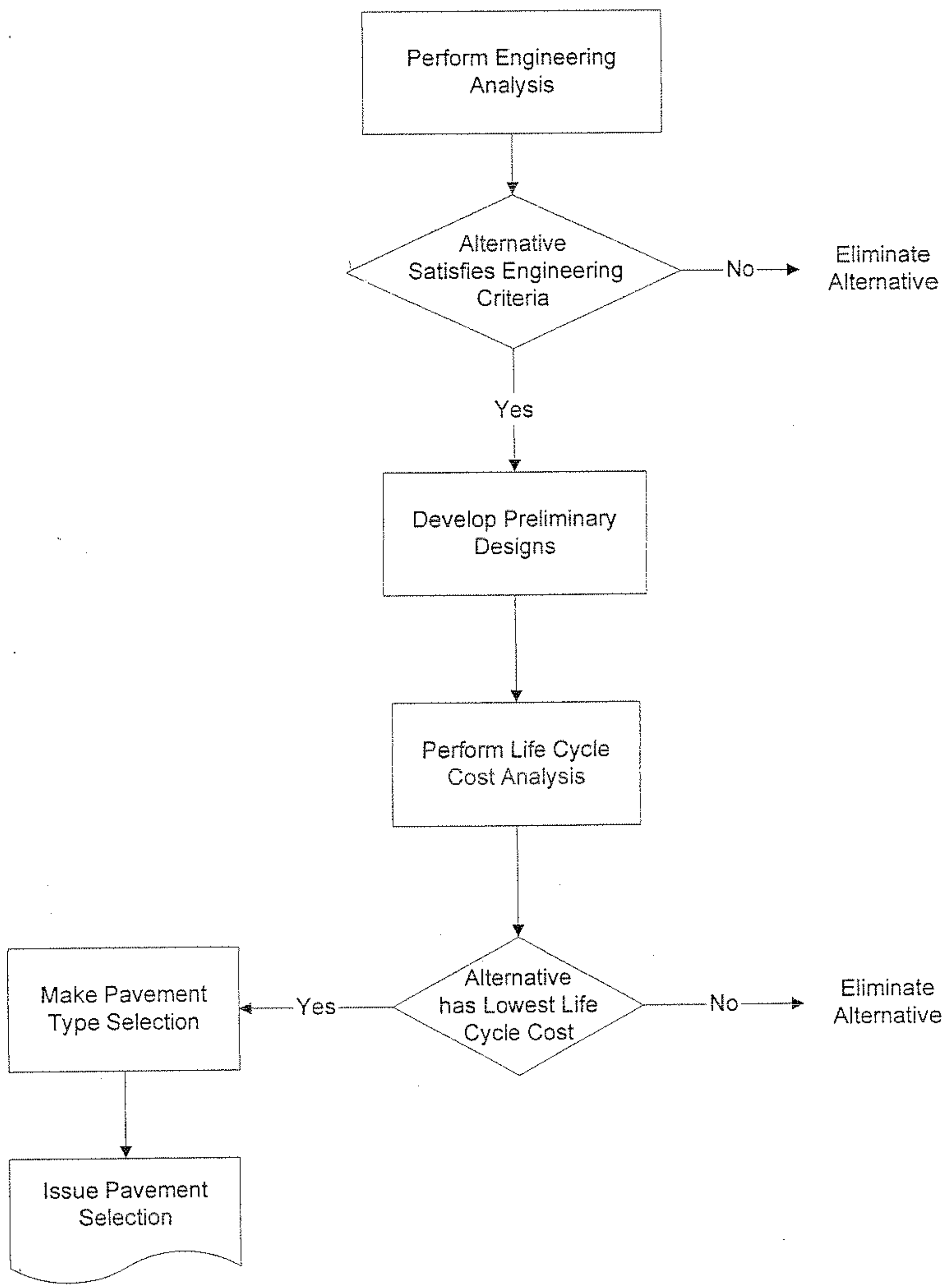
MICHIGAN DEPARTMENT OF TRANSPORTATION
TYPE SELECTION PROCESS



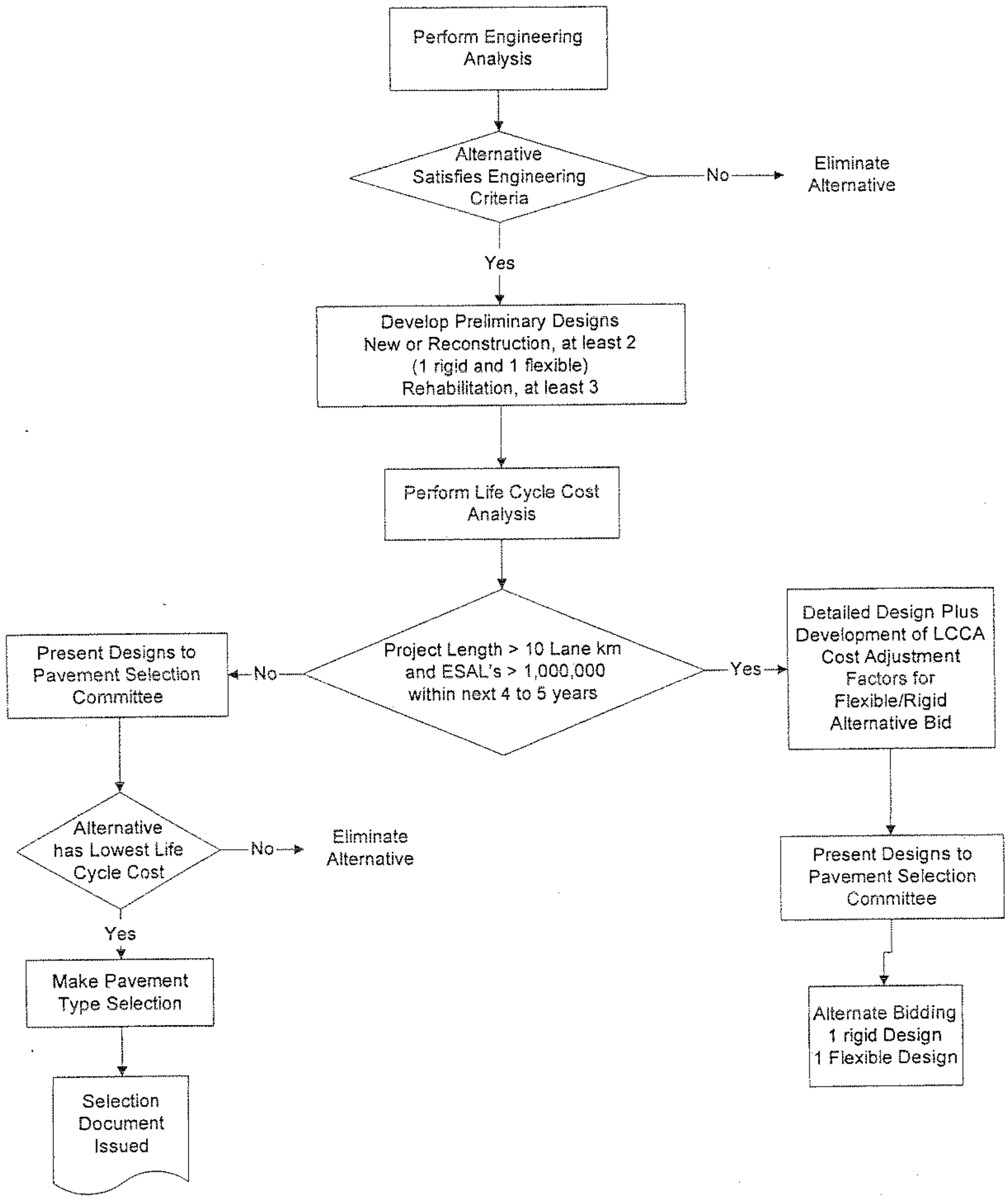
MINNESOTA DEPARTMENT OF TRANSPORTATION
PAVEMENT TYPE SELECTION PROCESS



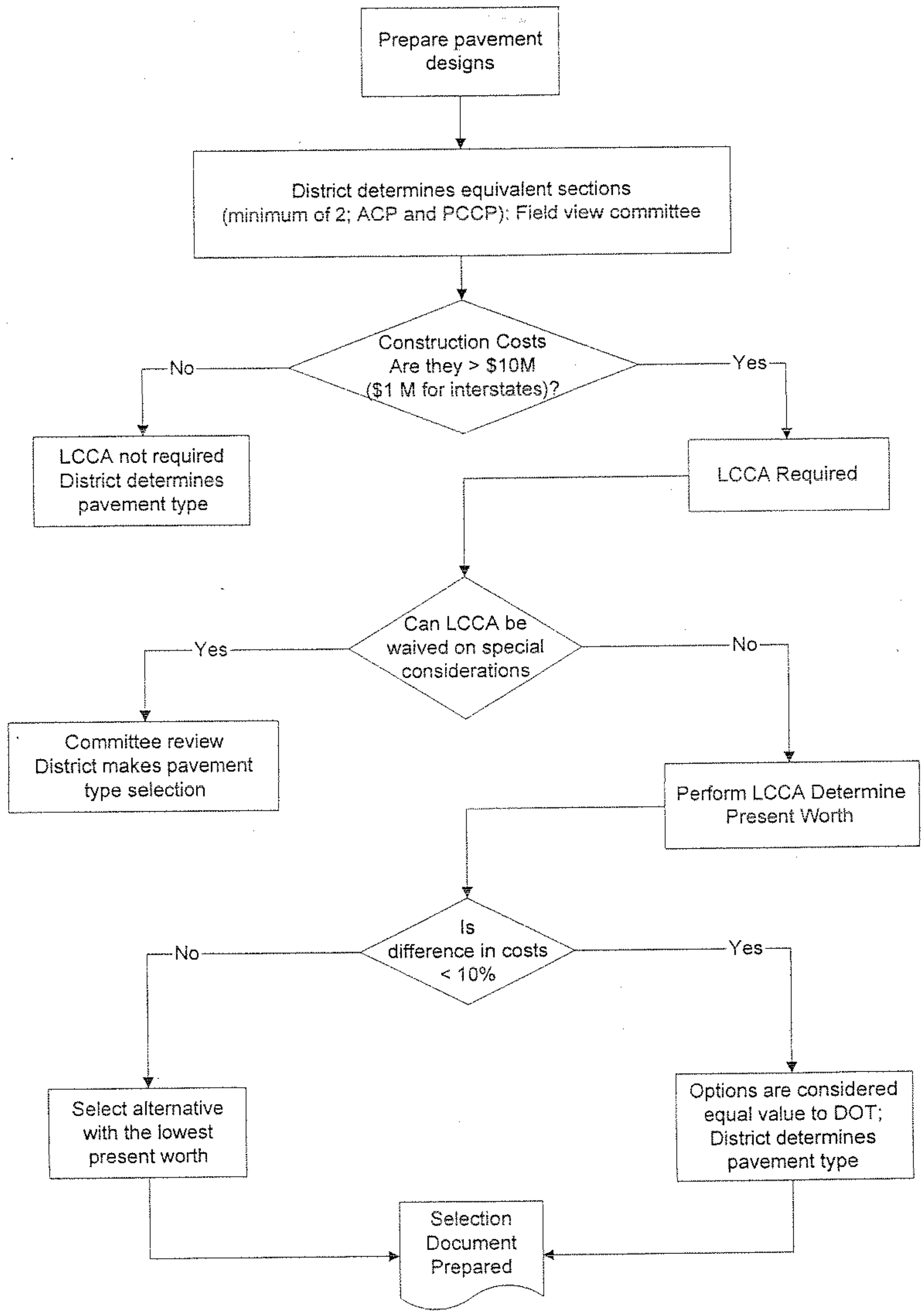
NEW YORK DEPARTMENT OF TRANSPORTATION TYPE SELECTION PROCESS



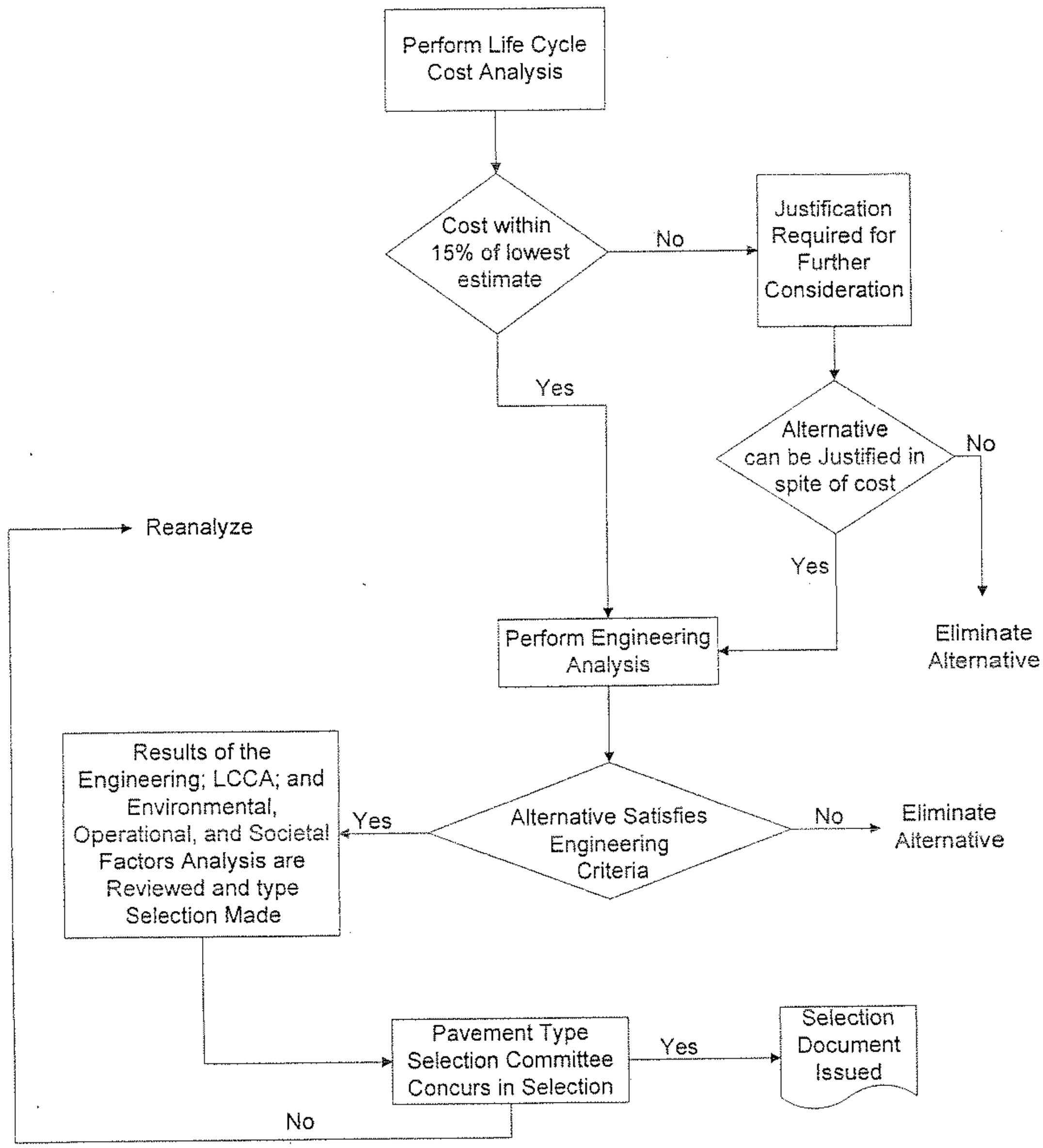
PROVINCE OF ONTARIO
PAVEMENT TYPE SELECTION



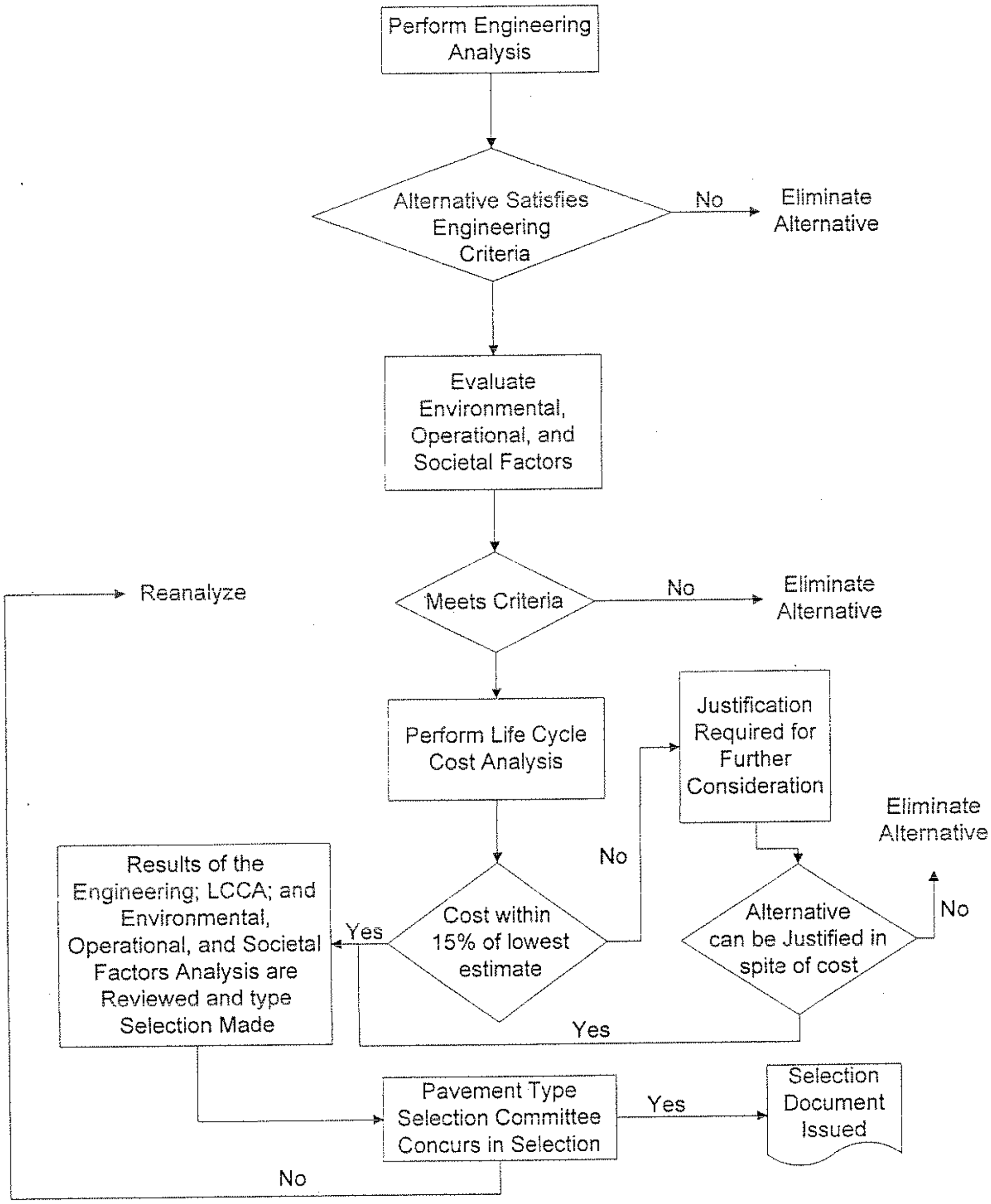
PENNSYLVANIA DEPARTMENT OF TRANSPORTATION
PAVEMENT TYPE SELECTION PROCESS



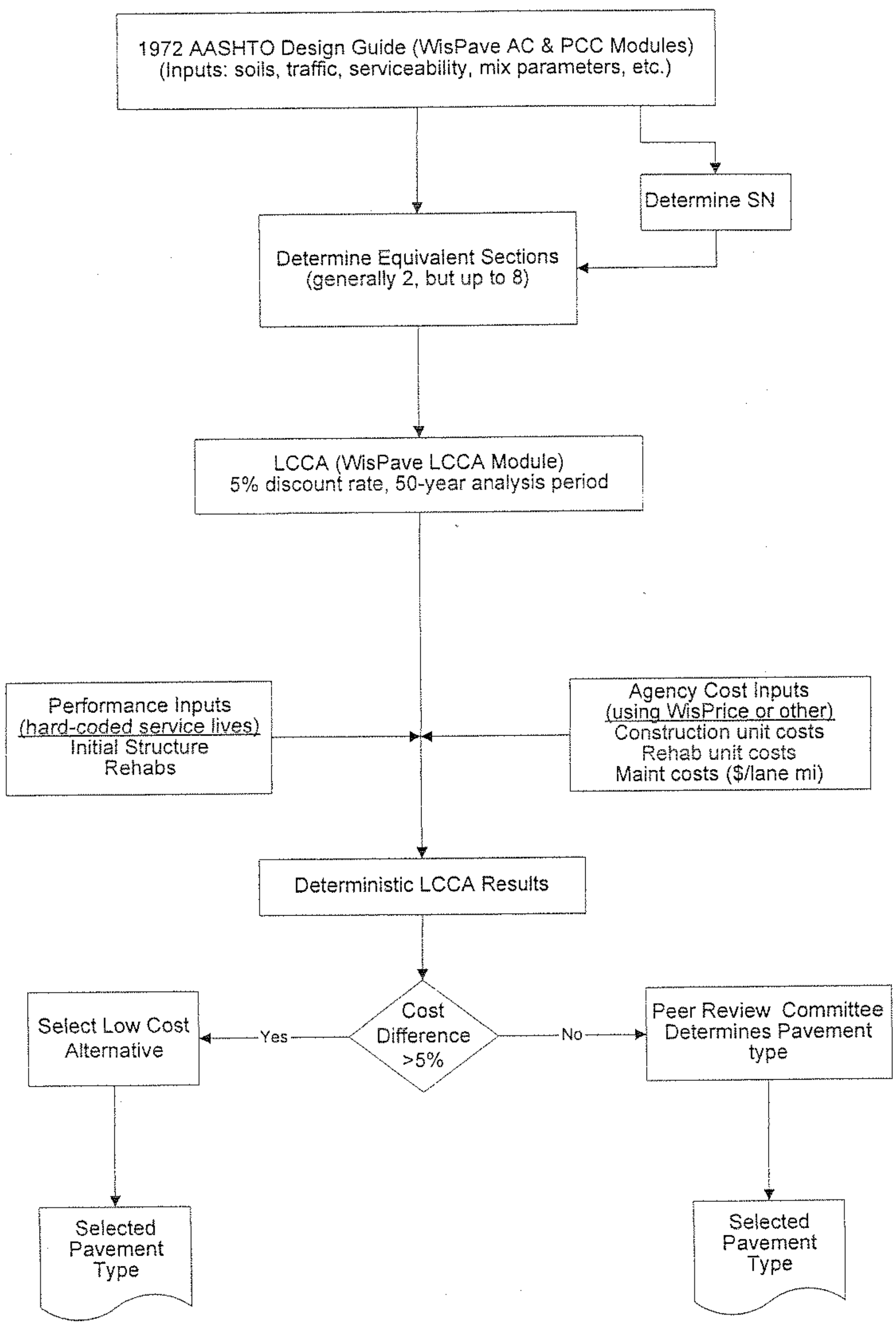
WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
TYPE SELECTION PROCESS
(Existing)



WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
TYPE SELECTION PROCESS
(Proposed revision)



WISCONSIN DEPARTMENT OF TRANSPORTATION PAVEMENT TYPE SELECTION PROCESS



Appendix C

Completed Questionnaires

for the

Comparison States

Purpose

The purpose of this interview is to gain insight into the following Illinois Department of Transportation practices:

- Pavement type selection
- Engineer's estimate and life cycle cost analysis
- Other items that affect cost

Agency Interviewed

Illinois Department of Transportation
I26 East Ash Street
Springfield, IL 62704-4792

Interview conducted between 10:00 AM and 12:30 PM on October 22, 2003.

Person(s) Interviewed

Name	Title	Phone	Email
David L. Lippert, P.E.	Engineer of Physical Research	217/782-7200 217/782-2572	lippertdl@nt.dot.state.il.us
Priscilla Tobias, P.E. David L. Piper, P.E.	Policy Engineer Highway Policy Engineer	217/524-1649 217/785-0720	tobiaspa@nt.dot.state.il.us piperdl@nt.dot.state.il.us
Matt Mueller, P.E.	Technical Services Engineer	217/782-3479	muellermw@nt.dot.state.il.us

1. **Do you have a documented pavement type selection procedure for:**

New Construction – Yes
Reconstruction – Yes
Rehabilitation – Yes (if the job is widening, the policy advises that selection be based on first cost.)

Special designs are not covered by policy. These include rubblization and unbonded concrete overlays, "high stress" locations, high traffic with traffic factor exceeding 35), etc. LCCA is not used for these situations.

Page 54-1(9), Figure 54-1A of Pavement Design manual covers this procedure.

2. **How long have you used the current type selection procedure?**

A procedure has been in place since mid 70s. Mechanistic-empirical (M-E) based design was adopted in 1989 by IDOT after 8 years of research and development. IDOT subjected the M-E procedures to field verifications and internal review prior to implementation. Issues ranging from design parameters and their effect on pavement design, to life cycle cost selection, were analyzed. An IDOT-Industry task force was set up to provide a forum for industry input during the decision-making process. Based on these activities, IDOT adopted and implemented the new pavement design procedures and associated type selection processes in 1990. These continue to serve IDOT to this day.

3. Changes made over the last 5 years:

The procedure has been "tweaked" slightly over the 5 years. Recently, the need to provide sealing of transverse joints in jointed concrete pavements has been eliminated. More changes are underway at this point, however, nothing has been made official as yet.

What prompted the change? Changes to design details (e.g., joint details such as saw cuts, dowel design, etc) prompted the minor "tweaks" to this point.

4. Have you used alternative bidding as a means of making a pavement type selection during the past 5 years? If yes describe the process. Was alternate bidding used on a Federal-aid project? If so, what was the basis of FHWA's approval?

No. IDOT does not use alternative bidding.

5. Importance and extent of industry involvement in the development of type selection process?

An IDOT-Industry task force was set up to facilitate industry input into the pavement type selection process during its development (see question 2 for details). Based on the industry review, IDOT re-evaluated and refined its design and type selection process. However, industry has no involvement in the way projects are selected within IDOT's pavement type selection process.

6. How was the selection process implemented within the agency?

The selection process is implement through a design manual. Districts perform the design and economic analyses of alternatives using the established unit costs and scheduled maintenance and rehabilitation and routine maintenance quantities and forward the results to the central bureau. The central bureau reviews the designs and economic analyses for accuracy. For new construction or reconstruction, if the LCCA leads to a cost difference of greater that 10 percent for competing alternatives, the alternative with the lowest cost is chosen. If the costs are within 10 percent of each other, then the districts refer the design to the Pavement Selection Committee for final decisions. The Committee comprises of 5 voting members – 3 central bureau members and 2 members where the project is located. The committee evaluates several "secondary" factors subjectively before arriving at a decision. These include:

- Construction considerations (e.g., staging, shallow utilities)
- Adjacent pavements (commonality, urban centers, signals, stop-go traffic, etc)
- District's local issues (past performance, impact on business due to construction, etc)
- First cost
- Project size and scope

7. **How is the type selection process related to the overall project selection, budgeting, planning process used by the agency?**

The type selection process is secondary to the overall programming of the DOT's capital outlay process. Programming is done years in advance and type selection is performed months (in some cases years) in advance of actual letting of jobs. Pavement type selection is done in Phase I and provides a more realistic estimate of costs.

8. **Pavement types used for new construction or reconstruction over the last 5 years (guesstimate)**

Pavement Type	Approximate sq. yd. (do not track lane miles)		Performance (Good Fair Poor)
	Interstate	Other 4 lane	
Full depth ACP	3,139,851		Good
Deep Strgth ACP	N/A	N/A	
ACP(less than 6") agg base	N/A	N/A	
Jointed Plain (JPCP)	4,577,865		Good
Jointed Reinforced (JRCP)	26038		N/A – Insufficient data since only small quantities built for compatibility with adjacent sections.
Continuously Reinf. (CRCP)	2,062,318		Good

*The last five years saw an unusual amount of interstate pavement being rehabilitated or reconstructed, which explains the high numbers for concrete.

9. **Thickness design procedure used and design life**

ACP (Full-depth AC) – M-E procedure (for new construction and reconstruction
PCCP (JPCP) – M-E procedure for new construction and reconstruction
PCCP (CRCP) – does not go through LCCA (special design); use modified AASHTO.

Widening jobs treated as special design. If widening is > 6' and involves resurfacing, modified AASHTO used for flexible and composite pavements.

10. **What analysis period used for each pavement type?**

For JPCP and full-depth AC, a 40-year life cycle capturing at least 1 rehabilitation is used.

11. **Are there different foundation/base requirements for AC and PCC?**

No. Both are treated similarly. A minimum of 12" improved subgrade (pozzolonically modified (most often lime-treated or granular backfill) is required to serve as an adequate working platform. This layer is not given structural credit and is not considered in cost analysis. Generally, JPCP requires as stabilized base and CRCP a bituminous stabilized base.

12. Do you use smoothness as criteria and if yes, do you use the same initial serviceability in design?

Smoothness is not used as a design criterion. It is only used as a construction specification.

13. Typical costs and method of contract measurement (e.g., last year's average bid price)

ACP in place $37/sy; Avg Thk = 14"
JPCP (slab only) $34/sy; Avg Thk = 10"
JRCP (slab only) N/A – Insufficient sample
CRCP (slab only) $30 to $44/sy (price based on completion schedule – accelerated completion costs more; Avg thk = 13 to 14"

Note that the CRCP design is not equivalent to other designs since it is typically considered only if heavy traffic is present (TF > 35).

14. How important is first cost versus future costs?

First cost, routine maintenance (paint markings, reflectors, lane markers, etc.), and maintenance and rehabilitation costs are all considered. There is not weighting attached to these categories in the LCCA process. All the dollar amounts are considered and reduced to present worth in LCCA.

First cost is discussed in the committee as a secondary factor when two alternate designs are within 10 percent of each other. It is possible that sometimes, this may drive decisions when the costs are very close.

15. Is life cycle cost analysis used?

Yes

16. Analysis period

40-year life cycle that ensures that at least 1 major rehab is covered.

17. Discount Rate (how established)

Department hired an economist in 1988 who reviewed the information present and established a rate of 3% for all public work. Prior to that Interest rate and Inflation rate were used.

18. Initial Costs – Estimating procedure

Quantity, material costs, and production costs enter the initial cost determination. Districts estimate costs and central bureau reviews them.

19. How does agency determine unit cost to include in the cost analysis (standardized or project by project)? Is the size of the project used in the database considered (economy of scale)? Age of the price data. How often updated.

There is a Statewide database of unit costs which are frequently updated. The Central office estimating engineer keeps a meticulous record of all the costs on unit cost worksheets and maintains a running total.

20. Are price adjustment factors used for any materials, and if so are they used in the life cycle cost analysis.

No.

21. Actual cost versus estimated cost (are completed projects evaluated for overruns etc.)

No ongoing process of active comparison. Actual costs versus estimated costs could differ based on market forces which are current to the time of letting, however, this does not affect type selection. Estimates are done sometimes years in advance. Projects are evaluated if there are overruns but not all projects are evaluated for overruns.

22. Routine maintenance (how estimated, operations included)

Routine maintenance as defined by IDOT refers to paint markings, lane markings, etc., which are common to both full-depth HMA and JPCP pavements. These quantities are assigned a fixed yearly value in the maintenance and rehabilitation schedule based on experience.

Other maintenance activities such as crack sealing, patching, etc., are directly considered in the maintenance and rehabilitation schedule. The schedule specifies that certain maintenance activities be done at fixed time intervals based on IDOT experience. These are applied in the LCCA process. The unit costs for these activities are updated annually and are a function of pavement type, location, and highway class.

Engineering and Construction Considerations

Note that all the factors listed below are secondary factors which will be considered by the Pavement Type Selection Committee only if the LCCA for the two design alternatives yields a difference of less than 10 percent.

Factor	C	P	I	Comments
1. Roadway/lane geometrics (lane widths, cross slopes, ability to provide drainage)	✓			
2. Highway functional class	✓			
3. Traffic				*Considered prior to LCCA being performed – in the design phase.*
4. Roadway peripheral features (overhead clearance, weigh-in-motion, guardrails, etc)	✓			
5. Construction considerations	✓			
a. Staging	✓			
b. Clearance for equipment	✓			
c. Construction operations				
d. Traffic operations during construction	✓			
e. Construction seasons	✓			
6. Consideration of future maintenance operations (maintenance of traffic, ease of maintenance)	✓			
7. Performance of similar pavements in the area	✓			
8. Availability of local materials, contractor's capabilities, and experienced agency personnel.	✓			
9. Pavement Continuity				
a. Adjacent sections	✓			
b. Adjacent lanes	✓			
10. Noise issues				
11. Subgrade soils	✓			
12. Climate				
13. District or local preference	✓			
14. Ease of maintenance	✓			
15. Recycling				*Indirectly accounted for in the LCCA – unit prices reflect the used of recycled materials.*
16. Conservation of materials and energy				*Indirectly accounted for in the LCCA – unit prices reflect the used of recycled materials.*
17. Stimulation of Competition				
18. Safety considerations (rutting, friction, lighting, etc)				*Addressed in specifications/maintenance rehabilitation schedule.*
19. Smoothness				*Addressed in specifications.*

C = considered; P = primary or secondary choice; I = importance (on a scale from 1 to 5)

23. Rehabilitation (how is timing estimated, techniques used, etc.)

Major rehabilitation activities such as overlays for full-depth AC pavements and CPR for JPCP are specified in the maintenance and rehabilitation schedule based on experience. The costs for these quantities are determined based on the cost worksheets maintained by IDOT.

Salvage Value (remaining life) – Not considered since it is assumed that life cycle is long enough.
Residual value (recycling) – Indirectly considered in unit cost sheets.
Construction traffic control (crossovers, added lanes, barriers, detours, etc.) – Secondary factor in type selection process.
Engineering and administration – Not considered.

24. How are users costs weighted in relation to agency costs?

N/A. User costs are not considered in LCCA.

25. Vehicle operating costs

Not considered.

26. User Delay

Not considered.

27. Description of the analysis process

N/A

28. Routine maintenance

IDOT definition differs from common perception. Definition could be revised. For full-depth AC and JPCP it includes lane striping, delineators, lane markets, etc.

29. Preventive maintenance

Preventive maintenance concepts are not used by IDOT at the present time.

30. What are the state's standard routine and preventive maintenance operation and schedule by pavement type?

As defined in Question 29, Routine maintenance is assigned a fixed cost which does not vary by pavement type. "Other" maintenance activities such as crack sealing, patching, etc., are provided in the schedules in the Pavement Design Manuals.

31. Allocation of resources between maintenance, rehab, new and reconstruction

IDOT operates on the principle of maintaining the existing system at optimum conditions. Adequate resources are allocated in each category to meet this goal.

32. Do you have a formal system to track pavement condition, cost, and survivability?

There is a system to track pavement condition (condition rating system -- CRS) and survivability. There is no system to track costs and there is no "formal" pavement management system. IDOT performs a routine review of CRS and assesses needs.

33. Do you allow old concrete to be recycled? If so into what products? Percentage limits?

Yes. Recycled concrete is used in concrete, as subbase layer, as capping layer for working platform, in fills/embankments, as well as in shoulders.

34. Do you allow HMA materials to be recycled? If so into what products? Percentage limits?

Yes. RAP is used in binder courses, shoulders, capping layers for working platform.

Purpose

The purpose of this interview is to gain insight into the following Indiana Department of Transportation practices:

- Pavement type selection
- Engineer's estimate and life cycle cost analysis
- Other items that affect cost

Agency Interviewed

Indiana Department of Transportation
120 S. Shortridge Road
Indianapolis, IN 46219

Person(s) Interviewed

Name	Title	Phone	Email
Dave Andrewski	Pavement Design Engineer	317-610-7251	dandrewski@indot.state.us
Kumar Dave	Pavement Design Engineer	317-610-7251	

1. Do you have a documented pavement type selection procedure for:

New Construction – In design Manual
Reconstruction – In design Manual
Rehabilitation

2. How long have you used the current type selection procedure?

At least 10 years

3. Changes made over the last 5 years:

Nothing significant

4. Have you used alternative bidding as a means of making a pavement type selection during the past 5 years? If yes describe the process. Was alternate bidding used on a Federal-aid project? If so, what was the basis of FHWA's approval?

No

5. Importance and extent of industry involvement in the development of type selection process?

Try to maintain an open relationship with both industries

6. How was the selection process implemented within the agency?

Included in the design manual

7. How is the type selection process related to the overall project selection, budgeting, planning process used by the agency?

Not directly related. Selection process occurs after a determination is made to proceed with the project.

8. Pavement types used for new construction or reconstruction over the last 5 years

Pavement Type	Approximate lane miles		Performance (Good Fair Poor)
	Interstate	Other 4 lane	
Full depth ACP			
Deep Strgth ACP	*		*Good*
ACP (less than 6") agg base			
Jointed Plain (JPCP)	*		*Good*
Jointed Reinforced (JRCP)			
Continuously Reinf. (CRCP)			

* Data not available from the State on miles of paving by type each year. However, subsequent conversations with industry reps indicated about 20 to 30 percent of the high reconstruction go to PCC each year.

9. Thickness design procedure used and design life (if AASHTO which version)

ACP AASHTO - DARWIN
PCCP AASHTO - DARWIN

10. What design period used for each pavement type?

Flexible – 20 years
Rigid – 30 years

11. Are there different foundation/base requirements for AC and PCC?

No

12. For those agencies that use smoothness as criteria do they use the same initial serviceability in design?

Have ride specifications for both pavement types. Currently not the same but they are moving towards that goal. Use same initial serviceability.

13. Typical costs and method of contract measurement

ACP in place $/_____42_____/ton sy cy other
JPCP (slab only) $/___10" 26.68, 11" 28.25____sy cy other
JRCP (slab only) $/__________sy cy other
CRCP (slab only) $/__________sy cy other

14. How important is first cost versus future costs?

First cost is one of the subjective factors considered

15. Is life cycle cost analysis used?

Yes - State currently has a research project underway at Purdue to improve the process

16. Analysis period

40 years

17. Discount Rate (how established)

For general purposes a 4% discount rate can be assumed. However, it is recommended that a range of rates between 0% and 10% be evaluated.

18. Initial Costs – Estimating procedure

Use recent unit costs for project let over the last 1 to 2 years

19. How does agency determine unit cost to include in the cost analysis (standardized or project by project)? Is the size of the project used in the database considered (economy of scale)? Age of the price data. How often updated.

Look at high and low bids, and then make a best estimate based on project factors. Industry is given the opportunity to provide input on the values used.

20. Are price adjustment factors used for any materials, and if so are they used in the life cycle cost analysis.

Not permitted by State law (constitution?)

21. Actual cost versus estimated cost (are completed projects evaluated for overruns etc.)

Not considered

Engineering and Construction Considerations

Factors used, scoring system, primary factors secondary factors, weights, importance, etc

Factor	Considered	Primary or Secondary	Importance (0 to 5)	Comments
1. Roadway/lane geometrics (lane widths, cross slopes, ability to provide drainage)	*N*			
2. Highway functional class	*N*			
3. Traffic	*Y*		5	
4. Roadway peripheral features (overhead clearance, weigh-in-motion, guardrails, etc)	*Y*		5	*Yes for white topping and break and seat*
5. Construction considerations				
a. Staging	*Y*		*1*	
b. Clearance for equipment	*N*			
c. Construction operations	*N*			
d. Traffic operations during construction	*N*			
e. Construction seasons	*N*			

Factor	Considered	Primary or Secondary	Importance (0 to 5)	Comments
6. Consideration of future maintenance operations (maintenance of traffic, ease of maintenance)	*N*			
7. Performance of similar pavements in the area	*N*			
8. Availability of local materials, contractor's capabilities, and experienced agency personnel.	*N*			
9. Pavement Continuity	*N*			
a. Adjacent sections	*N*			
b. Adjacent lanes	*N*			
10. Noise issues	*N*			*Is becoming an issue. State changed tining to address the issue*
11. Subgrade soils	*Y*		3	*Settlement*
12. Climate	*N*			
13. District or local preference	*N*			
14. Ease of maintenance	*N*			
15. Recycling	*N*			
16. Conservation of materials and energy	*N*			
17. Stimulation of Competition	*Y*			*Subjectively when cost are equal*
18. Safety considerations (rutting, friction, lighting, etc)	*N*			
19. Smoothness	*N*			

22. Routine maintenance (how estimated, operations included)

Based on maintenance management system, historical data, and pavement management data.

23. Rehabilitation (how is timing estimated, techniques used, etc.)

Based on pavement management data

Salvage Value (remaining life) – Consider the residual value of the pavements service life at the end of the analysis period
Residual value (recycling) – Not considered
Construction traffic control (crossovers, added lanes, barriers, detours, etc.) – Consider only if there is a significant difference between pavement types
Engineering and administration – No since similar for both

24. How are users costs weighted in relation to agency costs?

User costs will be incorporated when Purdue research is completed

25. Vehicle operating costs

26. User Delay

27. Description of the analysis process

In design manual

28. Routine maintenance

Reactive operations, pot holes, etc

29. Preventive maintenance

Crack and joint sealing, chip seals

30. What are the state's standard routine and preventive maintenance operation and schedule by pavement type?

Crack sealing every 2 to 3 years
Chip seal 4 to 6 years
Contraction joint sealing 8 to 12 years

31. Allocation of resources between maintenance, rehab, new and reconstruction

No formal allocation

32. Do you have a formal system to track pavement condition, cost, and survivability?

Pavement management system

33. Do you allow old concrete to be recycled? If so into what products? Percentage limits?

Becomes property of the contractor

Encourage the contractor to use as subgrade strengthening layer. Cap off with granular layer to prevent leaching

34. Do you allow HMA materials to be recycled? If so into what products? Percentage limits?

Becomes property of the contractor

In HMA up to 25%
Up to 15 % use grade of AC specified in contract. 15 to 25% an asphalt modifier is required to soften old asphalt.

Purpose

The purpose of this interview is to gain insight into the following Maryland State Highway Administration practices:

- Pavement type selection
- Engineer's estimate and life cycle cost analysis
- Other items that affect cost

Agency Interviewed

State Highway Administration, Maryland Department of Transportation
2323 W. Joppa Road
Lutherville, MD 21093

Person(s) Interviewed

Name	Title	Phone	Email
Tim Smith	Acting Pavement Division Chief	410-321-3110	Tsmith2@sha.state.md.us
Jeffrey N. Wthee	Transportation Engineer	410-321-3115	jwithe@sha.state.md.us

1. Do you have a documented pavement type selection procedure for:

New Construction: Not formally, Using interim procedure while further revisions are under development
Reconstruction: Not formally, Using interim procedure while further revisions are under development
Rehabilitation

2. How long have you used the current type selection procedure?

6 months

3. Changes made over the last 5 years:

Currently being revised. New process expected to be completed and adopted early next year.

What prompted the change? Trying to develop a more consistent and objective selection process. Being do to address issues raised by the HMA industry on a major project.

Engineering and Construction Considerations

Factors used, scoring system, primary factors secondary factors, weights, importance, etc

Factor	Considered	Primary or Secondary	Importance (0 to 5)	Comments
1. Roadway/lane geometrics (lane widths, cross slopes, ability to provide drainage)	*Y*		*1*	
2. Highway functional class	*N*			
3. Traffic	*Y*		*3*	*Land use – impact of materials hauling*
4. Roadway peripheral features (overhead clearance, weigh-in-motion, guardrails, etc)	*N*			
5. Construction considerations				
a. Staging	*Y*		*3*	
b. Clearance for equipment	*N*			
c. Construction operations	*Y*		*3*	
d. Traffic operations during construction	*Y*		*4*	
e. Construction seasons	*Y*		*1*	

Factor	Considered	Primary or Secondary	Importance (0 to 5)	Comments
6. Consideration of future maintenance operations (maintenance of traffic, ease of maintenance)	*Y*		*1*	
7. Performance of similar pavements in the area	*N*			
8. Availability of local materials, contractor's capabilities, and experienced agency personnel.	*Y*		*.5*	
9. Pavement Continuity				
a. Adjacent sections	*Y*		*2*	
b. Adjacent lanes	*Y*		*2*	
10. Noise issues	*Y*		*.5*	
11. Subgrade soils	*N*			
12. Climate	*N*			
13. District or local preference	*Y*		*.5*	
14. Ease of maintenance	*Y*		*1*	
15. Recycling	*N*			
16. Conservation of materials and energy	*N*			
17. Stimulation of Competition	*Y/N*	*S*		
18. Safety considerations (rutting, friction, lighting, etc)	*Y*		*2*	*rutting*
19. Smoothness	*N*			

19. How does agency determine unit cost to include in the cost analysis (standardized or project by project)? Is the size of the project used in the database considered (economy of scale)? Age of the price data. How often updated.

Have just instituted the procedure and plan to update annually.

20. Are price adjustment factors used for any materials, and if so are they used in the life cycle cost analysis.

Yes – for liquid asphalt

21. Actual cost versus estimated cost (are completed projects evaluated for overruns etc.)

No

22. Routine maintenance (how estimated, operations included)

Not used

23. Rehabilitation (how is timing estimated, techniques used, etc.)

Pavement management supplies average and standard deviation for different pavement types.

> **Salvage Value (remaining life):** Yes – remaining life at end of the analysis period
> **Residual value (recycling):** No
> **Construction traffic control (crossovers, added lanes, barriers, detours, etc.):** Yes
> **Engineering and administration:** No

24. How are users costs weighted in relation to agency costs?

equal

25. Vehicle operating costs

No

26. User Delay

Yes per FHWA procedure

27. Description of the analysis process

28. Routine maintenance

Reactive - potholes, etc.

29. Preventive maintenance

Slurry seals, thin overlays

30. What are the states standard routine and preventive maintenance operation and schedule by pavement type?

Preventive maintenance applied occasionally.

31. Allocation of resources between maintenance, rehab, new and reconstruction

Nothing formal

32. Do you have a formal system to track pavement condition, cost, and survivability?

Yes – pavement management system

33. Do you allow old concrete to be recycled? If so into what products? Percentage limits?

Yes – but have not removed any in recent years

34. Do you allow HMA materials to be recycled? If so into what products? Percentage limits?

Yes -15% surface, 25% base. May increase based on mix design. Above 15 % requires asphalt modifier.