# **Issues with Pavement Type Selection**



#### **NEAUPG - October 2004**

**Carlos Rosenberger** 

| 16 | 22  | <b>\$99</b> | 16,000      | 88 |    |
|----|-----|-------------|-------------|----|----|
| 4  | 333 | 66          | <b>\$12</b> |    | 56 |

You are going to see a lot of numbers, don't worry about specific numbers, it is the concept

| 27 | 2,500 |     | <b>\$3</b>  | 500 |
|----|-------|-----|-------------|-----|
| 2  | 300   | 105 | \$1,000,000 |     |
| 18 | \$23  |     | 500,000     | 1   |

### Pavement Type Selection Team Final Report Maryland State Highway Administration



## **Pavement Selection Flow Chart**



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### Publication No. FHWA -SA-98-079 Life-Cycle Cost Analysis in Pavement Design

- In Search of Better Investment Decisions -



Pavement Division Interim Technical Bulletin September 1998

### Equivalent Initial Pavement Thickness Designs



### LIFE CYCLE ANALYSIS



### ANALYSIS PERIOD

Year (typically 40 years)

Condition

### **NET PRESENT VALUE**

### **Invested Interest Rate - Inflation Rate = Discount rate**



|          |      | Discount Factor |        |        | Dis  | scount Fac | tor    |        |
|----------|------|-----------------|--------|--------|------|------------|--------|--------|
|          | Year | 3%              | 4%     | 5%     | Year | 3%         | 4%     | 5%     |
|          | 1    | 0.9709          | 0.9615 | 0.9524 | 21   | 0.5375     | 0.4388 | 0.3589 |
|          | 2    | 0.9426          | 0.9246 | 0.9070 | 22   | 0.5219     | 0.4220 | 0.3418 |
|          | 3    | 0.9151          | 0.8890 | 0.8638 | 23   | 0.5067     | 0.4057 | 0.3256 |
|          | 4    | 0.8885          | 0.8548 | 0.8227 | 24   | 0.4919     | 0.3901 | 0.3101 |
|          | 5    | 0.8626          | 0.8219 | 0.7835 | 25   | 0.4776     | 0.3751 | 0.2953 |
|          | 6    | 0.8375          | 0.7903 | 0.7462 | 26   | 0.4637     | 0.3607 | 0.2812 |
|          | 7    | 0.8131          | 0.7599 | 0.7107 | 27   | 0.4502     | 0.3468 | 0.2678 |
|          | 8    | 0.7894          | 0.7307 | 0.6768 | 28   | 0.4371     | 0.3335 | 0.2551 |
|          | 9    | 0.7664          | 0.7026 | 0.6446 | 29   | 0.4243     | 0.3207 | 0.2429 |
|          | 10   | 0.7441          | 0.6756 | 0.6139 | 30   | 0.4120     | 0.3083 | 0.2314 |
|          | 11   | 0.7224          | 0.6496 | 0.5847 | 31   | 0.4000     | 0.2965 | 0.2204 |
|          | 12   | 0.7014          | 0.6246 | 0.5568 | 32   | 0.3883     | 0.2851 | 0.2099 |
|          | 13   | 0.6810          | 0.6006 | 0.5303 | 33   | 0.3770     | 0.2741 | 0.1999 |
|          | 14   | 0.6611          | 0.5775 | 0.5051 | 34   | 0.3660     | 0.2636 | 0.1904 |
|          | 15   | 0.6419          | 0.5553 | 0.4810 | 35   | 0.3554     | 0.2534 | 0.1813 |
| 50 cents | 16   | 0.6232          | 0.5339 | 0.4581 | 36   | 0.3450     | 0.2437 | 0.1727 |
| ¢1       | 17   | 0.6050          | 0.5134 | 0.4363 | 37   | 0.3350     | 0.2343 | 0.1644 |
| φι       | 18   | 0.5874          | 0.4936 | 0.4155 | 38   | 0.3252     | 0.2253 | 0.1566 |
|          | 19   | 0.5703          | 0.4746 | 0.3957 | 39   | 0.3158     | 0.2166 | 0.1491 |
|          | 20   | 0.5537          | 0.4564 | 0.3769 | 40   | 0.3066     | 0.2083 | 0.1420 |

Table 2.16. Present value discount factors: single future payment.

### 4% Discount Rate 6% Discount Rate



Year

#### Material Cost Information – Large Quantities (also Small, Med. & All)

| Item<br>Classification | Generic Item          | Unit Cost | Standard Deviation |  |
|------------------------|-----------------------|-----------|--------------------|--|
|                        | Excavation (CY)       | \$9.80    | \$4.30             |  |
| Other                  | GAB (SY)              | \$5.60    | \$1.20             |  |
|                        | Borrow (CY)           | \$4.60    | 2.90               |  |
|                        | Surface (Ton)         | \$36.00   | \$5.00             |  |
|                        | Gap Graded (Ton)      | \$48.00   | \$7.00             |  |
|                        | Base (Ton)            | \$35.00   | \$5.00             |  |
| НМА                    | Wedge/Level (Ton)     | \$36.00   | \$6.00             |  |
|                        | Patching (SY)         | \$30.00   | \$15.00            |  |
|                        | Patching (Ton)        | \$56.00   | \$18.00            |  |
|                        | Grinding (SY)         | \$1.40    | \$0.60             |  |
|                        | Diamond Grinding (SY) | \$5.60    | \$1.60             |  |
| PCC                    | Surface (SY)          | \$44.00   | \$11.00            |  |
|                        | Patching (SY)         | \$123.00  | \$49.00            |  |

| Cycle                             | Flexible<br>Pavement | Rigid Pavement | Composite<br>Pavement |   |
|-----------------------------------|----------------------|----------------|-----------------------|---|
| Initial                           | 14.8                 | 20.0           |                       |   |
| 1 <sup>st</sup> Rehabilitation    | 11.9                 | 10.0           |                       | Average Service Lives for LCCA<br>(historical data) |
| 2 <sup>nd</sup><br>Rehabilitation | 11.1                 |                | 9.8                   |   |
| 3 <sup>rd</sup><br>Rehabilitation | 12.0                 |                | 8.1                   |   |

| Cycle                             | Flexible<br>Pavement | Rigid<br>Pavement | Composite<br>Pavement |
|-----------------------------------|----------------------|-------------------|-----------------------|
| Initial                           | 5.8                  | 5.7               |                       |
| 1 <sup>st</sup><br>Rehabilitation | 4.7                  | 2.8               |                       |
| 2 <sup>nd</sup><br>Rehabilitation | 4.4                  |                   | 3.0                   |
| 3 <sup>rd</sup><br>Rehabilitation | 4.5                  |                   | 1.9                   |

Service Lives Standard Deviation for LCCA

### **Future Rehabilitation Estimates**

| Cycle                          | Flexible Pavement                              | Rigid Pavement  | Composite Pavement                                   |
|--------------------------------|--|---|--|
| 1 <sup>st</sup> Rehabilitation | - 2" Grind<br>- 2" HMA OL<br>- 1% HMA patching | - 5% patching<br>-100 % clean/seal<br>joints<br>- Diamond Grind |  |
| 2 <sup>nd</sup> Rehabilitation | - 2" Grind<br>- 3" HMA OL<br>- 3% HMA patching |   | - min. 4" HMA OL<br>- 5% PCC patching                |
| 3 <sup>rd</sup> Rehabilitation | - 2" Grind<br>- 3" HMA OL<br>- 5% HMA patching |   | - 2" Grind<br>- 2" HMA OL<br>-3% HMA/PCC<br>patching |

#### Present Worth Analysis (In/mi) for 10 Year Life

### **Agency Costs**

<mark>Interest</mark> 6

| Year | Construction Item and/or Material     | Quantities | Unit | Cost/Unit    | Current Price | Present Worth |
|------|---------------------------------------|------------|------|--------------|---------------|---------------|
| 0    | 9" hma base course (mainline)         | 7040       | sy   | \$ 18.00     | \$126,720     | \$126,720     |
| 0    | 3" hma intermediate course (mainline) | 7040       | sy   | \$ 6.00      | \$42,240      | \$42,240      |
| 0    | 2" hma wearing surface (mainline)     | 7040       | sy   | \$ 4.15      | \$29,216      | \$29,216      |
| 0    | 9" hma base course (shoulder)         | 4106       | sy   | \$ 18.00     | \$73,908      | \$73,908      |
| 0    | 3" hma intermediate course (shoulder) | 4106       | sy   | \$ 6.00      | \$24,636      | \$24,636      |
| 0    | 2" hma wearing surface (shoulder)     | 4106       | sy   | \$ 4.15      | \$17,040      | \$17,040      |
| 0    | Maint. & Protection of Traffic @2.3%  | 1          | ls   | \$7,216      | \$7,216       | \$7,216       |
| 0    | Mobilization @5.5%                    | 1          | ls   | \$ 17,257.00 | \$17,257      | \$17,257      |
| 5    | Seal Coat Shoulders                   | 4106       | sy   | \$ 0.85      | \$3,490       | \$2,608       |
| 10   | Deep Patch 2% (mainline)              | 142        | sy   | \$ 81.00     | \$11,502      | \$6,423       |
| 10   | Mill 2" (mainline)                    | 7040       | sy   | \$ 1.60      | \$11,264      | \$6,290       |
| 10   | 2" hma overlay (mainline)             | 7040       | sy   | \$ 4.15      | \$29,216      | \$16,314      |
| 10   | Seal Coat Shoulders                   | 4106       | sy   | \$ 0.85      | \$3,490       | \$1,949       |
| 10   | Maint. & Protection of Traffic @2.3%  | 1          | ls   | \$ 1,276.00  | \$1,276       | \$713         |
| 10   | Mobilization @5.5%                    | 1          | ls   | \$ 3,051.00  | \$3,051       | \$1,704       |
| 15   | Seal Coat Shoulders                   | 4106       | sy   | \$ 0.85      | \$3,490       | \$1,456       |
| 20   | Deep Patch 2% (mainline)              | 141        | sy   | \$ 81.00     | \$11,421      | \$3,561       |
| 20   | #60 scratch course                    | 211        | ton  | \$ 34.00     | \$7,174       | \$2,237       |
| 20   | 2" hma (mainline)                     | 7040       | sy   | \$ 4.15      | \$29,216      | \$9,110       |
| 20   | Type 7 Paved Shoulders (2.25-inches)  | 4106       | sy   | \$ 5.85      | \$24,020      | \$7,490       |
| 20   | Maint. & Protection of Traffic @2.3%  | 1          | ls   | \$ 1,654.00  | \$1,654       | \$516         |
| 20   | Mobilization @5.5%                    | 1          | ls   | \$ 3,955.00  | \$3,955       | \$1,233       |
|      |                                       |            |      |              | \$0           | \$0           |
| 30   | Same Scenario as Year 10              | 1          | ls   | \$ 59,799.00 | \$59,799      | \$10,412      |
|      |                                       |            |      |              | \$0           | \$0           |
| 35   | Seal Coat Shoulders                   | 4106       | sy   | \$ 0.85      | \$3,490       | \$454         |
|      |                                       |            |      |              | \$0           | \$0           |
| 20   | Total Annual Maintenance (\$1825/yr)  | 40         | yr   | \$ 1,825.00  | \$73,000      | \$22,762      |
|      |                                       |            |      |              | \$0           | \$0           |
|      |                                       |            |      |              | \$0           | \$0           |
|      |                                       |            |      |              | \$0           | \$0           |
|      |                                       |            |      |              | \$0           | \$0           |
|      |                                       |            |      |              | \$0           | \$0           |
|      |                                       |            |      |              | \$0           | \$0           |
|      |                                       |            |      |              | \$0           | \$0           |
|      |                                       |            |      |              | \$0           | \$0           |
|      |                                       |            |      |              | \$0           | \$0           |
|      |                                       |            |      |              | \$0           | \$0           |
|      |                                       |            |      |              | \$0           | \$0           |
|      |                                       |            |      |              | \$0           | \$0           |
|      |                                       |            |      |              | \$0           | \$0           |
|      |                                       |            |      |              | \$0           | \$0           |
|      |                                       |            |      | Total        | Present Worth | \$433,462     |
|      |                                       |            |      |              |               |               |

78 %

8 %

6 %

2 %

5 %

\$ 433,462

#### Present Worth Analysis (In/m 15 Year Life

Interest 6

### **Agency Costs**

84 %

7 %

3 %

5 %

### \$ 403,138

| Year | Construction Item and/or Material     | Quantities | Unit | C  | Cost/Unit | Current Price | <b>Present Worth</b> |
|------|---------------------------------------|------------|------|----|-----------|---------------|----------------------|
| 0    | 9" hma base course (mainline)         | 7040       | sy   | \$ | 18.00     | \$126,720     | \$126,720            |
| 0    | 3" hma intermediate course (mainline) | 7040       | sy   | \$ | 6.00      | \$42,240      | \$42,240             |
| 0    | 2" hma wearing surface (mainline)     | 7040       | sy   | \$ | 4.15      | \$29,216      | \$29,216             |
| 0    | 9" hma base course (shoulder)         | 4106       | sy   | \$ | 18.00     | \$73,908      | \$73,908             |
| 0    | 3" hma intermediate course (shoulder) | 4106       | sy   | \$ | 6.00      | \$24,636      | \$24,636             |
| 0    | 2" hma wearing surface (shoulder)     | 4106       | sy   | \$ | 4.15      | \$17,040      | \$17,040             |
| 0    | Maint. & Protection of Traffic @2.3%  | 1          | ls   |    | \$7,216   | \$7,216       | \$7,216              |
| 0    | Mobilization @5.5%                    | 1          | ls   | \$ | 17,257.00 | \$17,257      | \$17,257             |
| 7    | Seal Coat Shoulders                   | 4106       | sy   | \$ | 0.85      | \$3,490       | \$2,321              |
| 15   | Deep Patch 2% (mainline)              | 142        | sy   | \$ | 81.00     | \$11,502      | \$4,799              |
| 15   | Mill 2" (mainline)                    | 7040       | sy   | \$ | 1.60      | \$11,264      | \$4,700              |
| 15   | 2" hma overlay (mainline)             | 7040       | sy   | \$ | 4.15      | \$29,216      | \$12,191             |
| 15   | Seal Coat Shoulders                   | 4106       | sy   | \$ | 0.85      | \$3,490       | \$1,456              |
| 15   | Maint. & Protection of Traffic @2.3%  | 1          | ls   | \$ | 1,276.00  | \$1,276       | \$532                |
| 15   | Mobilization @5.5%                    | 1          | ls   | \$ | 3,051.00  | \$3,051       | \$1,273              |
| 22   | Seal Coat Shoulders                   | 4106       | sy   | \$ | 0.85      | \$3,490       | \$969                |
| 30   | Deep Patch 2% (mainline)              | 142        | sy   | \$ | 81.00     | \$11,502      | \$2,003              |
| 30   | #60 scratch course                    | 211        | ton  | \$ | 34.00     | \$7,174       | \$1,249              |
| 30   | 2" hma (mainline)                     | 7040       | sy   | \$ | 4.15      | \$29,216      | \$5,087              |
| 30   | Type 7 Paved Shoulders (2.25-inches)  | 4106       | sy   | \$ | 5.85      | \$24,020      | \$4,182              |
| 30   | Maint. & Protection of Traffic @2.3%  | 1          | ls   | \$ | 1,654.00  | \$1,654       | \$288                |
| 30   | Mobilization @5.5%                    | 1          | ls   | \$ | 3,955.00  | \$3,955       | \$689                |
|      |                                       |            |      |    |           | \$0           | \$0                  |
| 37   | Seal Coat Shoulders                   | 4106       | sy   | \$ | 0.85      | \$3,490       | \$404                |
|      |                                       |            |      |    |           | \$0           | \$0                  |
|      |                                       |            |      |    |           |               |                      |
|      |                                       |            |      |    |           | \$0           | \$0                  |
| 20   | Total Annual Maintenance (\$1825/yr)  | 40         | yr   | \$ | 1,825.00  | \$73,000      | \$22,762             |
|      |                                       |            | ŕ    |    |           | \$0           | \$0                  |
|      |                                       |            |      |    |           | \$0           | \$0                  |
|      |                                       |            |      |    |           | \$0           | \$0                  |
|      |                                       |            |      |    |           | \$0           | \$0                  |
|      |                                       |            |      |    |           | \$0           | \$0                  |
|      |                                       |            |      |    |           | \$0           | \$0                  |
|      |                                       |            |      |    |           | \$0           | \$0                  |
|      |                                       |            |      |    |           | \$0           | \$0                  |
|      |                                       |            |      |    |           | \$0           | \$0                  |
|      |                                       |            |      |    |           | \$0           | \$0                  |
|      |                                       |            |      |    |           | \$0           | \$0                  |
|      |                                       |            |      |    |           | \$0<br>\$0    | \$0                  |
|      |                                       |            |      | -  |           | \$0<br>\$0    | \$0<br>\$0           |
|      |                                       |            |      |    |           | φ0<br>\$0     | \$0<br>\$0           |
|      |                                       |            |      |    | Total     | Present Worth | \$403,138            |
| 1    |                                       |            |      |    | iotai     |               | ÷                    |



# 10 Year Life for HMA\$ 433,46215 Year Life for HMA\$ 403,138

#### Difference of \$30,324 per Lane/Mile / 7.5 %



### Life Cycle Costs Difference to 1<sup>st</sup> Overlay

|                                | 8  | \$ 453,000 | + 4.6 % |
|--------------------------------|----|------------|---------|
| 1 <sup>st</sup> Overlay @ Year | 10 | 433,000    |         |
|                                | 12 | 421,000    | - 2.8 % |
|                                | 15 | 403,138    | - 7.5 % |
|                                | 17 | 397,000    | - 8.3 % |
|                                | 20 | 390,000    | - 9.9 % |
|                                |    |            |         |

**a** 6% discount rate

### **Construction Duration Estimates**<sup>\*</sup>

| Construction Operation                                 | Rehab OR Under MOT                         | New Construction OR few MOT |
|--|--|-----------------------------|
| HMA Placement  | 1,400 – 1,500 tons/day                     | 1,500 - 2,500 tons/day      |
| HMA Grinding   | 8,000 – 10,000 SY/day                      |                             |
| HMA Base Widening & HMA<br>Wedge/Level<br>HMA Patching | 800 – 1,000 tons/day<br>200 – 250 tons/day |                             |
| PCC Placement  | 3,000 - 4,000 SY/day                       | 4,000 - 5,000 SY/day        |
| PCC Patching   | 200 – 250 SY/day                           |                             |
| PCC Grinding   | 5,600 – 7,000 SY/day                       |                             |
| Clean and Seal Joints                                  | 5,000 – 6,000 LF/day                       |                             |
| Graded Aggregate Base Placement                        | 3,000 - 4,000 SY/day                       | 6,000 – 8,000 SY/day        |
| Class 1-A Excavation                                   | 1,600 - 2,400 SY/day                       | 4,000 - 6,000 CY/day        |
| Remove and Replace Concrete Curb<br>and Gutter         | 300 LF/day for forming or slipforming      |                             |

| 40 Life Cycle Analysis      |            |           |  |  |  |  |
|-----------------------------|------------|-----------|--|--|--|--|
|                             | 10 YEAR 15 |           |  |  |  |  |
| Original                    | \$433,462  | \$403,138 |  |  |  |  |
| Salvage Value               | \$426,215  | \$395,891 |  |  |  |  |
| Salvage Value + User Delay* | \$459,607  | \$414,800 |  |  |  |  |

11% difference

#### \* 35 second delay

\* Speed change 65MPH to 45 MPH for 1 mile (100k ADT @ 10% trucks for 5 days)

| 40 Life Cycle               | Analy        | SIS       |
|-----------------------------|--------------|-----------|
|                             | <b>10 YE</b> | AR 15     |
| Original                    | \$433,462    | \$403,138 |
| Salvage Value               | \$426,215    | \$395,891 |
| Salvage Value + User Delay* | \$526,391    | \$452,618 |

### 16% difference



\_



### **Life Cycle Activities**

Using the APA software we, the industry, evaluated effects of Maryland's Pavement Selection Process.

- a) Equivalent subgrade and aggregate base: HMA approximately 24% more economical
- b) 4" increased subgrade and aggregate base for HMA:

Maryland's first project differential 16% in favor of HMA

Critical issue is that when the difference is  $\leq 10\%$ , then other pavement selection factors kick in.

### What if the difference had been < 10%

| Bush            | 46%    |
|-----------------|--------|
| Kerry           | 44%    |
| Nader           | 3%     |
| Undecided       | 7%     |
| Margin of Error | +/- 4% |

Like the presidential race pavement type selection is too close to call < 10%

## **Pavement Selection Flow Chart**



## **Pavement Selection Team**



#### Matrix Inputs & Importance to Project



#### EXAMPLE

#### Matrix Scoring Criteria

|                                | Factor  | Component   | Final  |
|--------------------------------|---|---|--|
| Factor                         | Weight  | Weight  | Weight   |
|                                |   | 45%   |  |
| Agency Cost Present Worth      | 65%   |   | 29%  |
| User Delay Present Worth       | 35%   |   | 16%  |
|                                |   |   |  |
| *LCCA                          |   |   |  |
|                                |   | 30%   |  |
| Duration of Contract           | 20%   |   | 6%   |
| Utilities & Future Maintenance | 20%   |   | 6%   |
| Maintenance of Traffic         | <b>40%</b>  |   | 12%  |
| Maintenance of Access          | <b>20%</b>  |   | 6%   |
| *Material Sources              |   |   |  |
| *Reliability of Construction   |   |   |  |
|                                | Factor     Agency Cost Present Worth     User Delay Present Worth     *LCCA     Duration of Contract     Utilities & Future Maintenance     Maintenance of Traffic     Maintenance of Access     *Material Sources     *Reliability of Construction | FactorFactorFactorWeightAgency Cost Present Worth65%User Delay Present Worth35%*LCCA7*LCCA20%Duration of Contract20%Utilities & Future Maintenance20%Maintenance of Traffic40%Maintenance of Access20%*Material Sources20%*Reliability of Construction65% | FactorComponentFactorWeightWeight45%Agency Cost Present Worth65%User Delay Present Worth35%*LCCA |

#### **Matrix Scoring Criteria**

| Design &               |                                |     |     |     |
|------------------------|--------------------------------|-----|-----|-----|
| Environment            |                                |     | 25% |     |
|                        |                                |     |     |     |
|                        | Traffic & Geometry             | 55% |     | 14% |
|                        |                                |     |     |     |
|                        | Adjacent Pavement & Structures | 25% |     | 6%  |
|                        |                                |     |     |     |
|                        | Environmental Impact           | 20% |     | 5%  |
|                        |                                |     |     |     |
|                        | *Community Concerns            |     |     |     |
|                        |                                |     |     |     |
|                        | *Future Planning               |     |     |     |
| * non-scoring elements |                                |     |     |     |

Total = cost 45% + construction 30% + Design & Environment 25% = 100%

| Matrix Scoring - Example           |        |            |            |            |
|------------------------------------|--------|------------|------------|------------|
|                                    |        |            |            | Ratings    |
| Component / Factor                 | Weight | Alt #1     | Alt #2     | Alt #3     |
| Overall Rating                     |        | <u>4.6</u> | <u>5.2</u> | <u>5.5</u> |
| Cost                               | 45%    | 5.1        | 5.4        | <u>6.3</u> |
| Agency Cost – PW costs             | 65%    | 4.0        | 5.0        | 8.0        |
| User Delay – PW costs              | 35%    | 7.0        | 6.0        | 3.0        |
| Construction                       | 30%    | 4.0        | 4.8        | 4.8        |
| Duration of Construction (Climate) | 25%    | 4.0        | 6.0        | 5.0        |
| Maintenance of Traffic             | 50%    | 4.0        | 4.0        | 5.0        |
| Maintenance of Access              | 25%    | 4.0        | 5.0        | 4.0        |
| Design & Environment               | 25%    | 4.5        | 5.6        | 5.1        |
| Traffic & Geometry                 | 55%    | 4.0        | 6.0        | 6.0        |
| Adjacent Pavement & Structures     | 25%    | 5.0        | 5.0        | 3.0        |
| Environmental Impact               | 20%    | 5.0        | 5.0        | 5.0        |

## **Pavement Selection Flow Chart**



# **Issues with Pavement Type Selection**

# Equivalent Pavement Sections Life Cycle Analysis

- ✓ Analysis Period
- ✓ Discount Rate
- ✓ Performance Periods
- ✓ Material Prices
- ✓ Variability of Performance & Prices
- ✓ Rehabilitation Strategies
- Construction Duration

### Matrix

- Primary Inputs
- ✓ Secondary Inputs

Carlos Rosenberger Asphalt Institute Primarily based on Economics

Be based on Historical Facts



 Provide the Best Value for the Taxpayers and Road Users

 Be Rational, Objective, Understandable and Defensible



# Questions, Comments

Carlos Rosenberger Asphalt Institute