**IN THE COURT OF APPEALS OF OHIO**
**TENTH APPELLATE DISTRICT**

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| **OHIO CONCRETE CONSTRUCTION ASSOCIATION, et al.,** | : | **Case No. 08APE10 0905** |
| **Plaintiffs-Appellants,** | : | **ACCELERATED CALENDAR** |
| **vs.** | : | |
| **OHIO DEPARTMENT OF TRANSPORTATION, et al.,** | : | |
| **Defendants-Appellees.** | : | |

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**APPENDIX OF EXHIBITS IN SUPPORT OF BRIEF OF PLAINTIFFS-APPELLANTS**

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## CERTIFICATE OF SERVICE

The undersigned hereby certifies that a copy of the foregoing has been served regular United States mail, postage pre-paid, this 21st day of November, 2008, upon the following:

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853-001:189069

IN THE COURT OF COMMON PLEAS, FRANKLIN COUNTY, OHIO
CIVIL DIVISION

| | | |
|---|---|---|
| OHIO CONCRETE CONSTRUCTION ASSOCIATION, et al., | : | |
| Plaintiffs, | : | |
| v. | : | Case No. 08CV09-13167 |
| OHIO DEPARTMENT OF TRANSPORTATION, et al., | : | Judge Schneider |
| Defendants. | : | |



**DECISION (1) DENYING PLAINTIFFS' MOTION FOR A TEMPORARY RESTRAINING ORDER, FILED SEPTEMBER 29, 2008; (2) GRANTING DEFENDANT'S MOTION TO DISMISS, FILED OCTOBER 2, 2008; AND (3) GRANTING DEFENDANT'S MOTION TO DISMISS, FILED OCTOBER 2, 2008**
(Case Terminated)

Rendered this 6 day of October, 2008.

Schneider, J.

The above-captioned matter is before this Court on the motion of Plaintiffs The Harper Company ("Harper") and the Ohio Concrete Construction Association for a Temporary Restraining Order. The Defendants are the Ohio Department of Transportation ("ODOT"), E.S. Wagner Company ("Wagner") and John R. Jurgensen Company (JRJ").

On August 20, 2008, ODOT solicited bids for the construction of a multi-lane highway bypass around Wilmington, Ohio ("Project"). All bidders were required to submit alternative bids. One bid was to be for a concrete-pavement design, and a separate bid was for an asphalt-pavement design. Wagner, along

with several other prime contractors, submitted alternative bids. Harper submitted a price quote to Wagner as a subcontractor for the concrete specification, and JRS submitted a price quote to Wagner as a subcontractor for the asphalt specification. On September 19, 2008, Wagner was awarded the contract as the prime contractor for the Project with the asphalt specification.

Plaintiffs argue that ODOT failed to follow its own rules and procedures when analyzing the bids for the alternative pavement designs. Plaintiffs argue that, had ODOT followed its rules, the concrete pavement design would have been found to be the *lowest competent and responsible* alternative, and Wagner would have been awarded the contract—but with Harper as the sub-contractor.

In its memorandum in support of their motion, plaintiffs argue:

> ODOT's selection of the asphalt alternative, and the process that led to such selection, were contrary to Ohio law and public policy and constituted an abuse of discretion. As a result, Plaintiffs are entitled to immediate injunctive relief enjoining Defendants from executing and/or enforcing the asphalt portion of the Wilmington Bypass contract, and enjoining ODOT from awarding any other contracts without accepting and analyzing bids for alternative pavement designs in terms of the actual life cycle cost thereof.

The Court allowed each side to present both evidence and argument regarding Plaintiffs' motion. The Defendants filed motions to dismiss, arguing that the plaintiffs lack standing to bring this action. Plaintiffs filed a memorandum contra.

"Standing is a threshold test that, if satisfied, permits the court to go on to decide whether the relief sought can or should be granted to plaintiff." Tiemann v. University of Cincinnati (Franklin 1998), 127 Ohio App. 3d 312, 325. "The question of standing is whether a litigant is entitled to have a court determine the merits of the issues presented." Ohio Contractors Assn. v. Bicking (1994), 71 Ohio St. 3d 318, 320.

In the case that is before this Court, we have two different plaintiffs. Plaintiff Harper, which as a sub-contractor submitted an alternative pavement design quote to a prime contractor. The second plaintiff is The Ohio Concrete Construction Association ("OCCA"), an Ohio trade organization of which Harper is a member.

There is no question that in Ohio a trade organization such as OCCA has standing to bring an action on behalf of one of its members, even though the organization did not submit a bid or actually engage in the work necessary to be awarded a contract. However, this standing is not unlimited. OCCA has standing in this matter only if one of its members has standing in its own right to bring an action. Bicking, 71 Ohio St. 3d at 320 (citing Hunt v. Washington St. Apple Adv. Comm'n (1977), 432 U.S. 333, 343. This proposition of law was cited by the Tenth District Court of Appeals in Tiemann, 127 Ohio App. 3d at 325. See also State ex rel. Assoc. Bldrs. & Contrs., Cent. Ohio Chapter v.

Jefferson Cty. Bd. of Comm'rs (Jefferson 1995), 106 Ohio App. 3d 176.

Therefore, the issue of standing for OCCA is dependent upon Harper's standing to bring this action. As a threshold matter, the Court finds that Harper is a member of OCCA.

Harper argues that it submitted a bid and so has standing to prosecute this action. Harper argues that because Harper is member of OCCA, OCCA also has standing.

However, the Court does not believe that the question is that simple.

The purpose of the requirement that the State, in this case through ODOT, shall contract with the *lowest competent and responsible* bidder is to "enable a public contracting authority to obtain the best work at the lowest possible price while guarding against favoritism and fraud." State ex rel. Association Bldrs. & Contrs., 106 Ohio App. 3d. at 181 (citing Cedar Bay Constr., Inc. v. Fremont (1990), 50 Ohio St. 3d 19, 21). This is a requirement placed upon the State with regard to entities with which it contracts.

This issue was directly addressed in Treadon v. City of Oxford (Butler 2002), 149 Ohio App. 3d 713. The City of Oxford solicited bids for the construction of a parking garage. Two bids were submitted to Oxford, one by Hotel Development Services ("HDS") and one by Warm Bros. Construction Company ("Warm").

Robert J. Treadon & Associates ("Treadon"), an architectural firm, agreed to prepare the overall architectural design for Warm. The City of Oxford awarded the bid to HDS. Both Warm and Treadon filed a complaint alleging that Warm was the lowest-and-best bid.

In the City's motion for summary judgment, the trial court upheld the City's decision to award the contract to HDS as the lowest-and-best bidder and dismissed Treadon's complaint as a subcontractor for lack of standing. The single assignment of error on appeal was that the trial court erred to the prejudice of plaintiffs-appellants when it granted the defendant's motion for summary judgment. The trial court specifically found that Warm had standing to bring the action, so any discussion on appeal regarding standing relates only to Treadon.

The appellate court held, "In Ohio, in order to have standing to challenge the award of a contract on a public construction project, the party must have submitted a bid on the project." Treadon, 149 Ohio App. 3d at 715. The court rejected appellant's argument that Treadon was in fact a "joint bidder." More relevant to the case at bar, the court rejected appellant's argument that it had standing as a subcontractor. The court went on to state, "There is no genuine issue as to any material fact. Warm Bros. submitted the bid and that bid was rejected because HAPC guideline standards were not incorporated into the design.

Since appellants did not submit a bid, they have no standing to file suit." Id. at 715.

The conclusion reached by the Treadon court is consistent with other cases in Ohio and makes good sense. The obligation to accept the lowest competent and responsible bid rests with the State. In contrast, contractors submitting bids to the State have no such obligation. Subject to some discriminatory limitations, private contractors are free to associate with whomever they choose. A contractor may not have a good relationship with a particular subcontractor and therefore may choose not to work with that subcontractor, even if it offers the lowest price. Therefore, whether a subcontractor has the lowest quote accepted by the prime contractor has no bearing on the State. The State, in this case ODOT, has no dealings with the subcontractor, which in this case is Harper.

If a disappointed subcontractor were allowed to file suit, it could very possibly draw the prime contractor into protracted and expensive litigation that the prime contractor has decided is not in its best interest. Furthermore, if all disappointed subcontractors were granted standing to file suit, it could result in multiple litigation that could cripple a governmental entity from entering into a contract.

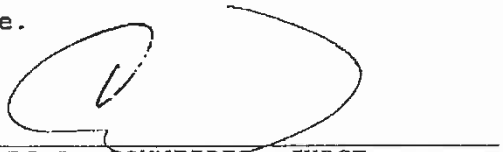
Plaintiffs have suggested that Connors v. Ohio Dep't of Transp. (Franklin 1982), 8 Ohio App. 3d 44, stands for the

proposition that subcontractors do have standing to file suit as a disappointed bidder. In Connors, the ODOT project's specifications imposed an absolute requirement that two percent of the awarded value of such contracts be subcontracted to minority contractors. If the successful bidder did not meet that mandatory requirement, the contractor was subject to termination. Both prime contractors and subcontractors filed suit before any contract was awarded to "challenge the bidding requirements."

The court found that both the contractors and the subcontractors had standing. However, the Connors decision has nothing to do with the award of a contract. Rather, it deals with the limited situation where the specifications of the contract are being challenged before a contract is awarded. In contrast, the case before this court does not concern such a situation, and so the Connors decision is not controlling.

In addition, Defendants argue that the Tiemann decision, also rendered by the Tenth District Court of Appeals, was issued seventeen years after the Connors decision and supports their position that Harper does not have standing. While it is true that Tiemann does cite Bicking, which contains language indicating that a contractor does not have standing if it does not submit a bid, this Court finds that the facts in Tiemann are distinguishable from both the facts of the present case and the Connors decision.

Based on the foregoing, this Court holds that Harper does not have standing to file this action. Because Harper lacks standing to bring this action, OCCA has no independent standing. Therefore, Defendants' motions to dismiss Harper and OCCA for lack of standing are GRANTED, and Plaintiffs' motion for a temporary restraining order is DENIED. Counsel for Defendants shall prepare an appropriate entry and submit the proposed entry to counsel for the adverse parties pursuant to Loc. R. 25.01. A copy of this decision shall accompany the proposed entry when presented to the Court for signature.



CHARLES A. SCHNEIDER, JUDGE

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COURT OF COMMON PLEAS
FRANKLIN COUNTY, OHIO

| | | |
|---|---|---|
| OHIO CONCRETE CONSTRUCTION ASSOCIATION, ET AL. | : | Case No. 08CVH09-13867 |
| Plaintiffs, | : | Judge Schneider |
| v. | : | |
| OHIO DEPARTMENT OF TRANSPORTATION, ET AL. | : | |
| Defendants. | : | |



TERMINATION NO. 18
BY KT 10/14/08

FINAL APPEALABLE ORDER

**JOURNAL ENTRY (1) DENYING PLAINTIFFS' MOTION FOR A TEMPORARY RESTRAINING ORDER, FILED SEPTEMBER 29, 2008;**

**AND**

**(2) GRANTING DEFENDANT JOHN R. JURGENSEN COMPANY'S MOTION TO DISMISS, FILED OCTOBER 2, 2008;**

**AND**

**(3) GRANTING DEFENDANT OHIO DEPARTMENT OF TRANSPORTATION'S MOTION TO DISMISS, FILED OCTOBER 2, 2008**

**(Case Terminated)**

This matter is before the Court to consider the (a) Motion of Plaintiffs The Harper Company and the Ohio Concrete Construction Association for a Temporary Restraining Order; (b) Motion of Defendant John R. Jurgensen Company's Motion to Dismiss; and (c) Defendant Ohio Department of Transportation's Motion to Dismiss and Memorandum in Opposition to Plaintiffs' Motion for Temporary Restraining Order. Upon consideration and being duly advised, and for those reasons set forth in this court's Order of October 6, 2008, it is ORDERED, ADJUDGED AND DECREED as follows:

1. Plaintiffs The Harper Company and the Ohio Concrete Construction Association's Motion for a Temporary Restraining Order is hereby DENIED;

2. Defendant John R. Jurgensen Company's Motion to Dismiss is GRANTED;

3. Defendant Ohio Department of Transportation's Motion to Dismiss is GRANTED; and

4. Plaintiffs' Complaint is dismissed as to all Defendants for lack of standing.

IT IS SO ORDERED.

Dated: 10/14/08

Honorable Charles A. Schneider

APPROVED:

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853-001:188375

COURT OF COMMON PLEAS
FRANKLIN COUNTY, OHIO

08CVH 09 13867

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|---|---|---|
| OHIO CONCRETE CONSTRUCTION ASSOCIATION<br>2600 Corporate Exchange Drive, Suite 165<br>Columbus, OH 43231, | : | Case No. _____ |
| and | : | |
| HARPER CONSTRUCTION<br>1648 Petersburg Road<br>Hebron, KY 41048, | : | Judge _____ |
| Plaintiffs, | : | |
| v. | : | |
| OHIO DEPARTMENT OF TRANSPORTATION<br>1980 West Broad Street<br>Columbus, OH 43223, | : | |
| and | : | |
| E.S. WAGNER COMPANY<br>840 Patchen Road<br>Oregon, OH 44706, | : | |
| and | : | |
| JOHN R. JURGENSEN COMPANY<br>11641 Mosteller Road<br>Cincinnati, OH 45241, | : | |
| Defendants. | : | |

FILED
COMMON PLEAS COURT
FRANKLIN COUNTY, OHIO
2008 SEP 29 AM 8:40
CLERK OF COURTS

## COMPLAINT FOR DECLARATORY AND INJUNCTIVE RELIEF

### PREAMBLE

This action arises from a challenge to the Ohio Department of Transportation's ("ODOT") decision to pursue an asphalt pavement option over a concrete pavement option with respect to its September 19, 2008 award of a contract for construction of a three-mile, multi-lane

highway bypass around Wilmington, Ohio (the "Wilmington Bypass"). As detailed below, in selecting the asphalt pavement option over the concrete option, ODOT intentionally picked a pavement product that is more expensive, less efficient, less durable, and more intrusive for the residents of Ohio than the concrete alternative. It did so in furtherance of a systematic and intentional bias in favor of asphalt over concrete, in violation of ODOT's statutory mandate and the public policy of Ohio, and at a substantial and unjustifiable cost to the taxpayers of Ohio.

## THE PARTIES

1. Plaintiff The Harper Co. ("Harper"), is a corporation incorporated under the laws of Ohio. Harper, as set forth below, is a concrete subcontractor that sought to obtain work on the Wilmington Bypass project, and which supplied the concrete pavement proposal for the Wilmington Bypass project that Defendant ODOT ultimately rejected. As an Ohio taxpayer, the Harper Company also has suffered a direct injury as a result of the actions and policies of ODOT as described herein.

2. Plaintiff Ohio Concrete Construction Association ("OCCA") is an Ohio-based trade association, comprised of concrete construction contractors who do business in Ohio. OCCA's members are qualified to bid on construction projects with ODOT. In addition, OCCA member Harper sought to obtain work as a subcontractor on the Wilmington Bypass project. OCCA's principal office is in Columbus, Ohio.

3. Defendant ODOT is a department of the state of Ohio, with its principal office at 1980 West Broad Street, in Columbus, Ohio.

4. Upon information and belief, Defendant E.S. Wagner Co. ("Wagner") is an Ohio limited liability company, with its principal place of business in Oregon, Ohio. Wagner, as set

forth below, is a general contractor and the winning bidder with respect to the primary contract awarded by ODOT for construction of the Wilmington Bypass project.

5. Upon information and belief, Defendant John R. Jurgensen Company ("Jurgensen") is an Ohio corporation with its principal place of business in Cincinnati, Ohio. Jurgensen, as set forth below, is the subcontractor that supplied the asphalt design alternative bid for the Wilmington Bypass project, which Defendant ODOT ultimately accepted.

6. Venue is appropriate in this Court because Defendant ODOT has its principal office in Franklin County.

## BACKGROUND

### A. History Of ODOT's Pavement Selection Procedures And Legislative Direction Thereof.

7. Historically, beginning with the creation of the federal interstate highway system, major highways in the state of Ohio and, indeed, across the country had been constructed with concrete paving materials.

8. In the 1980s and 1990s, at a time when substantial reconstruction of interstates was undertaken, Ohio—under the direction of ODOT—switched primarily to asphalt despite the fact that asphalt was inferior to concrete in terms of durability, maintenance and longevity. ODOT purportedly switched to mostly asphalt paving materials during this period because it was less expensive in terms of up-front cost without taking into consideration the additional cost of maintenance and resurfacing costs.

9. In fact, concrete has proven to be significantly more durable, less intrusive to motorists from a maintenance perspective, and more cost-effective for Ohio taxpayers than its asphalt counterpart.

10. Nonetheless, even into the early years of the 21st century, ODOT was apparently happy with its pavement selection process, which favored less-efficient and less-durable asphalt pavement over concrete by an overwhelming margin. The Ohio legislature clearly was not.

11. In 2003, the Ohio General Assembly enacted legislation designed with the goal of changing ODOT's pavement selection procedures to create an *objective* process by which ODOT would estimate the overall life-cycle cost of all feasible pavement alternatives, and select the alternative that provides taxpayers with the best overall, long-term value for their money.

12. Specifically, in 2003 the General Assembly passed Amended Sub. House Bill 87, which included a provision requiring ODOT to contract with a neutral third-party consultant to conduct an analysis of ODOT's pavement selection process. The consultant was to evaluate ODOT's process with similar selection processes employed by other states, and to make recommendations to ensure the efficiency and objectivity of Ohio's pavement selection process. Section 12 of Am. Sub. H.B. 87 ("H.B. 87") provided:

> 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 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. Once appointed, the council shall meet, at a minimum, every thirty days. 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 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.*

[Emphasis added.]

13. Pursuant to H.B. 87, ODOT contracted with ERES Consultants of Champaign, Illinois, which conducted its third-party analysis of ODOT's pavement selection procedures. ERES issued its final report on December 12, 2003. A true and accurate copy of the ERES Final Report is attached hereto as Exhibit A, and is expressly adopted and incorporated herein ("ERES Report").

14. In its final report, ERES offered a number of specific recommendations for improving both the objectivity and efficiency of Ohio's pavement selection process. These included recommendations designed to ensure that ODOT adequately and objectively considers long-term costs, with respect to maintenance as well as disruption to motorists, in making its pavement selection decisions.

15. ERES specifically recommended that ODOT adopt a "traditional" Life Cycle Cost Analysis ("LCCA") approach for evaluating the total long-term costs of feasible pavement alternatives prior to sending projects out for bids. As ERES recognized, this approach would allow ODOT to "calculate a net present value that includes initial cost comprised of all differential ... costs between the pavement alternatives and the total discounted future ... costs *including all expected contract resurfacing and rehabilitation work.*" See ERES Report, at 33 (emphasis added).

16. According to ERES, the LCCA approach is designed to allow ODOT to make an *objective comparison* of the total life-cycle costs of various pavement alternatives, and to make the pavement selection process "more transparent and easier to explain and understand" than the more subjective system ODOT had previously employed. Id.

17. In short, ERES—at the direction of the General Assembly—determined that a traditional life cycle cost analysis system would provide ODOT with an objective method of

determining the overall cheapest and most durable pavement alternatives, both in terms of overall cost (initial *and* long-term) and in terms of overall disruption to motorists as a result of future maintenance requirements.

18. Following the issuance of the ERES report, the Ohio legislature codified its mandate to ODOT with respect to pavement selection, and specifically directed ODOT to "identify and promote longer pavement life spans to lessen user delays and the disruption to traffic on the state highway system." See Ohio Rev. Code § 5501.11(B), effective March 29, 2005.

19. In September 2006, ODOT adopted a new department policy purportedly implementing, in significant part, the recommendations of ERES, specifically with respect to Life Cycle Cost Analysis of alternative pavement options. A true and accurate copy of ODOT Policy No. 20-006(P) is attached as Exhibit B hereto, and is expressly adopted and incorporated herein.

20. In Standard Procedure No. 520-001(SP), promulgated under Policy No. 20-006(P), ODOT announced a "data-driven, objective, transparent and repeatable process to determine pavement type for major projects [that] largely conforms to the pavement type selection processes of the majority of the states included in the [ERES] study." A true and accurate copy of SP No. 520-001 is attached as part of Exhibit B hereto, and is expressly adopted and incorporated herein.

21. Pursuant to this Standard Procedure, ODOT purportedly committed, in instances where more than one pavement alternative proves feasible from an engineering standpoint, to conduct an LCCA of the various alternatives and to base its pavement selections on the results of such "objective" analysis.

22. Upon information and belief, the application of a similar objective process in other climatologically similar states, including Indiana, Michigan and Illinois, has led those states to select concrete as the most cost-effective and durable pavement option for large-scale highway projects.

23. The same, however, cannot be said for Ohio.

**B. Despite Its Purportedly "Objective" Policy, ODOT Continues To Ensure That The Playing Field Is Tilted In Asphalt's Favor.**

24. Notwithstanding its "objective" pavement evaluation policy, ODOT—in contrast to many of its counterparts in neighboring states—has continued to wage an intentional campaign to ensure that asphalt remains "king" in Ohio, despite the cost to Ohio's taxpayers both in terms of dollars and long-term disruption. Indeed, ODOT continues to intentionally adopt and/or employ policies and procedures designed to effectively exclude concrete as a viable alternative to asphalt, in Ohio. This institutional bias is reflected in several respects.

**1. The Unilateral Asphalt Price Adjustment.**

25. The first, and perhaps most glaring example, of ODOT's efforts to favor the asphalt industry is the *automatic price adjustment* for asphalt provided in ODOT's standard specifications, applicable to all state highway construction projects. This price adjustment, which applies only to asphalt and *not to concrete or other pavement types*, indemnifies asphalt contractors where the unit price of asphalt increases by more than five (5) percent over the unit price at the time of bidding.

26. A true and accurate copy of ODOT's Construction and Materials Specifications Item 401 ("Asphalt Concrete Pavements—General"), is attached as Exhibit C hereto, and is expressly adopted and incorporated herein. Item 401.20 of the Construction and Materials Specifications provides, in pertinent part:

> Asphalt Binder Price Adjustment. Any contract item specifying asphalt concrete is eligible for a price adjustment, if the Department's asphalt binder index shows the price for asphalt binders has *increased* or decreased in excess of 5 percent and the adjustment is more than $100 for any individual item.
>
> [Emphasis added.]

27. Notably, since at least 2001, the price of asphalt has risen each year, regardless of fluctuations in the price of asphalt's underlying petroleum base. In fact, an August 2008 summary of percentage changes in Producer Price Indexes for Construction Materials and Components, compiled by the Associated General Contractors of America from price data provided by the federal Bureau of Labor statistics, shows that the overall price of asphalt increased by *double-digit percentage points* in each year from 2002 through 2008, except in 2007, when the price increased by a mere 5.8 percent (still above the price adjustment level). The same summary shows that the overall price of asphalt in July 2008 represented a 290 percent increase over 2003 prices. A true and accurate copy of the Producer Price Index summary, available at http://www.agc.org (last checked Sept. 25, 2008), is attached hereto as Exhibit D, and is expressly adopted and incorporated herein.

28. The practical effect of this unilateral price adjustment, in light of the historical trend in asphalt pricing, is to provide asphalt contractors with a free ticket to bid a particular project at the then-current asphalt cost, without accounting for the risk associated with future price increases. Instead, such risk, indeed substantial likelihood, of future price increases is simply borne by the state and, ultimately, the taxpayers.

29. Given that actual paving work often does not begin until years after a project is bid, the magnitude of this unilateral benefit to asphalt contractors cannot be overstated.

30. Upon information and belief, in this construction year alone, ODOT's asphalt price adjustment policy has required ODOT to spend *millions of dollars in unbudgeted funds* to cover asphalt contractors' increased material costs. That is millions of dollars that asphalt contractors, thanks to ODOT's policy, did not have to worry about at the time they made their respective bids. And, as discussed in more detail below, it is millions of dollars that ODOT *did not consider* in determining whether to select asphalt as opposed to another pavement option, such as concrete.

31. Of course, concrete and other pavement type contractors are not provided with the same level of protection as their asphalt counterparts. Rather, in making their respective bids, concrete contractors are required to account for the risk of future price increases, and must allocate such risk as part of their bid. In other words, without the prospect of guaranteed indemnification with taxpayer funds, concrete contractors must build the risk of future price increases into their bid price calculations.

32. The result of this policy is an inherently unequal allocation of risk and cost among equally viable pavement alternatives. The actual and intended effect of this policy is to afford asphalt contractors a free ticket to bid a particular project at the lower, current price of asphalt, even where they know that their *actual price* will be significantly higher at the time paving work begins. Concrete contractors, on the other hand, are not afforded a similar subsidy.

33. In short, ODOT has created an uneven playing field and, ultimately, it is the taxpayers who are unwittingly charged with ensuring that the field remains tilted in asphalt's favor.

### 2. ODOT Does Not Account For The Asphalt Price Adjustment In Its Life Cycle Cost Calculations.

34. But the mere existence of the asphalt price adjustment only accounts for half of the equation. In an effort to make certain that asphalt is given every conceivable advantage, ODOT does not account for the asphalt price adjustment as part of its pre-bid LCCA calculations.

35. Indeed, ODOT's LCCA calculations, pursuant to Policy No. 20-006(P), make no account for future increases in the price of asphalt even though, as recent history shows, such increases *will drastically increase the total price paid by Ohio's taxpayers if asphalt is selected.*

36. In other words, in evaluating which pavement type to select among feasible alternatives, ODOT does not even consider the impact of future asphalt price increases, even though *it (and not the contractors) will be required to absorb the cost of such increases*. This policy effectively results in an apples to oranges comparison between a life cycle cost for asphalt premised on an estimated asphalt price that does not reflect *the actual price to be paid by the state*, and a life cycle cost for concrete based on an estimated bid price that will *bind the concrete contractor for the duration of the contract*.

37. In short, ODOT, on the taxpayers' dime, indemnifies asphalt contractors for the likelihood of significant future price increases, but does not hold asphalt to account for these future increases in considering *which pavement type to select in the first place*. This policy only further guarantees asphalt's favored status in Ohio, again at the taxpayers' expense.

### 3. ODOT's Intentional Manipulation Of Data/Calculations In Favor Of Asphalt.

38. Upon information and belief, ODOT has further sought to insure asphalt's institutional advantage by intentionally manipulating data and/or inputs it considers as part of

engineering and economic feasibility analyses. Upon information and belief, this includes, but is not limited to, initial serviceability and loss of support design input values that are not consistent with American Association of State Highway and Transportation Officials ("ASHTO") guidelines followed by other state agencies, as well as utilizing more liberal than conservative engineering judgment for soil strength design inputs to favor the use of asphalt.

39. Also upon information and belief, ODOT has, in at least one instance, manipulated information as part of an LCCA to favor the selection of asphalt, where it appeared that without such manipulation, the LCCA would otherwise require a decision favoring concrete.

### C. The Wilmington Bypass Project Exemplifies ODOT's Intentional Asphalt Bias And Discrimination Against Concrete.

40. The Wilmington Bypass project exemplifies ODOT's intentional efforts to favor asphalt. Indeed, at both the LCCA stage and, ultimately, at the bidding and contracting stage of the Wilmington Bypass project, ODOT continues to demonstrate that there are no limits to its efforts to preserve asphalt's favored status in Ohio.

41. By way of background, the Wilmington Bypass project, as reflected in ODOT's August 20, 2008 proposal and the various addenda thereto, contemplates the construction of a 3.65-mile, multi-lane state highway near Wilmington Ohio. True and accurate copies of the August 20, 2008 Proposal for Project No. 080507, along with the five subsequent addenda thereto, are attached as Exhibits E and F hereto, and are expressly adopted and incorporated herein.

42. On September 10, 2008, ODOT received bids from general contractors that contained alternative proposals for concrete versus asphalt pavement options. The alternative pavement proposals were based on bids submitted to the general contractors by various pavement subcontractors.

43. Ultimately, on September 19, 2008, ODOT announced its decision to award the primary contract to Defendant Wagner and its election to pursue the asphalt design alternate.

44. Upon information and belief, Defendant Wagner's successful asphalt design alternate bid was premised on a subcontract proposal submitted to it by Defendant Jurgensen.

45. Wagner's concrete alternate design bid, which ODOT rejected, was based on a subcontract bid supplied to Wagner by Plaintiff Harper.

46. Although ODOT allowed submission of alternative bids for the project, as discussed below, its ultimate selection of asphalt pavement was never truly in doubt.

**1. ODOT's Failure To Account For The Asphalt Price Adjustment In Its LCCA For The Wilmington Bypass.**

47. ODOT conducted its original LCCA analysis for the Wilmington Bypass project in 2006. As part of this analysis, ODOT assumed a unit price of $70.24 for asphalt. A true and accurate copy of ODOT's original, 2006 LCCA for the Wilmington Bypass project is attached as Exhibit G hereto, and is expressly adopted and incorporated herein. This estimated unit price accounted for approximately 79 percent of the total initial construction cost of asphalt, for purposes of ODOT's LCCA calculations.

48. Based on this assumed price, ODOT calculated that the life cycle cost of asphalt would be approximately 16 percent less than concrete. This difference was based *entirely* on the assumed difference in up-front costs, even though the same LCCA revealed that the future maintenance costs for concrete were nearly $700,000 less than those estimated for asphalt.

49. Likewise, ODOT's LCCA for the Wilmington Bypass project did not consider potential costs for traffic control devices (such as pavement markings) for either asphalt or concrete.

50. ODOT's initial LCCA for the Wilmington Bypass project did not account for the asphalt price adjustment, let alone the exponential increase in petroleum and asphalt costs that ultimately occurred between 2006 and 2008, even before the project was actually bid.

51. In fact, the asphalt price ODOT ultimately awarded in September 2008 was more than $105, *nearly 50 percent higher than ODOT's LCCA per-unit estimate*. On the other hand, the actual bid price ODOT received for concrete in September 2008 was $32.44 per unit, $.17 less than it had estimated in the 2006 LCCA.

52. Nonetheless, on the basis of its unadjusted 2006 LCCA calculations, ODOT initially selected asphalt as the pavement type to be used on the Wilmington Bypass project.

### 2. ODOT Rigs The Alternative Bid Process After Realizing That Increases In Asphalt Costs Could No Longer Justify Its Original LCCA Calculations.

53. As noted above, by 2008, even before bidding began on the Wilmington Bypass project, it became clear that the unit price of asphalt was significantly higher than the figure ODOT used in its LCCA calculations. The price of concrete, however, had remained relatively constant.

54. Faced with the reality that its original calculations with respect to asphalt could no longer be justified, ODOT ultimately agreed to accept alternative bids for asphalt and concrete pavement types. But, as we now know, this concession did nothing to level the playing field.

55. Instead, even in allowing alternative bids, ODOT once again chose to create an unequal playing field and it established unequal specifications for the alternative asphalt and concrete bids. Such specifications imposed a disproportionate burden on concrete and ultimately drove up the up-front cost of concrete, thereby allowing ODOT to purportedly justify its preordained decision to select the asphalt alternative.

56. The specifications at issue required concrete bidders to incur significant additional costs for a top-of-the-line pavement marking system (i.e., typically "traffic control" items), and required concrete contractors—but not asphalt contractors—to account for an additional .50 inch of gravel aggregate base that was not part of the asphalt specifications. On the other hand, specifications for the asphalt alternative required a lower-priced pavement marking system, even though the same top-of-the-line pavement marking system required in the concrete alternative *could have been specified for the asphalt alternative*.

57. The addition of these unequal traffic control specifications, which were notably absent from ODOT's original LCCA, imposed approximately $184,000 in additional costs on concrete bidders. As a result of this newly-added cost, the actual concrete bid that ODOT received was $71,801.92 more than its asphalt counterpart. A true and accurate summary of the winning bidder's actual bid amounts for both asphalt and concrete pavement types is attached as Exhibit H hereto, and is expressly adopted and incorporated herein.

58. Absent these unequal traffic control specifications, however, the actual *up-front* bid price for concrete was *$112,268.31 lower than asphalt*—even without considering the asphalt price adjustment and the long-term cost savings associated with concrete, as documented in ODOT's initial LCCA.

59. Yet, even including the extra traffic control costs in the actual concrete bid, the initial $72,000 difference in up-front cost is off-set several times over by the $700,000 differential in long-term maintenance costs reflected in ODOT's initial LCCA (a differential that is likely even greater today given the recent increases in the price of asphalt). And, again, this analysis does not even account for the asphalt price adjustment, which will almost certainly result in an additional cost to the taxpayers when paving work actually begins.

60. Obviously, ODOT did not conduct an additional LCCA upon its receipt of the alternative bids. Nor did it otherwise account for potential future increases in the price of asphalt. Had it done so, or had it simply looked *at its original LCCA calculations* in light of the new asphalt prices, it would have concluded that concrete was the correct choice for this project.

61. Instead, ODOT simply ignored its own life cycle cost analysis and relied upon an artificially inflated upfront bid price to justify its pre-ordained selection of asphalt as Ohio's pavement of choice—at a significant cost to Ohio's taxpayers. In doing so, ODOT refused to select the lowest competent and responsible bidder.

62. Plaintiffs have been irreparably harmed and lack an adequate remedy at law.

## COUNT ONE

**(Declaratory Relief Pursuant to Ohio Rev. Code § 2721.01 et seq., and Rule 57 of the Ohio Rules of Civil Procedure As To The Illegality And Invalidity Of ODOT's Asphalt Price Adjustment and LCCA Policy and Procedure)**

63. Plaintiffs reallege the foregoing paragraphs as if fully rewritten herein.

64. Pursuant to Section 5525.01 of the Ohio Revised Code, ODOT is required to award publicly bid contracts to the "lowest competent and responsible bidder."

65. The Ohio General Assembly, both in its enactment of H.B. 87 and in Section 5501.11(B) has made clear that ODOT is to ultimately determine the "lowest competent and responsible bidder" on the basis of a life cycle cost analysis that determines which of various feasible pavement materials is most cost effective and durable over the long run. These legislative enactments also establish the public policy of Ohio.

66. In both applying a unilateral price adjustment to asphalt as part of the bidding process and in failing to account for such price adjustment as part of its LCCA for the various

pavement alternatives, ODOT has run directly afoul of its legislative mandate with respect to pavement selection, and it has violated the public policy of Ohio as reflected above.

67. In addition, in continuing to employ these policies in violation of its legal obligations, ODOT has acted in an arbitrary and capricious manner and it has, thus, abused its discretion as a public department of the state of Ohio.

68. Plaintiff Harper, as an unsuccessful subcontractor, and Plaintiff OCCA, as a trade association representing Plaintiff Harper, among others, have been and continue to be directly impacted by the above-described ODOT policies and practices and, thus, a justiciable controversy exists. Plaintiffs have a legal interest in the controversy, and declaratory relief from this Court will resolve this controversy and eliminate uncertainty as to the legality of the specific ODOT policies and actions at issue in this case.

69. As alleged herein, a real, substantial, and immediate controversy is presented regarding the rights, duties, and liabilities of the parties. Plaintiffs therefore request declaratory judgment from this Court pursuant to Civil Rule 57 and Section 2721.01 et seq., of the Revised Code that (a) ODOT is obligated to select the pavement design alternative that is the lowest competent and responsible bidder; (b) ODOT's unilateral asphalt price adjustment and its failure to account for such adjustment as part of the LCCA process are illegal and invalid, inasmuch as they violate the Ohio Revised Code with respect to consideration of overall long-term costs of pavement materials as part of the bidding and contracting processes; (c) ODOT's unilateral asphalt price adjustment and its failure to account for such adjustment as part of the LCCA process are invalid because they are illegal and/or violate Ohio public policy as reflected in the above-described legislative mandates; (d) ODOT's unilateral asphalt price adjustment and its failure to account for such adjustment as part of the LCCA process constitute an abuse of

ODOT's administrative discretion, and for this additional reason, they are invalid; and (e) identification of the lowest competent and responsible bidder for projects where there is a paving component requires a LCCA and a comparison with the LCCA for alternative pavement designs.

## COUNT TWO

### (Declaratory And Injunctive Relief As To The Illegality and Invalidity of the Asphalt Portion of the Wilmington Bypass Contract)

70. Plaintiffs reallege the foregoing paragraphs as if fully rewritten herein.

71. As set forth above, the LCCA analysis and bid consideration policies and processes ODOT employed in ultimately selecting the pavement alternative for the Wilmington Bypass project are both illegal and contrary to Ohio public policy.

- ODOT failed to account for asphalt price increases in its LCCA calculations for the Wilmington Bypass project.
- ODOT failed to account for long-term cost savings of concrete in its analysis of the actual bids it received.
- ODOT selected the alternative that was more expensive and less durable.

In each of these respects, both individually and collectively, ODOT failed to fulfill its obligations under Ohio law (and to the Ohio taxpayers).

72. As a result, the asphalt aspect of the Wilmington Bypass contract awarded to Defendant Wagner is illegal and contrary to Ohio public policy, and that portion of ODOT's award constituted an abuse of ODOT's administrative discretion.

73. In addition, ODOT's imposition of unequal specifications on concrete and asphalt bidders, and its failure to consider the life cycle costs upon receipt of the actual bids (where such costs actually favored concrete by a wide margin), reflects an arbitrary and capricious, and unjustified exercise by ODOT of its administrative authority. As a result, its decision to award

the asphalt alternative on the basis of such unequal specifications constituted an abuse of its discretion.

74. As alleged herein, a real, substantial, immediate, and justiciable controversy is presented regarding the rights, duties, and liabilities of the parties with respect to the asphalt portion of the Wilmington Bypass contract. Plaintiffs therefore request declaratory judgment from this Court pursuant to Civil Rule 57 and Section 2721.01 et seq., of the Revised Code that the asphalt aspect of the Wilmington Bypass contract is void because it is illegal, contrary to public policy, and constitutes an abuse of ODOT's discretion.

75. Plaintiffs are also entitled to an order temporarily and permanently restraining and enjoining enforcement of the void asphalt portion of the Wilmington Bypass contract because it is illegal and constitutes an abuse of ODOT's discretion.

**COUNT THREE**

**(Violation Of Equal Protection Clause)**

76. Plaintiffs reallege the foregoing paragraphs as if fully rewritten herein.

77. For purposes of ODOT's LCCA calculations and consideration of alternative bids, asphalt and concrete are similarly situated because they constitute directly competitive pavement products and are substitutes for purposes of ODOT's pavement selection process.

78. For purposes of its LCCA and bid analysis policies and procedures, however, ODOT classifies these similarly situated products and the contractors that supply them differently in applying a price adjustment only to asphalt and in failing to account for the asphalt price adjustment as part of its LCCA calculations.

79. As a result of the different classifications of similarly situated competitors, ODOT evaluates the future cost of asphalt on the basis of an artificially low price calculation and asphalt

contractors are able to submit artificially low bids. Concrete contractors, on the other hand, are not afforded the same opportunity. These built in advantages have enabled asphalt to retain its dominance as the pavement type of choice for ODOT, at the expense of concrete and other similarly-situated pavement products and industries. ODOT further fails to apply an LCCA in identifying the lowest competent and responsible bidder. This failure further arbitrarily favors asphalt suppliers and contractors.

80. There is no rational justification for ODOT's disparate treatment of similarly situated and substitute pavement products and industries.

81. In addition, as part of its systematic practice of favoring asphalt over concrete, ODOT has exhibited intentional and purposeful discrimination against concrete and other pavement alternatives rooted in an institutional bias in favor of asphalt. The badges of this intentional discrimination include ODOT's unilateral price adjustment for asphalt, ODOT's failure to account for the price adjustment as part of the LCCA process, and in the unequal specifications imposed on the asphalt and concrete alternatives as part of the Wilmington Bypass project bidding process.

82. ODOT's unlawful, disparate treatment of concrete and asphalt competitors, and its intentional bias in favor of asphalt and intentional discrimination against concrete violate the equal protection clause of Ohio's constitution, Art. I § 2.

WHEREFORE, Plaintiffs demand judgment against Defendants as follows:

A. An order declaring:

(1) That ODOT is obligated to select the payment design alternative that is the lowest competent and responsible bidder;

(2) That ODOT's unilateral asphalt price adjustment and its failure to account for such adjustment as part of the LCCA process are illegal and invalid, inasmuch as they violate the Ohio Revised Code with respect to consideration of overall long-term costs of pavement materials as part of the bidding and contracting processes;

(3) That ODOT's unilateral asphalt price adjustment and its failure to account for such adjustment as part of the LCCA process are invalid because they are illegal and/or violate Ohio public policy as reflected in the above-described legislative mandates;

(4) That ODOT's unilateral asphalt price adjustment and its failure to account for such adjustment as part of the LCCA process constitute an abuse of ODOT's administrative discretion, and for this additional reason, they are invalid;

(5) That identification of the lowest competent and responsible bidder for projects where there is a paving component requires an LCCA and a comparison with the LCCA for alternative pavement designs; and

(6) That the asphalt aspect of the Wilmington Bypass contract is void because it is illegal, contrary to public policy, and constitutes an abuse of ODOT's discretion.

B. Temporary, preliminary, and permanent injunctive relief:

(1) Restraining and enjoining Defendants and their agents, servants, employees, attorneys, and those in active concert or participation with them from executing, implementing, and/or enforcing the asphalt portion of ODOT's Wilmington Bypass contract between ODOT and Defendant Wagner;

(2) Restraining and enjoining Defendant ODOT and its agents, servants, employees, attorneys and those in active concert or participation with it from awarding any other

contract for a project with a paving component unless the actual bid prices received are assessed pursuant to an LCCA and compared with the LCCA for alternative pavement designs; and

(3) Requiring ODOT to select the concrete alternative for the Wilmington Bypass project.

Respectfully submitted,

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# Neutral Third Party
# Ohio Pavement Selection Process Analysis

## Final Report

Prepared for
Ohio Department of Transportation
Pavement Selection Advisory Council
1980 W. Broad Street
Columbus, Ohio 43223

Prepared by
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505 W. University Avenue
Champaign, Illinois 61820

December 12, 2003

## FOREWORD

During the 2003–2004 regular session of the General Assembly, the Ohio State Legislature included in Section 12 of House Bill 87 the following provision calling for an evaluation of the Ohio Department of Transportation's (ODOT's) pavement type selection process:

> 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 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. Once appointed, the council shall meet, at a minimum, every thirty days. 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 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.

This report presents the findings and recommendations reached by the neutral third party (NTP), the ERES Consultants Division of Applied Research Associates, Inc. The NTP interviewed and took testimony from representatives of the Flexible Pavements of Ohio, Ohio Concrete Construction Association, and ODOT. In addition, the NTP team traveled to 10 States/Provinces where they interviewed respective DOT staff members regarding the processes they follow in making pavement type selections. Informal discussions were also held with representatives of the asphalt and concrete pavement associations in those 10 States/Provinces, as well representatives of the Federal Highway Administration (FHWA) in the Ohio Division and Washington Headquarters offices.

This report was prepared by key staff members of the NTP. These individuals include Mr. John P. Hallin (Project Manager), Mr. David K. Hein (Assistant Project Manager), Mr. Harold L. Von Quintus, Dr. Michael I. Darter, Mr. Kelly L. Smith, and Mr. Jag Mallela.

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## INTRODUCTION

Pavement type selection is one of the more challenging engineering decisions that highway administrators face today. They must balance issues of both short- and long-term performance with initial and long-term costs. The stakeholders that highway administrators answer to, the traveling public, generally do not express strong feelings on the type of pavement constructed, as long as reasonable levels of service, safety, and ride quality are provided. However, administrators must deal with the spirited competition that exists between the asphalt and concrete pavement industries.

Competition can be healthy when it leads to improvements in overall quality and cost reductions. It becomes unhealthy when it results in engineering decisions being moved to the political arena. It is an agency's responsibility to provide its constituents (the traveling public) with cost effective, good-performing roads. Conversely, it is the responsibility of the industries to illustrate that their products meet or exceed established performance criteria and are cost effective. It is prudent for both parties to use innovation and new technologies to improve the overall performance and long term cost effectiveness of Ohio's roads.

The dilemma facing the highway engineer or administrator can be summarized best by the following quote from the American Association of State Highway and Transportation Officials (AASHTO) *Guide for Design of Pavement Structures* [1]:

> The selection of pavement type is not an exact science but one in which the highway engineer or administrator must make a judgment on many varying factors such as traffic, soils, weather, construction, maintenance, and environment.
>
> The selection process may be facilitated by comparison of alternative structural designs for one or more pavement types using theoretical or empirically derived methods. However, such methods are not so precise as to guarantee a certain level of performance from any one alternate or comparable service for all alternatives.
>
> Also, comparative cost estimates can be applied to alternate pavement designs to aid in the decision-making process. The cost for the service of the pavement should include not only the initial cost but also subsequent cost to maintain the service level desired. It should be recognized that such procedures are not precise since reliable data for maintenance, subsequent stages of construction, or corrective work and salvage value are not always available, and it is usually necessary to project costs to some future point in time. Also, economic analyses are generally altruistic in that they do not consider the present or future capabilities of the contracting agency.

To further cloud the issue of pavement type selection, highway administrators face a high degree of uncertainty regarding the types of loadings a pavement will experience during a pavement life that can range from 20 to 50 years. During the nearly 50 years since the beginning of the

Interstate program, the United States has experienced a number of unforeseen changes in traffic and traffic loadings. These have included legislative changes that increased the size and weight of trucks, a large move from rail freight movement to truck freight, and just-in-time delivery.

Because of this uncertainty, pavement type selection processes are largely subjective and tailored to the needs of each individual State highway agency. The neutral third party (NTP) was tasked by the Ohio Pavement Selection Advisory Council (PSAC) with minimizing the subjectivity of Ohio's pavement selection process by reviewing the existing process and making recommendations for improvement. We began this assignment with a number of beliefs, and those beliefs were not altered during our review of what other States are doing:

- Pavement type selection is an engineering decision that is the sole responsibility of the highway agency.

- In most cases where pavement type selections are made on high-volume routes (Interstates, freeways, toll roads), properly designed and constructed flexible or rigid pavements will provide an excellent level of service.

The recommendations provided in this document are based largely on practices of the States/Provinces selected for review, along with guidance provided by AASHTO and the Federal Highway Administration (FHWA). When reviewing the practices of other States, we tried to identify advantages and disadvantages with specific aspects of their systems. We also consulted the trade organizations in a number of the States to get their views on pavement type selection.

This report is structured to present a summary of the issues that were raised by the pavement industries in Ohio, a review of the pavement design and selection processes of 10 highway agencies, a review of AASHTO and FHWA guidance on pavement type selection, and conclusions and recommendations to address the issues raised for the pavement type selection process in Ohio. Detailed information collected during the study is presented in the appendices.

## BACKGROUND

The Ohio Department of Transportation (ODOT), as part of its responsibility to make economically sound decisions that provide the most benefit for each dollar spent, began an effort in the fall of 2001 to develop a formalized, objective, unbiased pavement selection process. It was envisioned that the revised pavement type selection would be developed through a consensus process by a committee composed of members from the ODOT Office of Pavement Engineering, Ohio/Kentucky Chapter of the American Concrete Pavement Association (now Ohio Concrete Construction Association), Flexible Pavements of Ohio, FHWA, ODOT Office of Construction Administration, ODOT Multi-Lane Coordinator, and ODOT District Offices.

The committee held three meetings between September 2001 and May 2002. Shortly after the May 2002 meeting, ODOT management became impatient with the progress being made by the committee and charged the Office of Pavement Engineering with developing a new pavement type selection by July 31, 2002.

The first draft of the revised pavement type selection was submitted for industry and FHWA review in August 2002. The revised system was a matrix type of analysis that considered various cost, traffic, and engineering factors objectively. It was based on a concept presented in National Highway Institute (NHI) Course 13114, "Highway Pavements," and the 1993 AASHTO Design Guide (section 3, chapter 2), as well as suggestions received from Flexible Pavements of Ohio. Each industry provided extensive comments on the first draft. A second draft was issued in December. Again, numerous comments were received. On April 17, 2003, a final version of "Pavement Selection the ODOT Way" was issued. This document is included in appendix A.

The controversy over the draft pavement selection documents resulted in the Ohio Legislature including Section 12 of House Bill 87 requiring a NTP review of the pavement type selection process in Ohio.

## ISSUES

As the majority of the pavement type selection issues were raised by the industry trade organizations in Ohio, the first step in the review process was to conduct detailed interviews with each of the paving industries. The significant issues raised by each trade organization are summarized in the following sections.

### Flexible Pavement Industry Issues

Flexible Pavements of Ohio was interviewed on September 3, 2003, with a follow-up interview on October 14, 2003. Transcripts were made of these interviews, and they are available on the Internet at http://www.ohiopavementselection.org/. The following were the significant comments and issues raised by Flexible Pavements of Ohio at these interviews:

- The first scheduled rehabilitation for flexible pavements should be revised from 12 to 17 years. Furthermore, the mill and overlay should be limited to the mainline only. Currently, the first rehabilitation is mill and overlay of 1.5 inches. The second mill and overlay should be 14 years after the first rehabilitation and should consist of a 2-inch thick overlay instead of 3.75 inches. Industry feels that the initial pavement design provides adequate structural capacity for the full analysis period.
- The cost analysis should consist of a life cycle cost and a future cost, which should be considered separately.
- The cost analysis would be easier to understand if both initial and life cycle costs had the same weight but different levels of importance (e.g., I=10 initial, I=8 future).
- Spread factors for initial cost, life cycle cost, initial user delay, and future user delay should be 1.0, 0.75, 0.50, 0.25, and 0 to provide a uniform separation.
- There is a need to evaluate engineering and administration costs and relate the percentages to the type of work. Currently, a figure of 7 percent is used by ODOT, and industry believes that this is excessive. The costs for engineering and administration should be commensurate with the complexity of the project.
- There should be an attempt to quantify the actual maintenance of traffic cost (the industry believes that the 10 percent currently applied to all projects may not reflect actual costs).
- Maintenance of traffic, and engineering and administration costs should be added to both the initial costs and the future costs.
- Noise is an important consideration and should be included in the scoring evaluation. Noise should be a scoring factor with an importance of 8 in urban areas and 6 in rural areas. The spread factor should be quantified as follows:
  - 0 to 2 decibels of the quietest pavement equals 1.
  - 2 to 4 decibels of the quietest pavement equals 0.5.
  - 4 to 6 decibels of the quietest pavement equals 0.25.
  - 6 to 8 decibels of the quietest pavement equals 0.125.
  - Greater than 8 decibels of the quietest pavement equals 0.
- 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.

- User delay should have an importance factor for future maintenance of 3 instead of 6, which gives it the same importance as initial construction user delay.
- The reliability of ride should be increased from 3 to 5, since the measurement of ride quality is standard for pavement construction projects in Ohio.
- Flexible reconstruction projects should be treated the same as rigid pavement reconstruction projects in terms of construction traffic management. In other words, if traffic is diverted to one side for rigid pavements, it should be the same for flexible pavements.
- Step 4 of the pavement selection process should be modified to evaluate other factors, such as bridge construction, that could be the primary factor influencing traffic disruption.
- Revise layer coefficients.
  - Increase surface and intermediate layers from 0.35 to 0.45
  - Revise bituminous base from 0.35 to 0.37 (these revisions would reduce the required layer thicknesses and, therefore, initial cost).
- Recycled asphalt.
  - ODOT should review the current limitations on use based on an ODOT study performed by CTL Engineering.
- Break and seat.
  - ODOT should allow the use of break and seat rehabilitation, based on a study completed by the University of Cincinnati.

**Rigid Pavement Industry Issues**

The Ohio Concrete Construction Association (OCCA) was interviewed on September 4, 2003. A transcript was made of the meeting and is available on the Internet at http://www.ohiopavementselection.org/. The following were the significant comments and issues raised at this interview:

- There is an inherent bias at ODOT that favors hot mix asphalt (HMA).
  - Bias = systemic familiarity with HMA.
  - Much of Ohio's interstate system was built using long jointed reinforced concrete (JRCP). The JRCP designs still carried several times their initial design traffic.
  - Many early portland cement concrete (PCC) pavements in Ohio suffer from D-cracking, which is caused by the deterioration of certain aggregates under freeze thaw conditions. Improved aggregate selection has largely addressed this problem.
- Industry has a major concern with the methods used to estimate initial construction costs for PCC pavements.
  - There are insufficient representative projects and geographical diversity to develop an accurate unit cost for life cycle cost analysis (LCCA).
  - The unit cost data being used to establish unit costs include non-mainline paving and/or small projects that are not representative of the true costs of concrete pavement construction.

- The estimating procedure should be similar to that used by contactors and include items such as materials, labor, equipment, and placement costs at a specific project location.
- A shorter time horizon than 3 years should be used for the development of unit prices.
- Unit prices should be developed and published every 6 months.

- "Pavement Selection the ODOT Way."
  - The OCCA is not in favor of the scoring system used in this document, preferring decisions based primarily on life cycle cost analysis. There is no basis or documentation for the scoring factors (weight, importance, reliability, spread). OCCA feels that the scoring system is unnecessarily complex and that any system should be readily understandable and transparent.
  - User delay costs, not user delay days, should be factored into the LCCA calculations.
  - There is no provision for making future changes (e.g., how would you include another pavement type, such as composite pavements?).
  - No provision for specification changes.
  - No factor for pavement-related safety (e.g., rutting, lighting).
  - Should include routine maintenance in LCCA (e.g., crack sealing, pothole patching, seal coats, joint sealing).
  - Due to the limited use of the current PCC pavement design in Ohio, consideration should be given to using pavement performance data from other agencies to assist in developing the future rehabilitation schedule for concrete pavements.
  - ODOT does not plan to review post-bid information to see if their procedure for determining unit prices is valid or to assess the impact of the asphalt price adjustment on the unit price of HMA.
  - There is general agreement with the schedule for future rehabilitation for PCC; however, an asphalt overlay should not be required as a structural enhancement at year 32.
  - The maintenance repair quantities for PCC pavements at Year 22 are too high.
  - The initial cost is over-weighted in the decision matrix.
  - Ride should not be included in the scoring system because it is already accounted for in the pavement smoothness specifications.
  - Recycling should not be used as a scoring factor, and even if it is used, the spread factors for recycling should be the same for PCC and HMA.
  - Discount rate should be based on factors in Ohio, not OMB A94.
- Pavement design.
  - The relationship used to convert California Bearing Ratio (CBR) to resilient modulus may not be appropriate for use in Ohio.
  - The improvement in the CBR value due to soils stabilization is questionable.
  - The quantity of undercutting during construction should be less for PCC than HMA.
  - Since both pavement types are constructed to the same ride quality specifications, the same initial serviceability level should be used for both pavement types.
  - 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.

- Construction/specifications.
  - The asphalt price adjustment provides an unfair advantage to the HMA.
  - PCC should be considered recyclable.
  - The 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 and PCC is 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.

**Issues Raised by the General Public**

There was a presentation by two private citizens on tire/pavement noise for PCC pavements at the August 7 meeting of the PSAC. In addition, numerous e-mails were received at the project Web site related to the subject of pavement noise. It is these citizens' opinion that it will be a disservice to roadway users if pavement noise is not included in the list of pavement selection process criteria.

## PRACTICES OF COMPARISON STATES/PROVINCES

### Background

A major component of this study was to visit 10 highway agencies and to document their pavement type selection procedures to permit comparison with ODOT's selection process. The selection of the States/Provinces to be interviewed was made in consultation and with the concurrence of the Pavement Selection Advisory Council. Selection of the 10 States interviewed was based on the following criteria:

- Climate similar to Ohio—This evaluation was accomplished using the climatic zones contained in Part III, Section 3.3.5 of the *AASHTO Guide for Design of Pavement Structures* [1]. As shown in figure 1, the United States is divided into nine regional zones that are formed by the intersection of three moisture regions and three temperature regions. The three moisture regions are:

  I. High potential for moisture presence in the entire pavement structure throughout the year
  II. Seasonal variability of moisture in the pavement structure
  III. Very little moisture in the pavement structure during the year

  The three temperature regions are:

  A. Severe winters with a high potential for frost penetration to appreciable depths into the subgrade
  B. Freeze-thaw cycles in the surface and base. Severe winters may produce frozen subgrade, but long-term freezing problems are minor.
  C. Low temperatures are not a problem. Stability at high temperature should be considered.

  Pavements within a given climatic zone typically exhibit similarities in performance, moisture-related distress, and drainage-related rehabilitation work required.

- Traffic volumes similar to Ohio—The selected State was to have interstate routes carrying high volumes of total traffic and truck traffic.
- Existence of sizeable metropolitan areas—The selected State was to have several medium to large urban areas.
- Balance of pavement types used—The selected States were to represent a mix of pavement types on their system. This would include a balance of States that predominately build one type of pavement.

Table 1 provides a list of the States selected for review, along with details concerning their conformance with the selection criteria.

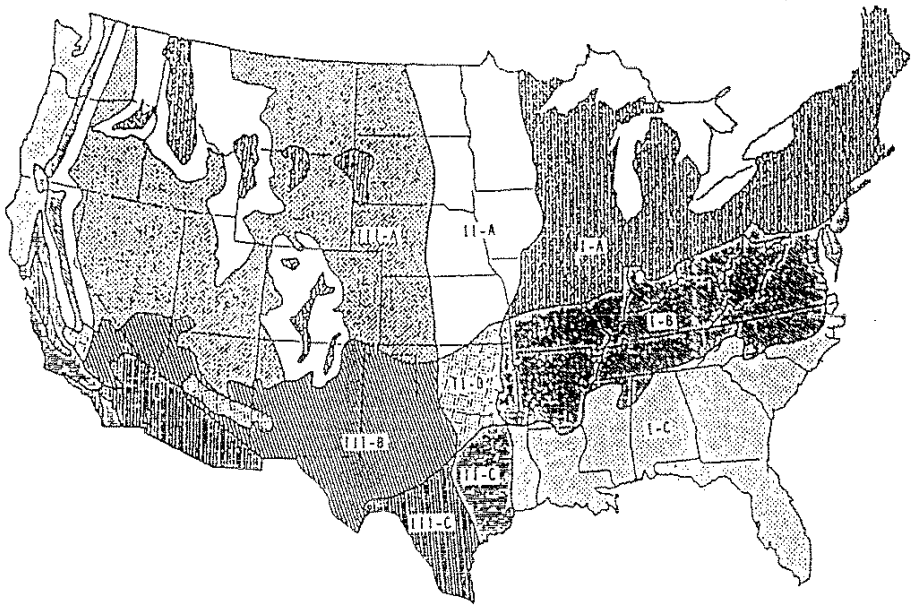


Figure 1. Climatic zones in the United States [1].

Table 1. States selected for comparison and their conformance with selection criteria.

| Rank | State | Climatic Zone | Truck Volumes | Total Traffic | Urban Areas | NHS Divided ≥ 4 lanes (Miles) | Interstate System | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | % ACP | % PCC | % Comp[1] |
| 1 | Illinois | I-A | High | High | Large | 3408 | 3.0 | 25.2 | 71.8 |
| 2 | Michigan | I-A | High | High | Large | 2243 | 12.3 | 50.7 | 37.0 |
| 3 | Pennsylvania | I-A | Med-High | High | Large | 3217 | 11.0 | 32.7 | 56.2 |
| 4 | Indiana | I-A | High | High | Large | 1984 | 7.9 | 14.4 | 77.8 |
| 5 | New York | I-A | Med-High | High | Large | 3060 | 27.7 | 17.7 | 54.6 |
| 6 | Maryland | I-B | High | High | Large | 1205 | 88.6 | 6.2 | 5.2 |
| 7 | Wisconsin | I-A | Med-High | Med High | Medium | 2012 | 0.0 | 49.5 | 50.5 |
| 8 | Ontario | I-A | High | High | Large | 1286 | 69.1 | 6.6 | 24.2 |
| 9 | Washington | II-A/III-A/I-C | Med-High | High | Large | 1306 | 60.4 | 36.0 | 2.2 |
| 10 | Minnesota | I-A/II-A | Med | Med High | Large | 1930 | 12.2 | 54.7 | 33.1 |

1. Includes pavements originally constructed as PCC and overlaid with asphalt concrete (AC) as a rehabilitation activity.

The highway agency reviews were performed in September and October 2003. Each review consisted of meeting with the person responsible for developing the pavement type selection documentation and/or overseeing its application/use within the agency. During the interview a review questionnaire was completed. The completed questionnaires for each of the agencies are included in appendix C. Copies of manuals containing the agencies' procedures for pavement type selection were also obtained during the interview. In addition, the agency's construction specifications, available at each agency's Web site, were reviewed for information on methods of payment for pavement items and specifications related to the use of recycled materials.

A flow chart was developed for each agency summarizing their pavement type selection process. These flow charts are included in appendix B. A spreadsheet was also developed as an aid in comparing each of the agencies procedures with those of ODOT. This spreadsheet is included in appendix D.

**Agency Pavement Type Selection Processes**

In our reviews, we found three processes that were being followed. For later reference, we will label them as methods A, B, and C. The processes are described in the following sections.

Pavement Type Selection Method A

This is the process generally followed by Indiana, Maryland, Washington, Illinois, Wisconsin, and Pennsylvania. This process, which is illustrated in figure 2, consists of two principal steps:

1. Alternatives are developed and LCCA is performed. If the life cycle cost is within a set range, generally 10 percent (Washington 15 percent, Wisconsin 5 percent), the life cycle costs are considered equivalent.
2. Alternatives with equivalent life cycle costs are evaluated subjectively. Factors that may be considered include adjoining pavement types, constructability, traffic control, subgrade support, and traffic volumes.

   A variation of this method is currently under consideration by Maryland. They are considering a modification to their system, as shown on page B-5, to replace the subjective evaluation of other factors with a matrix driven of evaluation of these factors.

The range of 10± percent at which deterministic life cycle cost values are considered equal is based on the fact that all of the inputs used in the LCCA are estimates with potential for significant variability. Table 2 is from the FHWA *Technical Bulletin on Life Cycle Cost* [2]. This table highlights the fact that there are no fixed values used when performing a LCCA.

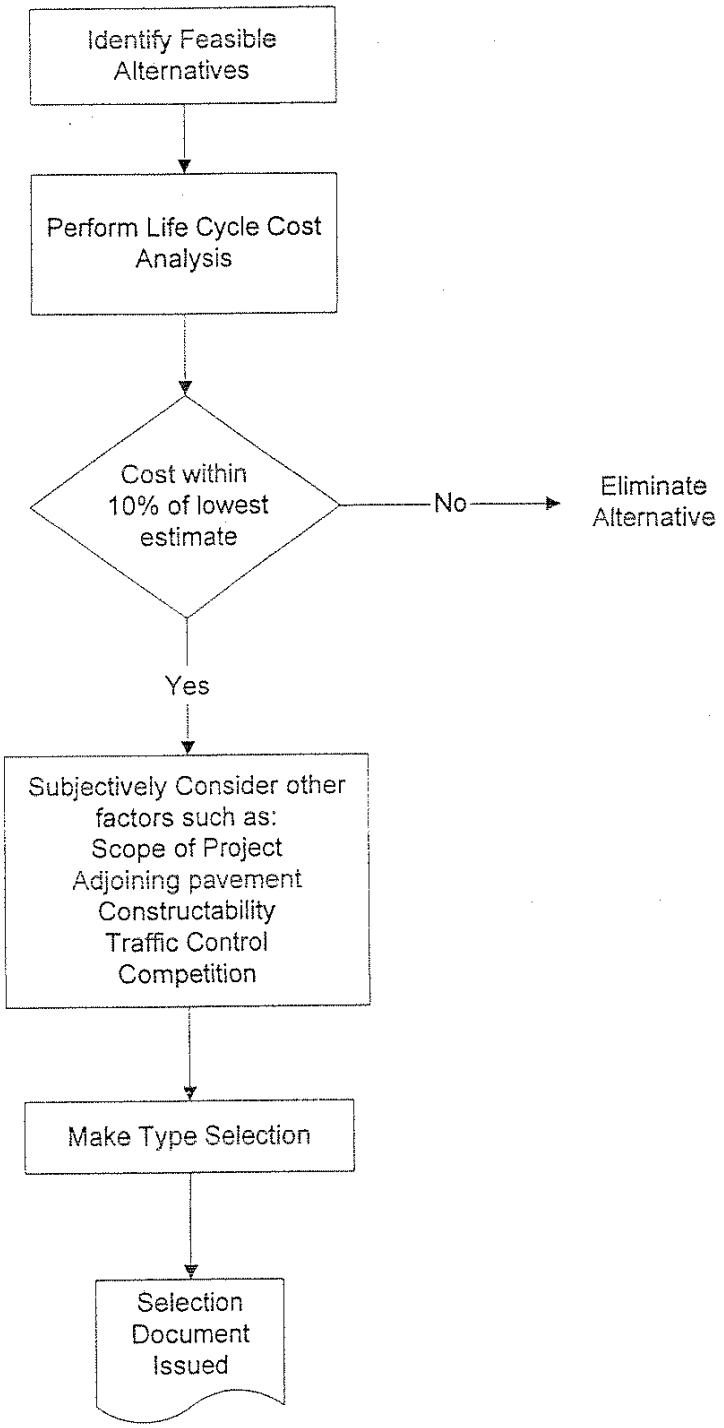


Figure 2. Pavement type selection method A.

Table 2. LCCA input variables (from FHWA).

| LCCA Component | Input Variable | Source |
|---|---|---|
| Initial and Future Agency Costs | Preliminary Engineering | Estimate |
| | Construction Management | Estimate |
| | Construction | Estimate |
| | Maintenance | Assumption |
| Timing of Costs | Pavement Performance | Projection |
| User Costs | Current Traffic | Estimate |
| | Future Traffic | Projection |
| | Hourly Demand | Estimate |
| | Vehicle Distributions | Estimate |
| | Dollar Value of Delay Time | Assumption |
| | Work Zone Configuration | Assumption |
| | Work Zone Hours of Operation | Assumption |
| | Work Zone Duration | Assumption |
| | Work Zone Activity Years | Projection |
| | Crash Rates | Estimate |
| | Crash Cost Rates | Assumption |
| Net Present Value | Discount Rate | Assumption |

Pavement Type Selection Method B

This is the process followed by New York and Ontario. The process is illustrated in figure 3 and involves two principal steps:

1. Each alternative is evaluated to determine if it meets the engineering criteria for the project site.
2. If the alternative satisfies the engineering criteria, preliminary designs are developed and a life cycle cost analysis is performed on each design. The design with the lowest life cycle cost is selected. In the case of Ontario, for projects longer than 10 lane km and annual equivalent single axle load repetitions expected to be greater than 1,000,000 within the next 4 to 5 years, detailed designs for flexible and rigid design are prepared and the pavement type is selected through an alternate bidding process.

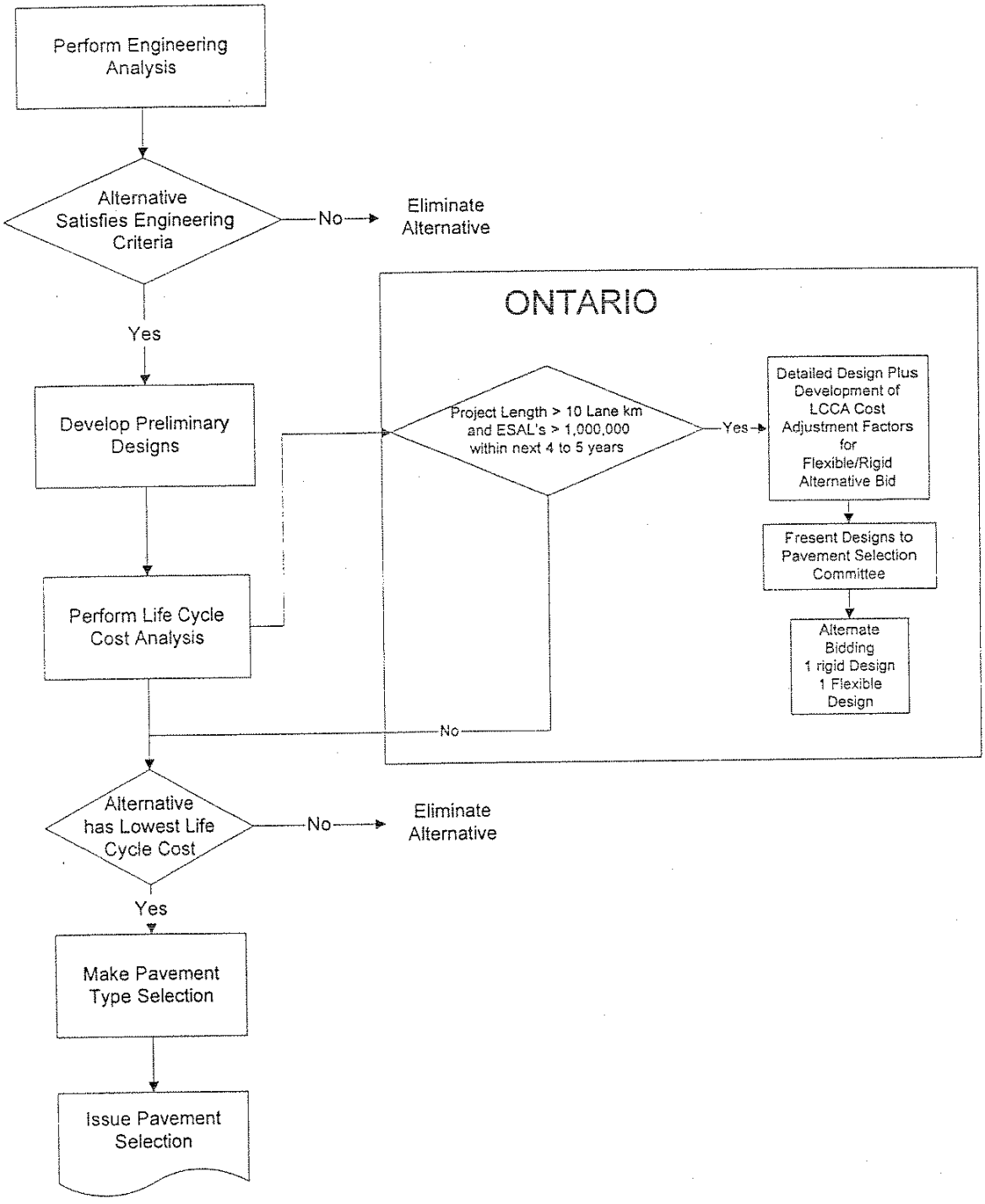


Figure 3. Pavement type selection method B.

Pavement Type Selection Method C

Pavement type selection method C (figure 4) is the process followed by Minnesota and Michigan. In this process, type selection is based solely on LCCA.

In reviewing the flow chart for Minnesota in appendix B, one might get the impression that traffic loadings rather than cost result in the type of pavements selected. Between 1990 and 1995, Minnesota completed life cycle cost comparisons on all projects involving new or reconstructed pavements. In all cases where the design traffic loadings were greater than 7 million, based on bituminous equivalent axle loadings (BESAL's), they found that the rigid design had the lowest life cycle cost. Where the design BESAL's were less than 7 million and the subgrade soil R-value was greater than 40, flexible pavement always had the lowest life cycle cost.

Therefore, in 1997 it was concluded that performing LCCA on projects falling into these categories was not a worthwhile exercise. In 2001, the process was modified to raise the threshold for determining that all pavements would be a rigid design from 7 million to 10 million BESAL's. Minnesota has indicated that when the new AASHTO mechanistic/empirical design process is adopted, they will begin performing LCCA on all designs.

In Michigan, legislation drives the format of the pavement type selection process. Senate Bill No. 303 of the 1997 Session of the Michigan Legislature contained the following section:

> Sec. 1g. The department shall develop and implement a life cycle cost analysis for each project for which total pavement costs exceed $1,000,000 funded in whole, or in part, with state funds. The department shall design and award paving projects utilizing material having the lowest life cycle cost. All pavement design life shall ensure that state funds are utilized as efficiently as possible.
>
> (2) As used in this section, "life-cycle cost" means the total cost of the initial project plus all anticipated costs for subsequent maintenance, repair, or resurfacing over the life of the pavement. Life-cycle cost shall also compare equivalent designs and shall be based upon Michigan's actual historic project maintenance, repair, and resurfacing schedules and costs as recorded by the pavement management system, and shall include estimates of user costs throughout the entire pavement life.

Because of the wording of this section, there are several questionable aspects of the Michigan process. Future costs must be based on the historic performance of pavements in Michigan. In reality, most pavements constructed in Michigan today use different designs and/or materials than were used in the past. For example, in the past Michigan used JRCP; now they are using short jointed plain pavements. Michigan has adopted Superpave mix design and stone matrix asphalt (SMA) design for their HMA pavements. However, none of the expected improvements in performance can be reflected in the LCCA.

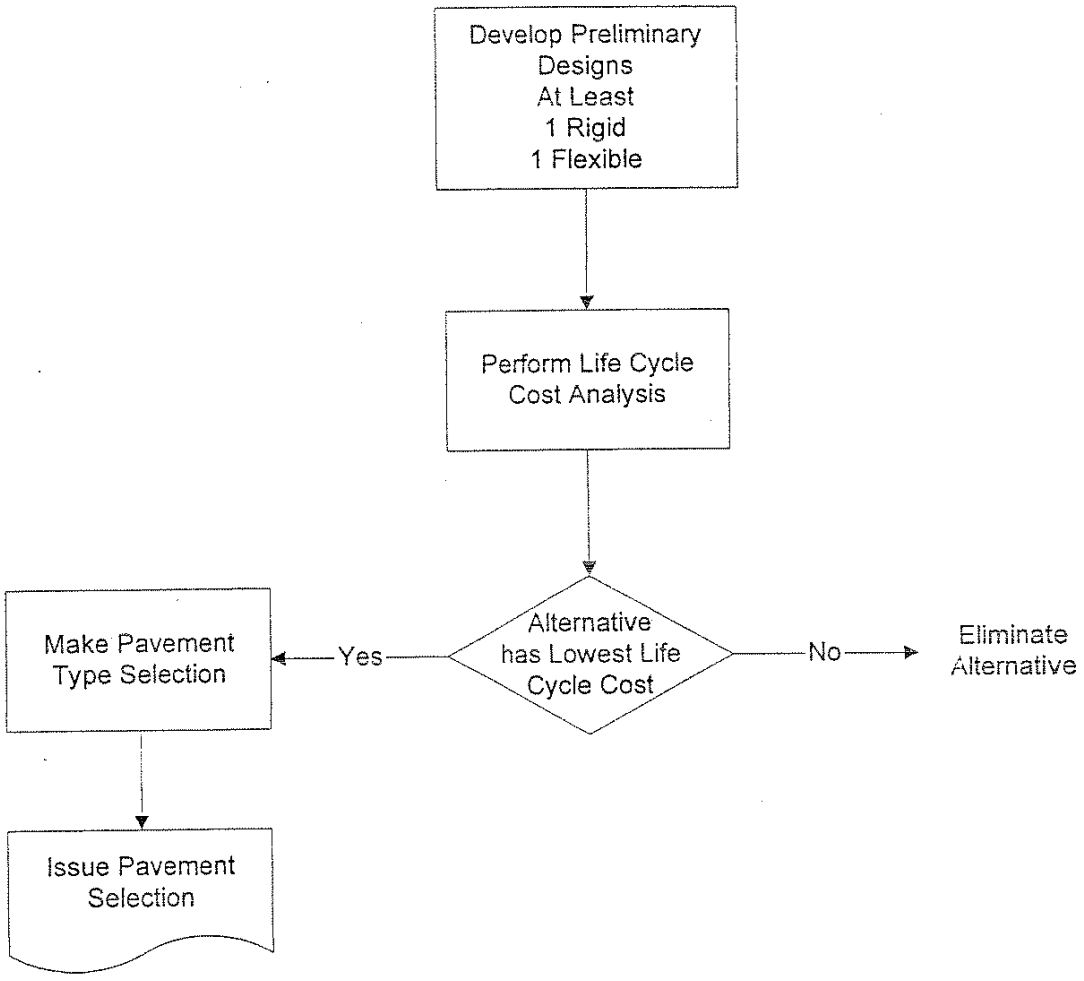


Figure 4. Pavement type selection method C.

Neither the Minnesota procedure nor the Michigan procedure considers the variability of the inputs for the LCCA when evaluating their results. In their approach, assumptions, projections, and estimates are used for input, but the results are considered final, no matter how small the difference in the results of the LCCA.

**Detailed Findings of State Practices**

Life Cycle Cost Analysis

All of the highway agencies interviewed utilize LCCA as part of their pavement type selection. Nine of the States use the net present value approach for calculating the life cycle cost. These States use the same analysis period for all alternatives considered in the analysis. Michigan uses

the equivalent uniform annual cost (EUAC) approach and varies the analysis period for the strategy. The length of Michigan's analysis period is equal to the service life of the alternative being considered. A summary of the State highway agency practices is provided in the paragraphs below and in table 3.

| | |
|---|---|
| Life Cycle Cost Analysis: | All highway agencies interviewed use a life cycle cost analysis that consists of the sum of initial construction costs and discounted future costs. Ohio does not use the typical LCCA and is not considered consistent with other highway agency practice. |
| Analysis Period: | Ranges from 35 to 60 years, with most agencies using 40 years. Ohio and Minnesota have the lowest analysis period of 35 years. Ohio is considered consistent with other highway agency practice. |
| Discount Rate: | Discount rates ranged from a low of 3 percent in Illinois to a high of 6 percent in Pennsylvania. Ohio is using the OMB A94 specified discount rate of 3.2 percent. Ohio is considered consistent with other highway agency practice. |
| Sensitivity Analysis: | Sensitivity analysis is used by only three highway agencies. Ohio does not currently use a sensitivity analysis. Ohio is considered consistent with other highway agency practice. |
| Initial Cost: | Four agencies, including Ohio, have centrally developed cost data for LCCA. The other agencies interviewed have project-specific costs or are centrally developed with discretionary adjustments for the LCCA. While there is a similarity in the general practice, several States have addressed life cycle cost issues more rigorously. For example, Wisconsin and Michigan complete a statistical analysis of their unit cost data. If sufficient cost data are not available in a specific project area, the data included in the analysis are expanded until sufficient information is available to develop a confident estimate of the costs. In Minnesota, cost estimates are based on site-specific factors such as materials costs. |
| LCCA Quantity Adjustment: | No agencies surveyed developed or used any adjustment factors to account for the difference between estimated and as-built quantities. Ohio is considered consistent with other highway agency practice. |
| Routine Maintenance: | Only two agencies include the cost of annual routine maintenance. Ohio does not include annual routine maintenance in its LCCA, which is considered consistent with other highway agency practice. |

Table 3. State highway agency LCCA practices.

| Practices | Illinois | Indiana | Maryland | Michigan | Minnesota | New York | Ontario | Pennsylvania | Washington | Wisconsin | Ohio |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Use LCCA | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Mod [1] |
| Analysis Period (years) | 40 | 40 | 40 | var.[2] | 35 | 50[3] | 50[3] | 40 | 60 | 50 | 35 |
| Discount Rate (%) | 3 | 4 | 4 | OMB[4] | 4.5[5] | OMB[4] | 5.3[6] | 6 | 4 | 5[7] | OMB[4] |
| Sensitivity analysis | No | 0%-10% | 3%-5% | No | No | No | ±2% | No | 2%-5%[8] | No | No |
| Initial Cost | | | | | | | | | | | |
| Centrally developed | Yes | No | Yes | Yes[9] | No | No | No | No | No | No | Yes |
| Project-discretionary | No | Yes | No | No | Yes[10] | Yes | Yes | Yes | Yes | Yes | No |
| Adjust LCCA for as built quantities | No | No | No | No | No | No | No | No | No | No | No |
| Routine Maintenance ($/lane mile) | Yes[11] | No | No | No | No | No | No | Yes | No | No | No |
| Scheduled Maintenance | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | No | Yes | No |
| How estimated | Com[12] | MM[13] | n/a | Hist[14] | Com[12] | Est[15] | Est[15] | MM[13] | n/a | MM[13] | n/a |
| Rehabilitation Cost | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| How estimated | Est[15] | PM[16] | PM[16] | PM[16] | Est[15] | Est[15] | Est[15] | PM[16] | PM[16] | PM[16] | Est[15] |
| HMA | | | | | | | | | | | |
| 1st rehab (years) | var.[17] | Proj[18] | Proj[18] | 10[19] | 15 | 15 | 19 | 10 | 15 | 18 | 12 |
| 2nd rehab (years) | var.[17] | Proj[18] | Proj[18] | 13[19] | 27 | 27 | 31 | 20 | 30 | Proj[18] | 22 |
| PCC | | | | | | | | | | | |
| 1st rehab (years) | 20 | Proj[18] | Proj[18] | 9[19] | 17 | 15 | 18 | 20 | 20 | 25 | 22 |
| 2nd rehab (years) | none | Proj[18] | Proj[18] | 15[19] | 27 | 30 | 28 | 30 | 40 | Proj[18] | 32 |
| Residual Value | No | No | No | No | No | No | No | No | No | No | No |
| Salvage Value | No | RL[20] | RL[20] | No | No | RL[20] | RL[20] | No | RL[20] | RL[20] | No |
| Const. Traffic Control | | | | | | | | | | | |
| Initial | No | No | Yes | No | Yes | No | No | No | Yes | No | No |
| Rehabilitation | No | No | No | Yes | No | No | No | Yes | Yes | No | Yes |
| Engr. and admin. cost | | | | | | | | | | | |
| Initial | No | No | No | No | No | No | No | No | Yes | No | No |
| Rehabilitation | No | No | No | Yes | No | 27% | No | Yes | Yes | No | Yes |
| User Delay | No | No | Yes | Yes | Fut[21] | Fut[21] | Fut[21] | Yes | Yes | No | Ind[22] |
| Spread of LCCA Considered Equal | 10% | 10% | 10% | 0% | 0% | 0% | 0% | 10% | 15% | 5% | Var[23] |

Notes:

1. Consider and weigh initial cost and future cost separately.
2. Analysis period varies to match pavement service life.
3. 50 years for new and reconstruction and 30 years for rehabilitation.
4. Office of Management and Budget Circular A94
5. Currently 4.5% but going to Office of Management and Budget Circular A94
6. Ministry of Finance social discount rate
7. Set by long standing policy
8. Use a probabilistic analysis
9. Regionally adjusted
10. Not unit cost based. Develop costs based on materials and construction costs at the specific site.
11. Fixed cost, includes striping, lane delineators, reflectors, etc.
12. Developed by committee
13. Maintenance management system
14. Past history
15. Best estimate
16. Pavement management system
17. Four categories based on traffic
18. Project specific
19. The strategies reflect the overall maintenance approach that has been used network wide for a specific fix based on historical maintenance and pavement management records.
20. Remaining life
21. Plan to incorporate user delay costs into the life cycle cost analysis in the near future
22. Consider user delay days in the type selection process
23. 3% initial cost and 10% future cost

| | |
|---|---|
| Scheduled Maintenance: | Eight agencies include the cost of regularly scheduled maintenance, such as crack sealing, joint resealing, and seal coats. Ohio does not include these items in its LCCA and is therefore not considered consistent with other agency practice. |
| Rehabilitation: | All agencies, including Ohio, include the cost of rehabilitation activities, such as overlays and concrete pavement restoration. Ohio is considered consistent with other highway agency practice. |
| Time for First Rehabilitation: | The year of the first rehabilitation for flexible pavements varies considerably, from 10 to 19 years, with a median of 15 years. Ohio, at 12 years, is lower than the median.<br><br>The year of the first rehabilitation for rigid pavements is highly variable, ranging from 9 to 25 years, with a median value of about 18 years. Ohio currently uses a time to first rehabilitation for rigid pavements of 22 years, which is higher than the 18-year median. |
| Second Rehabilitation: | The year of the second rehabilitation for flexible pavements varies considerably, from 13 to 30 years, with a median of 27 years. Ohio, at 22 years, is below the median of the other highway agencies.<br><br>The year of the second rehabilitation for rigid pavements is highly variable, ranging from 15 to 40 years, with a median value of about 30 years. Ohio currently uses a time to second rehabilitation for rigid pavements of 32 years, which is considered consistent with other highway agency practice. |
| Method for Rehab Schedule: | Six agencies used pavement management data as the basis for the rehabilitation schedule used in the LCCA and four agencies used engineering opinions. Ohio bases its rehabilitation schedules on engineering opinions. |
| Residual Value: | No highway agencies use residual value in their LCCA. Ohio is considered consistent with other highway agency practice. |
| Salvage Value: | Six highway agencies consider remaining life in the LCCA, so that each alternative is relatively equal from a condition standpoint at the end of the analysis period. Michigan is included, as their analysis period equals their service life. Ohio does not consider salvage value in the LCCA. The last overlay for flexible pavements is placed at 34 years, while the last overlay for rigid pavements is placed at 32 years. The maintenance schedules currently contained in "Pavement Selection the ODOT Way" result |

in equal remaining service lives for both pavement types negating the need for consideration of salvage value.

Traffic Control Costs: Only three of the highway agencies interviewed included the cost of initial construction traffic control costs in their analysis. Ohio is considered consistent with other highway agency practice.

Three of the highway agencies interviewed included the cost of future rehabilitation construction traffic control costs in their analysis. Ohio does include the cost of future rehabilitation traffic control. However, there is some controversy over the accuracy of these costs.

Engineering and Admin. One highway agency includes the cost of engineering and administration costs in its initial construction cost estimate for LCCA. Ohio is considered consistent with other highway agency practice.

Three agencies include the costs of engineering and administration in their cost estimate for future rehabilitation activities. Ohio includes the cost of future rehabilitation engineering and administration costs; however, there is some controversy over the accuracy of these costs.

User Delay: Four highway agencies consider user delay in their LCCA, and three others are considering including user delay in the future. Ohio does not currently include user delay costs for LCCA.

LCCA Spread Equivalency: Four highway agencies consider life cycle costs within ±10 percent to be equivalent. One agency uses 15 percent and another uses 5 percent. Four highway agencies use 0 percent. Ohio does not use the typical LCCA.

Pavement Design Practices

A summary of the State pavement design practices is provided in table 4 and in the paragraphs below.

*Flexible Design*

Design Method: Seven of the highway agencies interviewed use the AASHTO 1993 design procedure. One agency uses the AASHTO 1972 design procedure, one agency uses a modified procedure based on AASHTO data, and one agency uses a mechanistic-empirical procedure. Ohio uses the AASHTO 1993 design procedure.

Table 4. State pavement design practices.

| Practices | Illinois | Indiana | Maryland | Michigan | Minnesota | New York | Ontario | Pennsylvania | Washington | Wisconsin | Ohio |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Flexible pavements | | | | | | | | | | | |
| Design method | M-E[1] | A93[2] | A93[2] | A93[2] | MN[3] | A93[4] | A93[2] | A93[2] | A93[2] | A72[5] | A93[2] |
| Design life | 20 | 20 | 15 | 20 | 20 | 50 | 20 | 20 | 40 | 20 | 20 |
| "a" surface | n/a | .34 | .44 | .42 | n/a | .42 | .42 | .44 | .44 | .44 | .35 |
| "a" intermediate | n/a | .36 | .40 | .36 | n/a | .42 | .42 | .44 | .44 | .44 | .35 |
| "a" bound base | n/a | .34 | .25 | .36 | n/a | .42 | .42 | .40 | .30 | .30 | .35 |
| Rigid pavements | | | | | | | | | | | |
| Design method | M-E[1] | A93[2] | A93[2] | A93[2] | A86[6] | A93[4] | A93[2] | A93[2] | A93[2] | A72[5] | A93[2] |
| Design life | 20 | 30 | 25 | 20 | 35 | 50 | 30 | 20 | 40 | 20 | 20 |
| PCC Mr ($S'_c$) psi | 650[7] | 652 | 700 | 670 | 675 | 650 | 725[8] | 631[8] | 650 | 650 | 700 |
| PCC Ec psi x $10^6$ | | 3.4 | 5.0 | 4.2 | | 4 | 4.35 | 4.0 | | 4.2 | 5.0 |
| Flexible/rigid foundations equal | Yes | Yes | Yes | No | No | Yes | Yes | No | Yes | Yes | Yes |
| Initial serviceability same for PCC and HMA | n/a | Yes | No[9] | Yes | n/a | n/a[10] | Yes | No[9] | Yes | No[11] | No[12] |

Notes
1. Mechanistic/empirical design procedure developed in Illinois
2. AASHTO – 1993 version
3. Procedure developed by Minnesota based on AASHO Road Test data
4. Modified procedure based on AASHTO – 1993 version
5. AASHTO – 1972 version
6. AASHTO – 1986 version
7. 14-day center point loading
8. Based on actual field data
9. $p_o$ = 4.5 for PCC pavements and 4.2 for flexible pavements
10. Not directly considered in the modified procedure
11. Not an input variable in the 1972 Guide where $p_o$ is fixed in the equation at 4.5 for PCC pavements and 4.2 for flexible pavements
12. $p_o$ = 4.2 for PCC pavements and 4.5 for flexible pavements, based on measurements of new pavements

Traffic Design Life: The range is from 15 to 50 years with a median of 20 years. Ohio uses 20 years and is consistent with the other highway agencies.

Asphalt Layer Coefficients: For surface courses, the range was from 0.34 to 0.44 with a median of 0.42. Ohio currently uses a surface course layer coefficient of 0.35.

For intermediate asphalt courses, the range was from 0.36 to 0.44 with a median of 0.42. Ohio currently uses an intermediate asphalt course layer coefficient of 0.35.

For base courses, the range was from 0.25 to 0.42 with a median of 0.36. Ohio currently uses a base course layer coefficient of 0.35.

*Rigid Design*

Design Method: Seven of the highway agencies interviewed use the AASHTO 1993 design procedure. One agency uses the AASHTO 1972 design procedure, one agency uses a modified procedure based on AASHTO data, and one agency uses a mechanistic-empirical procedure. Ohio uses the AASHTO 1993 design procedure.

Traffic Design Life: The range is from 20 to 50 years with a median of about 25 years. Ohio uses 20 years and is consistent with the other highway agencies.

PCC Modulus of Rupture: The modulus of rupture ranges from 631 to 725 psi with a median of 650 psi. Ohio uses a modulus of rupture of 700 psi. Based on a limited amount of test data provided for our review, the value of 700 psi appears reasonable.

PCC Modulus of Elasticity The modulus of elasticity (Ec) varies from 3,408,390 to 5,000,000psi. Ohio uses an Ec of 5,000,000. This value is based on testing of concrete on Ohio SHRP Project DEL-23. Further, as shown in figure 5 the impact of Ec on pavement thicknesses designed using the 1993 AASHTO Guide is minimal.

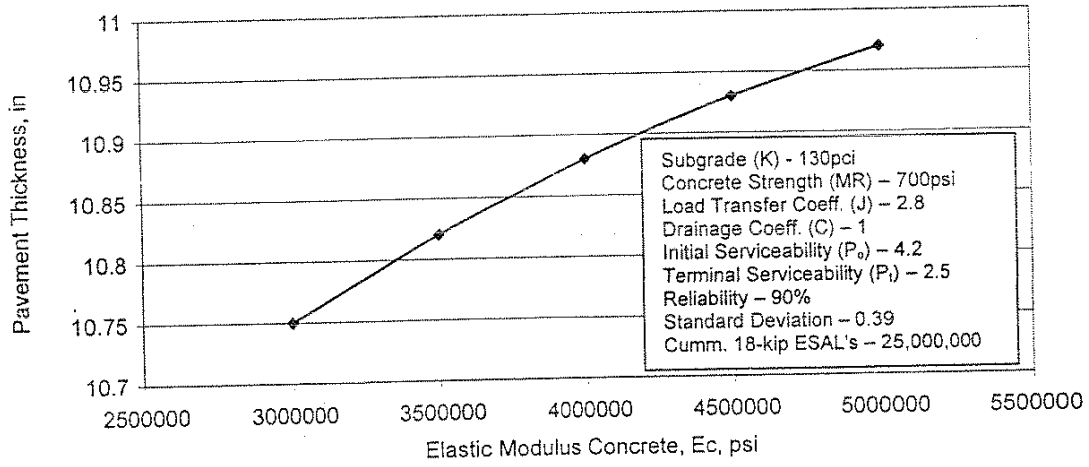


Figure 5. The impact of the elastic modulus of concrete on thickness.

*Common Design Parameters*

Foundation Requirements: Seven highway agencies treat the foundation requirements the same for flexible and rigid pavements. Ohio also treats the foundation requirements the same for both pavement types.

Initial Serviceability: Four highway agencies use the same initial serviceability for both flexible and rigid pavement types. Three agencies do not use initial serviceability for both pavement types. Two agencies use an initial serviceability value of 4.2 for flexible and 4.5 for rigid pavements. Ohio uses an initial serviceability of 4.5 for flexible and 4.2 for rigid pavements. ODOT indicated that the initial serviceability values used were based on measurements of newly constructed pavements, in conformance with the 93 AASHTO Guide; however the original study could not be located. In late 2002, the State reviewed the serviceability values on one-year old pavements constructed since 1997. The data indicated that the initial serviceability of asphalt pavements was approximately 0.5 higher for flexible pavements than rigid pavements. The study indicated that recently constructed flexible pavements were smoother than rigid pavements and provides support for the initial serviceability numbers being used. Because of the limited nature of the study, ODOT decided not to modify the values being used at this time.

Construction-Related Issues

As part of the review, methods of payment and the reuse of salvaged materials were investigated. The findings are summarized in table 5 and discussed in the paragraphs below.

Payment for HMA: Eight agencies use tonnage produced as a method of payment for HMA. Two agencies pay by square yards. Ohio pays for HMA based on a cubic yard using a unit weight conversion factor based on laboratory-measured density.

Payment for PCC: Seven agencies pay for PCC based on plan area. One agency uses a combination of square yards and cubic yards based on plan area and thickness. One agency uses cubic yards based on plan area and thickness. One agency pays based on plan area and measured thickness up to 0.5 inch over the plan thickness. Ohio pays based on plan square yards and is consistent with the majority of the other highway agencies.

Table 5. State pavement construction practices.

| Practices | Illinois | Indiana | Maryland | Michigan | Minnesota | New York | Ontario | Pennsylvania | Washington | Wisconsin | Ohio |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Method of payment | | | | | | | | | | | |
| Hot mix asphalt | sq y | ton | ton | ton | ton | ton | ton | sq y | ton | ton | cu y |
| Concrete pavement | sq y | sq y | sq y | sq y | [1] | cu m | sq m | sq y | [2] | sq y | sq y |
| Recycling | | | | | | | | | | | |
| PCC | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Uses | [3] | sb[4] | b/sb[5] | b/sb[5] | b/sb[5] | b/sb[5] | b/sb[5] | Bf[6] | g m[7] | [8] | gm[7] |
| HMA | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Uses | HMA | HMA | HMA | HMA | HMA | HMA | HMA | HMA | HMA | [9] | HMA |
| Max % surface | 30[10] | 25[11] | 15 | 14[12] | 30[13] | 20 | [14] | [15] | 20[16] | 20[17] | 20[18] |
| Max % intermediate. | 30[10] | 25[11] | | 28[12] | 50[13] | 20 | [14] | [15] | 20[16] | 35[17] | 35[18] |
| Max % base | 30[10] | 25[11] | 25 | 28[12] | 50[13] | 30 | 30 | [15] | 20[16] | 35[17] | 35[18] |
| Liq. asphalt price adj. | No | No | Yes | No | No | Yes | Yes | Yes | No | Yes | Yes |

Notes:

1. Payment is a combination of sq. yd. plus cu. yd. based on plan quantity
2. Payment is cu. yd based on core thicknesses up to 0.5 over design
3. Capping, subbase, concrete, shoulders, fill
4. Subbase
5. Base and subbase
6. Backfill for structures
7. Granular materials
8. Unbound base (generally) and portland cement concrete (rarely)
9. HMA and unbound base
10. The maximum percentage of RAP is a function of mix design and ranges from 0 percent for an Ndesign of 105 to 30 percent for an Ndesign of 30 and is not allowed in polymer modified mixes.
11. Up to 15% use grade of asphalt binder specified for the project. 15% to 25% asphalt softer required
12. Percentage is by weight of total binder in the mix. Above 17% binder grade adjustments required
13. Subject to meeting mix design requirements
14. Varies between 10% and 30%
15. Permit 5% to 15%. For mixtures with more than 15 percent RAP, the department evaluates the asphalt cement content of the RAP source material and determines the grade of the asphalt cement and recycling agent the contractor will be required to use in the final mixture. When RAP is used, a plan to control RAP and procedures to handle the RAP of different compositions must be developed and provided to the department.
16. Up to 20% no new mix design, over 20% required a new mix design
17. Combined RAP and virgin aggregate shall meet percent crushed and natural sand quality requirements. The blend of new asphaltic material with extracted RAP asphaltic material shall meet the penetration or viscosity requirements for the specified asphaltic material.
18. Whenever more than 10% of reclaimed asphalt concrete pavement is used it must be included in the mix design to establish the job mix formula and conform to the requirements of the specified asphalt binder for the asphalt binder proposed for use in the mixture, by the combination of reclaimed asphalt, virgin asphalt, and rejuvenating agents. A maximum of 10% RAP is allowed in polymer modified surface mixtures.

Liquid AC Price Adjustment: Five highway agencies use a liquid AC price adjustment. Ohio uses a liquid AC price adjustment.

PCC Recycling: All highway agencies interviewed permit the use of recycling PCC on the project. Generally, the recycled materials must meet the specification requirements for which the material is being substituted. In most agencies, the PCC material removed from the project becomes the property of the contactor who uses this material for other non-highway agency projects. Ohio is consistent with the practices of the other States.

HMA Recycling: HMA recycling is permitted by all highway agencies interviewed. All agencies permit the use of recycled asphalt pavement (RAP) in HMA from 10 to 30 percent. For amounts ranging from 10 to 20 percent, mix design adjustments are not generally required. Above these values, the HMA must meet the requirements of virgin HMA. Ohio permits varying amounts of RAP in new HMA mixes.

## FHWA AND AASHTO GUIDANCE

### FHWA Policy and Guidance

The FHWA's policy on pavement design and type selection is contained in Part 626 of Tile 23 of the Code of Federal Regulations.

> **Sec. 626.1 Purpose.**
>
> To set forth pavement design policy for Federal-aid highway projects.
>
> **Sec. 626.2 Definitions.**
>
> Unless otherwise specified in this part, the definitions in 23 U.S.C. 101(a) are applicable to this part. As used in this part:
>
> Pavement design means a project level activity where detailed engineering and economic considerations are given to alternative combinations of subbase, base, and surface materials which will provide adequate load carrying capacity. Factors which are considered include: Materials, traffic, climate, maintenance, drainage, and life-cycle costs.
>
> **Sec. 626.3 Policy.**
>
> Pavement shall be designed to accommodate current and predicted traffic needs in a safe, durable, and cost effective manner.

As written, the policy provides a broad framework under which the State highway agencies are required to operate. The regulation does not specify procedures to be followed to meet this requirement. Instead, each highway agency is expected to use procedures that are appropriate for their conditions. In a non-regulatory supplement, the FHWA provides the following additional guidance on pavement type selection:

> 4) Engineering Economic Analysis. The design of both new and rehabilitated pavements should include an engineering and economic evaluation of alternative strategies and materials. The project specific analysis should be evaluated in light of the needs of the entire system. The "1993 AASHTO Guide for Design of Pavement Structures" (Appendix B) and the "FHWA Pavement Rehabilitation Manual," provide guidance on engineering considerations. The engineering evaluation should include consideration of the use of recycled materials and/or pavement recycling techniques, where feasible. Economic considerations include an economic analysis based on Life Cycle Costs (LCC). The FHWA Final Policy Statement on LCC analysis published in the September 18, 1996, Federal Register provides guidance on LCC Analysis. The FHWA Memorandum "National Highway System Designation Act - Life Cycle Cost Analysis Requirements" (April 19, 1996), provides supporting information and guidance to assist in

implementing Life-Cycle Cost Analysis (LCCA) requirements in the National Highway System (NHS) Designation Act of 1995. The FHWA Office of Pavement Technology's "Interim Technical Bulletin: Life Cycle Cost Analysis in Pavement Design FHWA-SA-98-079, September 1998" and FHWA's "Demonstration Project 115: Probabilistic Life Cycle Cost Analysis in Pavement Design" provide technical guidance and training on good practice.

(a) Pavements are long-term public investments and all the costs (both agency and user) that occur throughout their lives should be considered. LCCA identifies the long-term economic efficiency of competing pavement designs. However, the resulting numbers themselves are less important than the logical analysis framework fostered by LCCA in which the consequences of competing alternatives are evaluated. When performing LCCA for pavement design, the variability of input parameters needs to be considered. The results of LCCA should be evaluated to determine whether differences in costs between competing alternatives are statistically significant. This evaluation is particularly important when the LCC analysis reflects relatively small economic differences between alternatives.

(b) The FHWA's policy on alternate bids, which would include bids for alternate pavement types, is addressed in 23 CFR 635.411(b). This section requires the use of alternate bid items "When ... more than one... product... will fulfill the requirements... and these... products are judged...equally acceptable on the basis of engineering analysis and the anticipated prices... are estimated to be approximately the same."

(1) The FHWA does not encourage the use of alternate bids to determine the mainline pavement type, primarily due to the difficulties in developing truly equivalent pavement designs.

(2) In those rare instances where the use of alternate bids is considered, the SHA's engineering and economic analysis of the pavement type selection process should clearly demonstrate that there is no clear cut choice between two or more alternatives having equivalent designs. Equivalent design implies that each alternative will be designed to perform equally, and provide the same level of service, over the same performance period and have similar life-cycle costs.

In reading the policy and supplement guidance, the conclusion can be drawn that both engineering factors and LCCA should be considered in selection pavement alternatives. They further highlight the non-deterministic nature of LCCA in their supplemental guidance when they state:

When performing LCCA for pavement design, the variability of input parameters needs to be considered. The results of LCCA should be evaluated to determine

whether differences in costs between competing alternatives are statistically significant.

A number of highway agencies recognize the uncertainty and variability of LCCA and have adopted a spread factor to account for these differences. For example, if the life cycle costs of two alternatives are within a certain percentage of each other (e.g., 10 percent), they are considered equal in terms of life cycle cost.

The guidance is also clear that the FHWA discourages the use of alternate bidding as a routine means of pavement type selection. One of the primary problems with the bidding of pavement alternates is that the contract may not be awarded to the contactor with the lowest bid for initial construction. Because the two pavement types have different rehabilitation costs, the contractor's bid incorporates the bid for construction plus a valuation for future rehabilitation costs. The valuation for future costs is a value determined by the agency based anticipated performance.

However, over the past 7 years a number of agencies have expressed the desire to utilize alternate bidding. This interest developed as a result of both the agencies' and industries' desire to foster additional competition. The FHWA has accommodated this desire by incorporating alternative pavement design bidding under Special Experimental Project No. 14 (SEP-14), Innovative Contracting Practices. The objective of SEP-14 is to evaluate contracting processes that have the potential to reduce life cycle costs, while at the same time maintain quality. Missouri (5 projects), Kentucky, Louisiana (7 projects), Michigan (2 projects), and Maryland have used alternate pavement bidding procedures under SEP-14.

### AASHTO Guidance

AASHTO's guidance on pavement type selection is found in appendix B of the *AASHTO Guide for Design of Pavement Structures* [1]. Figure 6 outlines the pavement selection process contained in the Guide.

The Guide lists factors that may have some influence on the decision-making process. These factors are placed into two groups. Principal factors are those factors that may have a major influence and may dictate the pavement type in some instances. Secondary factors include those factors that have a lesser influence and are taken into account when there are no overriding considerations or one type is clearly not superior from an economic standpoint. The principal and secondary factors are listed below:

Principal Factors

1. Traffic.
2. Soils characteristics (problem soils).
3. Weather.
4. Construction consideration (stage construction, maintenance of traffic).
5. Recycling (opportunity to recycle from existing pavement or future opportunities).
6. Cost comparison.

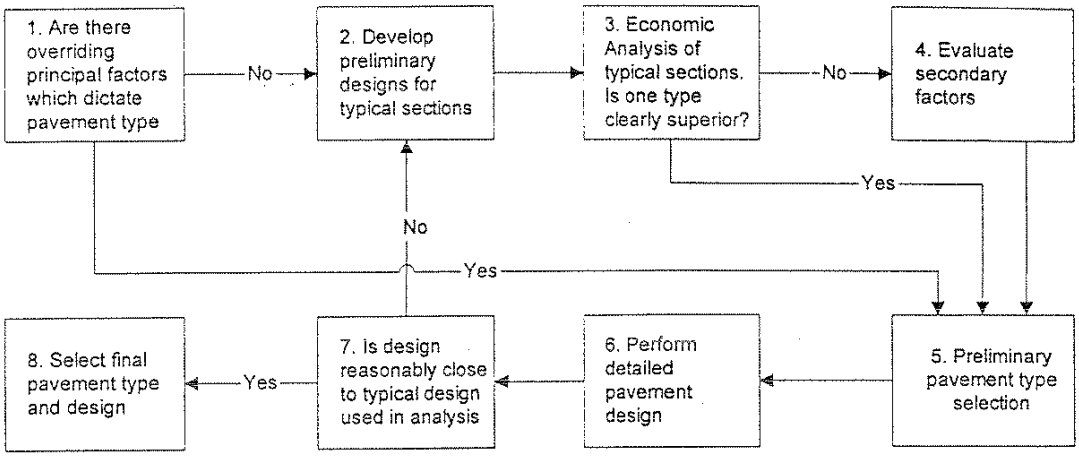


Figure 6. Pavement type selection process (figure B.1, AASHTO Guide).

Secondary Factors

1. Performance of similar pavements in the area
2. Adjacent existing pavements
3. Conservation of materials and energy
4. Availability of local materials or contractor capabilities
5. Traffic safety
6. Incorporation of experimental features
7. Stimulation of completion
8. Municipal preference, participating local government preference and recognition of local industry

## CONCLUSIONS AND RECOMMENDATIONS

This study called for a review and analysis of ODOT's pavement type selection process. The primary benchmark for the analysis was to be based on comparing and contrasting Ohio's process with those used by other highway agencies and recommendations of AASHTO and the FHWA.

The NTP team visited 10 highway agencies and reviewed and discussed their processes. When reviewing the practices of other highway agencies, we tried to identify advantages and disadvantages with specific aspects of their systems. We also consulted the trade organizations in a number of the States to get their views on pavement type selection.

The team has reviewed the written guidance provided by AASHTO and the FHWA. In addition, we have had informal discussions with FHWA officials in their Ohio Division Office and the Pavement Division and Contract Administration Group in the headquarters Office of Infrastructure.

### Conclusions

As the review of the highway agencies indicated, there are many and diverse approaches to the pavement selection process. The team's approach was to extract and evaluate, from the highway agencies visited, those attributes that address issues in Ohio. Further, we attempted to comply as closely as possible with the recommendations of both AASHTO and FHWA.

ODOT has attempted to develop an objective process that will eliminate second-guessing of their project-level decisions, by industry or other affected groups. As we have observed in Ohio and other highway agencies that have objective systems, the affected pavement industries realize that every detail in the process may have a significant impact on their future ability to obtain work in Ohio. This is in contrast to a more subjective system followed by a majority of the highway agencies interviewed, where, when net-present value is approximately equal, the highway agency has more flexibility in choosing secondary factors to help make the decision on pavement type. While in our opinion the Department has the sole authority to develop and implement a pavement type selection procedure, it is imperative that both the public and the pavement industries perceive the process as unbiased.

In the development of an objective type selection process it is important that the agency and the paving industries work together to try and reach some type of accord on the factors being considered. From what we have observed, coupled with the history and issues raised, this will be difficult in Ohio. The problem with this type of controversy is that it can lead to direction from outside sources. One avenue that is often pursued is a legislative remedy. This has been tried in the past, often with less than satisfactory results.

One example was Section 1038(d) of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), which mandated the use of quantities of asphalt pavement containing recycled rubber. This Section also contained specific penalties for those States unable to certify to the annual usage requirement. Section 205(b) of the NHS Designation Act of 1995 amended Section

1038 by striking subsection (d) eliminating the crumb rubber mandate and all associated penalties. One of the consequences of the Act was the inappropriate (from an engineering standpoint) application of the material resulting in excessive costs and in some cases to premature pavement failure. The problems encountered during the time of the mandate hampered implementation after the mandate ended. In addition, the mandate caused political fallout within the rubber asphalt industry and thus created a rift from its parent industry.

The issue of systemic bias raised by OCCA was not something that the NTP believes can be solved through technical modifications of the selection process. This must be addressed by the OCCA through effective marketing, education, product improvement, etc.

**Recommendations**

Based on all the above considerations, the NTP makes the following recommendations concerning the pavement type selection process in Ohio.

Recommendation #1—Improve Communication

Both the pavement industry and ODOT need to make a strong commitment to implement a plan to improve communications. The assertions of bias, legislative involvement, and the large number of detailed issues raised by both industries, indicate a need to improve the communication process.

We strongly encourage that all parties minimize the level of rhetoric and establish a more effective approach to address the many detailed issues that arise relative to pavement design, construction, and type selection. It is apparent that this will not be an easy recommendation to implement. As a first step we recommend that a facilitator be used to conduct meetings between industry and ODOT. The facilitator would work with the participants to develop a common understanding of the issues, to understand the interests of all the parties, to identify and evaluate solutions and to create an agreement that parties can implement. Meetings should be held on a regularly scheduled basis. The meetings should focus on technical issues. Industry suggestions should be supported with facts/data, and ODOT responses should also be supported by facts/data. The primary ODOT participants should be those technical managers responsible for pavement design and pavement type selection.

We would expect the use of a facilitator to be limited to approximately 6 one- to two-day meetings occurring during calendar year 2004. A scope of work for obtaining and selecting a facilitator is included in appendix F.

*Implementation*—Facilitator selected and meetings initiated during the first quarter of calendar year 2004.

*Benefit*—The benefit of implementing Recommendation #1 is that it will promote a more productive interaction between ODOT and the paving industries. It will provide a forum more conducive to addressing and resolving pavement design, pavement type selection, and specification issues. It is believed that many of the technical issues raised by the paving

industries during the NTP interviews could have been resolved if there was an effective communication system in place.

Recommendation #2—Adopt a Modified Pavement Type Selection Procedure

This recommendation consists of modifying "Pavement Selection the ODOT Way" to more closely follow a management decision-making process. In the recommended process, the primary and secondary engineering factors and the economic factors would be evaluated. Rather than basing a decision on the absolute values developed by the process, the manager responsible for pavement type selection would weigh all the factors and make a decision. The current system has most of the components in place, and the intent of this recommendation is to strengthen certain aspects of the process and provide ODOT managers with needed flexibility. The NTP does not believe ODOT's current procedure is so flawed that pavement selection should be deferred pending implementation of a new process. Rather, we would expect that recommended modifications to the process will occur incrementally over the next 12 months.

Based on our review of the practices used by other highway agencies and the recommendations of AASHTO and FHWA, it is recommended that ODOT modify its pavement type selection procedure to follow the process shown in figure 7. This procedure is a modification of method A (see figure 2). The modifications are based on the AASHTO procedure outlined in figure 6. The key components of the procedure are as follows:

1. Complete an engineering review and analysis of the principal factors (as defined by AASHTO and ODOT) to determine which pavement alternatives are feasible for the project site.

2. Perform a LCCA in accordance with Recommendations 2a thru 2f below.

3. Evaluate the differences in life cycle costs between the various alternatives. This evaluation should consider the uncertainty and variability of the input factors used in the LCCA. Because of the uncertainty and variability in input factors, when the life cycle cost of an alternative is within 10 percent of the lowest life cycle cost alternative, they should be considered equivalent. The value of 10 percent is the typical value used by other highway agencies in evaluating equivalent costs. It is expected that the appropriateness of the 10 percent value will be better addressed as more highway agencies apply the probabilistic approach to LCCA outlined in FHWA's *Technical Bulletin on Life-Cycle Cost Analysis in Pavement Design* [2].

   At ODOT's discretion, an industry review of the LCCA would be appropriate at this time. This review would be primarily for the purpose of insuring that appropriate input factors used in the analysis are appropriate for the specific project.

4. For those alternatives with equivalent life cycle costs as defined above, an engineering analysis of the secondary factors as identified by AASHTO and ODOT should be completed. This process could follow a matrix type approach similar to the one currently being used in ODOT's type selection process.

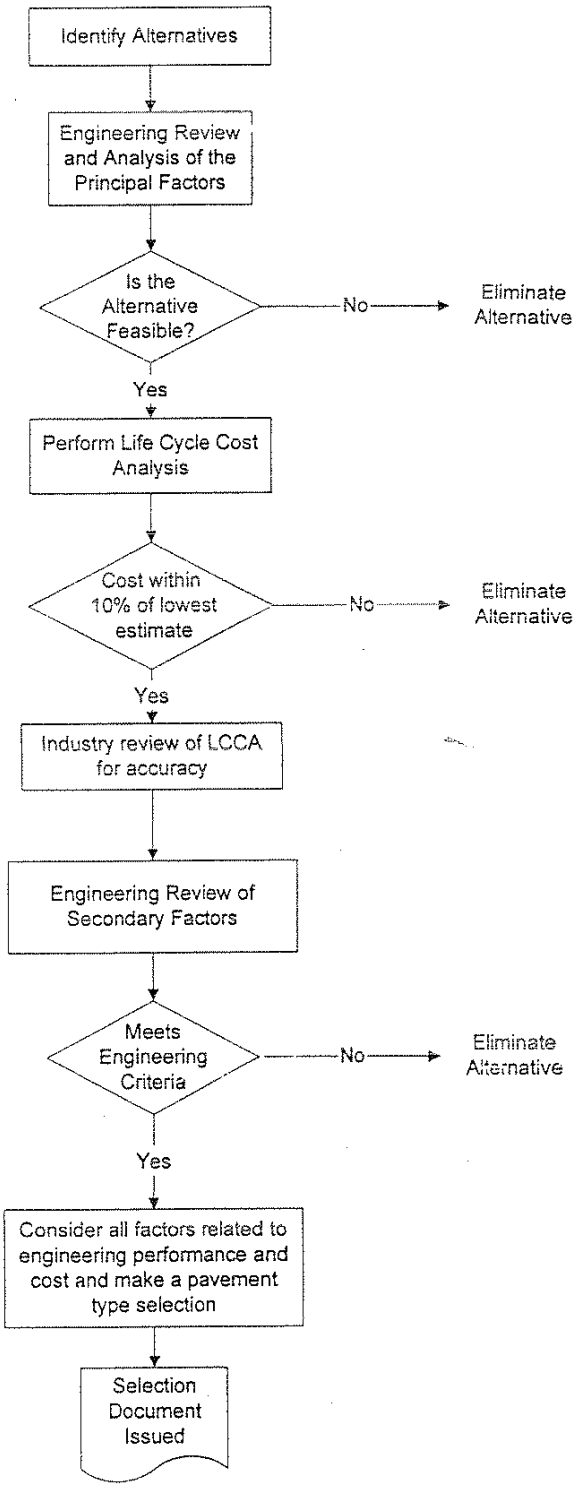


Figure 7. Recommended pavement type selection procedure for Ohio.

5. Upon completion of the secondary analysis those alternatives identified as being essentially equivalent from both engineering and LCCA standpoint would be evaluated. If the alternatives being evaluated are considered equivalent, it would be appropriate to consider factors such as first cost, minor differences in life cycle cost, or uncertainty about the expected level of performance.

*Implementation*—It is expected that the decision-making process outlined above can be implemented for all pavement type selections (on major rehabilitation projects longer than 4 lane miles calling for new or reconstructed pavements) made after January 1, 2004, using the data currently being developed for use in "Pavement Selection the ODOT Way." Incremental improvements in the development of the data used in the pavement selection process are expected to occur over the following 12 months. The NTP expects that over time ODOT may also find it necessary to make modifications to the process to meet their management needs.

*Benefit*—While the "Pavement Selection the ODOT Way" process is objective in its application, it is composed entirely of subjective factors. The NTP-recommended process recognizes the subjectivity of pavement type selection. It permits ODOT management to weigh the engineering and economic factors on a project-by-project basis, permitting site conditions to be addressed. The recommended process fully complies with the recommendations of AASHTO and FHWA.

The following are recommended modifications to strengthen the process:

*Recommendation #2a—Adopt a Traditional LCCA Approach*

The factors for initial construction and future maintenance should be eliminated and combined into one factor, life cycle cost. The LCCA should calculate a net present value that includes an initial cost comprised of all differential agency costs between the pavement alternatives and the total discounted future agency costs including all expected contract resurfacing and rehabilitation work. Where the remaining lives of the alternatives being considered are not equal, a salvage value based on remaining life should be included in the analysis. This type of LCCA is used by all of the 10 highway agencies interviewed.

*Implementation*—Traditional LCCA is expected to be used on all pavement type selections made after January 1, 2004. The data currently being used to estimate current and future costs can be used as input for the initial implementation of the LCCA, with recommended improvements to the data occurring incrementally.

*Benefit*—Adoption of a traditional LCCA approach will provide a process that is more transparent and easier to explain and understand than the weighting system currently used to evaluate current and future costs.

*Recommendation #2b—Develop Pavement Survival Curves to Better Establish Pavement and Overlay Lives for Use in LCCA*

The State should undertake a program to utilize pavement survival curves for Ohio pavements to evaluate and adjust the maintenance and rehabilitation schedules in their LCCA. ODOT should critically review the features of its pavement management database to ensure that the database will support the continued development and updating of project-related survival curves. The survival curves should reflect the current designs that are being used, age and traffic, etc. Examples of agencies that have developed survival curves include Illinois [3] and Ontario [4]. Other highway agencies that have reported using survival curves include Wisconsin and Michigan.

During the course of the review it was suggested that the NTP undertake the development of survival curves. However, it was determined that ODOT had an ongoing research project, "Evaluation of the Variation in Pavement Performance Between ODOT Districts," that includes the development of an informational database of all relevant pavement performance data and analysis procedures that will allow for the development and updating of pavement survival curves. This work is scheduled to be completed in April 2004. Appendix E contains a discussion on the application of survival curves.

At the request of the PSAC, the NTP explored the development of interim maintenance schedules for use in the LCCA pending the implementation of Recommendation 2b. The results of the NTP's analysis are contained in appendix G. Based on this analysis, the NTP believes the schedules currently included in "Pavement Selection the ODOT Way" are suitable for use on an interim basis. However, based on the practices followed by ODOT during the last 5 years, the NTP recommends that the width of planing for the 1.5-inch functional overlays of flexible pavements be reduced to mainline only.

*Implementation*—Within 6 months of the completion date of the research project, ODOT will adjust the pavement rehabilitation schedules in the LCCA procedure to reflect the expected performance of Ohio pavements.

*Benefit*—Developing and maintaining survival curves for pavements constructed in Ohio will provide the basis for developing logical and defensible pavement maintenance and rehabilitation schedules for Ohio pavements. Although this recommendation will require a commitment of resources to implement, it will eventually form the basis for most of the inputs required to evaluate future costs in the LCCA. The survival curves will also provide a benchmark for measuring the effectiveness of design changes or the implementation of new technologies.

*Recommendation #2c—Continue to Use the OMB A94 Discount Rates*

The OMB A94 30-year real discount rate should continue to be used in the LCCA. This is the rate recommended in FHWA's *Technical Bulletin on Life-Cycle Cost Analysis in Pavement Design*, dated September 1998 [2].

All of the highway agencies reviewed are using the discount rate contained in OMB A94 or one closely paralleling that rate (3 to 6 percent).

*Benefit*--The OMB A94 discount rate is widely accepted for LCCA and is easily defended. The development and basis of this rate is described in the circular prepared by OMB.

*Recommendation #2d—Evaluate the Application of Engineering and Administration Costs and Traffic Maintenance Costs in LCCA*

ODOT should not include the current 7% engineering and administration and 10% traffic maintenance costs in their LCCA. There are questions relative to proportion of these factors directly applicable to the pavement portion of a project and whether the percentage should vary by the type of rehabilitation work. The majority of highway agencies interviewed do not consider maintenance of traffic costs and engineering and administration costs in their LCCA. Most agencies consider these costs to be equal for each pavement type or the difference is considered to be insignificant between pavement types.

*Implementation*—This recommendation is expected to be incorporated into all pavement type selections performed after January 1, 2004. In the future, ODOT may wish to reconsider application of these factors as the LCCA process matures and improvements are made to the cost database.

*Benefit*—There has been controversy over the magnitude of the maintenance of traffic and engineering and administration costs that should be included in LCCA. Removal of these factors, pending the future availability of conclusive data to develop the factors, eliminates controversy over factors that many other States are not including in their analysis.

*Recommendation #2e—Develop Alternate Methods of Determining Unit Costs for PCC*

Until such time as ODOT has an adequate number of PCC projects to provide reliable unit costs for PCC pavements, ODOT should evaluate alternative procedures for developing initial cost estimates for PCC pavements. Because of the limited number of projects being constructed in Ohio, there is the possibility that cost estimates for some locations in the State may not be accurate. In areas where sufficient unit cost data are not available, it is recommended that estimating processes that consider the differences in materials or labor costs be used to adjust statewide unit prices for that area.

*Implementation*—Full implementation of this recommendation is expected within 6 months. In the interim, it is recommended that ODOT solicit industry comments on the unit costs being incorporated into the LCCA.

*Benefit*—Estimated initial cost is one of the most significant factors in LCCA. Improvement in procedures for estimating initial cost will make LCCA a more effective tool for managing the limited resources available for highway construction.