To: Anthony J. Quigley
From: Jack A. Elston
Subject: Pavement Design Approval
Date: March 26, 2019

Route: IL 171 (Archer Ave)  Job No.: Tollway
Section:  Contract No.: Tollway
County: Cook Target Letting: 11-2019
Limits: at I-294/US 45 (La Grange Road)

We have reviewed the pavement design for the above referenced Tollway project which was submitted on March 6, 2019. The scope of the project is to reconstruct portions of IL 171 (Archer Ave) and 79th Street, along some of their structures and ramps, to improve access to I-294.

We concur with the District's determination this is a "special design" due to the grades and volume of trucks; and as such, a life cycle cost analysis is not required. We also concur with the District's selection of full-depth HMA.

In summary, the approved pavement designs are as follows:

**IL 171 (Archer Ave)**
- 14" Full-Depth HMA Pavement with HMA Shoulders (some PCC C&G)
- 12" Aggregate Subgrade Improvement

**79th Street**
- 12.75" Full-Depth HMA Pavement with HMA Shoulders (some PCC C&G)
- 12" Aggregate Subgrade Improvement

**IL 171 at US 45 Rams**
- 13.75" Full-Depth HMA Pavement with HMA Shoulders
- 12" Aggregate Subgrade Improvement

If you have any questions, please contact Mike Brand at (217) 782-7651.
To: Jack Elston
From: Jose A. Dominguez
Subject: Pavement Analysis*

Date: March 6, 2019

*Route: Illinois Route 171 (Archer Avenue)
Limits: at I-294/US 45 (LaGrange Road)
Section: Unknown
Current target: 11CY19

Attn: Michael Brand
By: Ojas Patel

County: Cook
Contract No.: Tollway
Job No.: Tollway

We have completed the pavement analysis for the above captioned location. Review by the Central Office is required since the total pavement area for reconstruction exceeds 4,750 Square Yards. The following is the scope of the project:

_Tollway Authority project to reconstruct the IL 171 (Archer Avenue) interchange at I-294 and at US 45 (LaGrange Road)._ 

A 20-year pavement analysis was performed for the above roadway segments. These segments including the IL 171 and the 79th Street intersection with Oak Grove Avenue are a “High Stress” location since the design lane MU ADT exceeds 200 vehicles and some approach grades are greater than 3.5%. As such, this pavement design will be classified as a “Special Design” per BDE Figure 54-1.A. A mechanistic-flexible pavement design is recommended as follows for uniformity and ease of maintenance for these segments as existing roadway network is HMA surfaced. In addition, Stone Matrix Asphalt is recommended for this high stress location.

**IL 171 (Archer Avenue)**
Reconstruction
HMA Shoulder / Portions C&G
14" Full Depth HMA

2" Polymerized HMA Surface Course, SMA, 9.5, N80
2 ½" Polymerized HMA Binder Course, IL-19.0, N90
9 ¾" HMA Base Course, IL-19.0, N90
12" Aggregate Subgrade Improvement
79th Street
Reconstruction\(^5\)
HMA Shoulder / Portions C&G
12 ¾" Full Depth HMA\(^2\)
   2" Polymerized HMA Surface Course, SMA, 9.5, N80
   2 ½" Polymerized HMA Binder Course, IL-19.0, N90
   8 ½" HMA Base Course, IL-19.0, N90
12" Aggregate Subgrade Improvement\(^4\)

IL 171 at US 45 Ramps
Reconstruction\(^5\)
HMA Shoulder
13 ¾" Full Depth HMA\(^3\)
   2" Polymerized HMA Surface Course, SMA, 9.5, N80
   2 ½" Polymerized HMA Binder Course, IL-19.0, N90
   9 ½" HMA Base Course, IL-19.0, N90
12" Aggregate Subgrade Improvement\(^4\)

\(^1\)Designer Note 1: Use pay item 40701961, HOT-MIX ASPHALT PAVEMENT (FULL-DEPTH), 14", paid for in square yards.

\(^2\)Designer Note 2: Use pay item 40701936, HOT-MIX ASPHALT PAVEMENT (FULL-DEPTH), 12 ¾", paid for in square yards.

\(^3\)Designer Note 3: Use pay item 40701956, HOT-MIX ASPHALT PAVEMENT (FULL-DEPTH), 13 ¾", paid for in square yards.

\(^4\)Designer Note 4: Use pay item 30300112, AGGREGATE SUBGRADE IMPROVEMENT, 12", paid in square yards.

\(^5\)Designer Note 5: Refer to the District One, Bureau of Materials' “Hot-Mix Asphalt – Mix Selection” tables to determine the corresponding HMA mix table requirements for the plans.

If you have any questions or need additional information, please contact Ojas Patel, Pavement Design Engineer, at (847)705-4550.

By:
José A. Dominguez, P.E.
Project Support Engineer
EXISTING LEGEND

1. EXIST. P.C. CONCRETE PAVEMENT, 10.5" & VARIES
2. EXIST. SUB-BASE GRANULAR MATERIAL, DEPTH VARIES
3. EXIST. HMA SHOULDER, 10.5" & VARIES
4. EXIST. HMA CONCRETE BINDER COURSE, 1.5" & VARIES
5. EXIST. HMA CONCRETE SURFACE & BINDER, 3" & VARIES
6. EXIST. HMA SHOULDER, 6" & VARIES
7. EXIST. HMA AGGREGATE SHOULDER, 3" & VARIES
8. EXISTING CURB & GUTTER
9. EXISTING AGGREGATE SHOULDER, 8" & VARIES

NB LA GRANGE ROAD RAMP
STA. 1+06 TO 8+74

SB LA GRANGE ROAD RAMP
STA. 404+59 TO 415+76
EXISTING LEGEND

1. EXIST. P.C. CONCRETE PAINTMENT 10.5" & VARIES
2. EXIST. SUB-BASE GRANULAR MATERIAL DEPTH & Varies
3. EXIST. HMA SHOULDER, 10.5" & VARIES
4. EXIST. HMA CONCRETE BINDER COURSE, 3" & VARIES
5. EXIST. HMA CONCRETE SURFACE COURSE, 3.5" & VARIES
6. EXISTING CURB & GUTTER
7. EXISTING AGGREGATE SHOULDER, 6" & VARIES
8. EXIST. HMA SHOULDER, 6" & VARIES
9. EXISTING SELECTED SUBGRADE, 8" & VARIES
10. EXISTING GRANULAR SUB-BASE, 4" & VARIES
11. EXISTING P.C. CONCRETE PAINTMENT, 10" & VARIES
12. EXISTING HMA CONCRETE SURFACE & BINDER, 3" & VARIES
13. EXISTING HMA SHOULDER, 3" & VARIES
14. EXISTING AGGREGATE SHOULDER, 3" & VARIES
15. EXISTING SELECTED SUBGRADE, 8" & VARIES

PLAN DATE = 11/9/2018
PLATE TIME = 5:41:31 PM
PLOT SCALE = 20.0000' / in.
FILE NAME = pw:\aecom-n-aue-bentley.com:AECOM_DSN Documents\60545817-Central...7-4296-SG1\11-A03-4296101-DGN\12-SHT4296-A03-SHT-TYP02-HDR.dgn
EXISTING LEGEND

1. EXIST. P.C. CONCRETE PAVEMENT 10.5" & VARIES
2. EXIST. SUB-BASE GRANULAR MATERIAL, DEPTH VARIES
3. EXIST. HMA SHOULDER, 10.5" & VARIES
4. EXIST. HMA CONCRETE BINDER COURSE, 1.5" & VARIES
5. EXIST. HMA CONCRETE SURFACE COURSE, 3" & VARIES
6. EXISTING CURB & GUTTER
7. EXISTING AGGREGATE SHOULDER, 6" & VARIES
8. EXISTING SELECTED SUBGRADE, 8" & VARIES
9. EXISTING GRAINARIAL SUB-BASE, 4" & VARIES
10. EXISTING P.C. CONCRETE PAVEMENT, 10" & VARIES
11. EXISTING HMA CONCRETE SURFACE & BINDER, 3" & VARIES
12. EXISTING HMA SHOULDER, 6" & VARIES
13. EXISTING AGGREGATE SHOULDER, 3" & VARIES

EXISTING RAMP
STA. 10+00 TO 10+05 (RAMP D)
STA. 50+00 TO 57+76 (RAMP E)
**LEGEND**

1. Proposed HMA Surface Course (to be determined by IDOT)
2. Proposed HMA Binder Course (to be determined by IDOT)
3. Proposed Subgrade Aggregate (to be determined by IDOT)
4. Proposed Single Face Barrier
5. Proposed Curb & Gutter, Type B-6.24
6. Proposed Aggregate Shoulder

---

**EB 79TH STREET**

STA. 801+19 TO 809+60.26

**WB 79TH STREET**

STA. 701+98.87 TO 713+21.58
LEGEND

1. Proposed HMA Surface Course (to be determined by IDOT)
2. Proposed HMA Binder Course (to be determined by IDOT)
3. Proposed Subgrade Aggregate (to be determined by IDOT)
4. Proposed Single Face Barrier
5. Proposed Curb & Gutter, Type B-6.24
6. Proposed Aggregate Shoulder

ARCHER AVENUE RAMP D
STA. 300+00.00 TO 308+70.97

ARCHER AVENUE RAMP E
STA. 48+13.37 TO 57+76.03

ARCHER AVENUE RAMP F
STA. 607+49.76 TO 609+26.39

PLANS IN PROGRESS
PROJECT AND TRAFFIC INPUTS

(Enter Data in Gray Shaded Cells)

Route: 79th Street
Comments: Tollway Project to reconfigure the interchange

BDE Coordination Required

Section: Cook

County: Cook at US 45 and at I-294

Design Date: 02/04/2019
ONP

Modify Date: 02/04/2019

ADT Year

Current: 27,400

Future: 30,000

Subgrade Support Rating (SSR): Poor

Construction Year: 2019

Design Period (DP) = 20 years

Struct. Design ADT = 28,300 (2029)

# of Lanes = 4

Number of Lanes

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>1 Lane Ramp</th>
<th>2 or 3</th>
<th>4</th>
<th>6 or more</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>P</td>
<td>S</td>
<td>M</td>
<td>P</td>
</tr>
<tr>
<td>Rural</td>
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<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Urban</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Contact BMPR for Assistance

NEW CONSTRUCTION / RECONSTRUCTION PAVEMENT DESIGN CALCULATIONS

Full-Depth HMA Pavement

Use TF flexible = 12.95

PG Grade Lower Binder Lifts = PG 64-22 (Fig. 5-3.4-R)

HMA Mixture Temp. = 75.0 deg. F (Fig. 54-5-C)

Design HMA Mixture Modulus (E(HMA)) = 690 ksi (Fig. 54-5.D)

Design HMA Strain (k(HMA)) = 58 (Fig. 54-5-E)

Full Depth HMA Design Thickness = 12.75 in. (Fig. 54-5-I)

Limiting Strain Criterion Thickness = 14.75 in. (Fig. 54-5-I)

Use Full-Depth HMA Thickness = 12.75 inches

CRCP Thickness = 9.75 in. (Fig. 54-5-M)

TF MUST BE > 60 FOR CRCP

RECONSTRUCTION ONLY (SUPPLEMENTAL) PAVEMENT DESIGN CALCULATIONS

HMA Overlay of Rubblized PCC

Use TF flexible = 12.95

HMA Overlay Design Thickness = 10.25 in. (Fig. 54-5-U)

Limiting Strain Criterion Thickness = in. (Fig. 54-5-V)

Use HMA Overlay Thickness = 999.00 inches

JPCP Thickness = NA inches

CONTACT BMPR FOR ASSISTANCE

DESIGN TABLES FROM BDE MANUAL CHAPTER 54 - PAVEMENT DESIGN

Class I Roads

4 lanes or more
Part of a future 4 lanes or more
One-way Streets with ADT > 3500

Class II Roads

2 lanes with ADT > 2000
One way Street with ADT <= 3500
(ADT 750 -2000)
(ADT < 750)

Class III Roads

2 Lanes

Class IV Roads

2 Lanes

Facility Type

PV | SU | MU

Interstate or Freeway | 0 | 500 | 1500

Other Marked State Route | 0 | 250 | 750

Unmarked State Route | No Min. | No Min. | No Min.

Traffic Factor ESAL Coefficients

<table>
<thead>
<tr>
<th>Class</th>
<th>Csu</th>
<th>Cmu</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>143.81</td>
<td>896.42</td>
</tr>
<tr>
<td>II</td>
<td>135.78</td>
<td>567.21</td>
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<tr>
<td>III</td>
<td>129.58</td>
<td>562.47</td>
</tr>
<tr>
<td>IV</td>
<td>129.58</td>
<td>562.47</td>
</tr>
</tbody>
</table>

Design Lane Distribution Factors For Structural Design Traffic (Fig. 54-5-B)

Number of Lanes

Rural

Urban

<table>
<thead>
<tr>
<th>Number of Lanes</th>
<th>P</th>
<th>S</th>
<th>M</th>
<th>P</th>
<th>S</th>
<th>M</th>
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<td>100%</td>
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<tr>
<td>2 or 3</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>4</td>
<td>32%</td>
<td>45%</td>
<td>45%</td>
<td>32%</td>
<td>45%</td>
<td>45%</td>
</tr>
<tr>
<td>6 or more</td>
<td>20%</td>
<td>40%</td>
<td>40%</td>
<td>8%</td>
<td>37%</td>
<td>37%</td>
</tr>
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</table>
**PROJECT AND TRAFFIC INPUTS**

<table>
<thead>
<tr>
<th>Route: IL 171 at US 45 Ramps</th>
<th>Comments: Tollway Project to reconfigure the interchange</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section: WB IL 171 to NB US 45 Controls - BDE Coordination Required</td>
<td></td>
</tr>
<tr>
<td>County: Cook</td>
<td>Design Date: 02/06/2019 ONP &lt;-- BY</td>
</tr>
<tr>
<td>Location: at US 45 and at I-294</td>
<td>Modify Date: &lt;-- BY ADT Year</td>
</tr>
<tr>
<td>Facility Type: Other Marked State Route</td>
<td>Current: 15,500 2015</td>
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</tbody>
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**PROJECT AND TRAFFIC INPUTS**

<table>
<thead>
<tr>
<th># of Lanes</th>
<th>Structural Design Traffic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Lane Ramp</td>
<td></td>
</tr>
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</table>

**TRAFFIC FACTOR CALCULATION**

<table>
<thead>
<tr>
<th>Flexible Pavement</th>
<th>Rigid Pavement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cpv = 0.15</td>
<td>Cpv = 0.15</td>
</tr>
<tr>
<td>Csu = 132.5</td>
<td>Csu = 143.81</td>
</tr>
<tr>
<td>Cmu = 482.53</td>
<td>Cmu = 696.42</td>
</tr>
<tr>
<td>TF flexible (Actual) = 18.85</td>
<td>TF flexible (Min) = 2.85</td>
</tr>
<tr>
<td>TF rigid (Actual) = 25.38</td>
<td>TF rigid (Min) = 4.13</td>
</tr>
</tbody>
</table>

**NEW CONSTRUCTION / RECONSTRUCTION PAVEMENT DESIGN CALCULATIONS**

<table>
<thead>
<tr>
<th>Full-Depth HMA Pavement</th>
<th>JPC Pavement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use TF flexible = 18.85</td>
<td>Use TF rigid = 25.38</td>
</tr>
<tr>
<td>PG Grade Lower Binder Lifts = PG 64-22 (Fig. 53-4.R)</td>
<td>Edge Support = Tied Shoulder or C.&amp;G.</td>
</tr>
<tr>
<td>HMA Mixture Temp. = 75.0 deg. F (Fig. 54-5.C)</td>
<td>Rigid Pavt Thick. = 10.50 in. (Fig. 54-4.E)</td>
</tr>
<tr>
<td>Design HMA Modulus (E,M) = 690 ksi (Fig. 54-5.D)</td>
<td>CRC Pavement</td>
</tr>
<tr>
<td>Design HMA Strain (k,M) = 52 (Fig. 54-5.E)</td>
<td>Use TF rigid = 25.38</td>
</tr>
<tr>
<td>Full Depth HMA Design Thickness = 13.75 in. (Fig. 54-5.F)</td>
<td>IBR value = 3</td>
</tr>
<tr>
<td>Limiting Strain Criterion Thickness = 14.75 in. (Fig. 54-5.I)</td>
<td>CRCP Thickness = 10.25 in. (Fig. 54-4.M)</td>
</tr>
<tr>
<td>Use Full-Depth HMA Thickness = 13.75 inches</td>
<td>TF MUST BE &gt; 60 FOR CRCP</td>
</tr>
</tbody>
</table>

**RECONSTRUCTION ONLY (SUPPLEMENTAL) PAVEMENT DESIGN CALCULATIONS**

<table>
<thead>
<tr>
<th>HMA Overlay of Rubblized PCC</th>
<th>Unbonded Concrete Overlay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use TF flexible = 18.85</td>
<td>Review 54-4.03 for limitations and special considerations.</td>
</tr>
<tr>
<td>HMA Overlay Design Thickness = 11.25 in. (Fig. 54-5.U)</td>
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</tr>
<tr>
<td>Limiting Strain Criterion Thickness = in. (Fig. 54-5.V)</td>
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</tr>
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</table>

**CLASS TABLES FROM BDE MANUAL CHAPTER 54 - PAVEMENT DESIGN**

<table>
<thead>
<tr>
<th>Class I Roads</th>
<th>Class II Roads</th>
<th>Class III Roads</th>
<th>Class IV Roads</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 lanes or more</td>
<td>2 lanes with ADT &gt; 2000</td>
<td>2 Lanes</td>
<td>2 Lanes</td>
</tr>
<tr>
<td>Part of a future 4 lanes or more</td>
<td>One way Street with ADT &lt;= 3500 (ADT 750 -2000)</td>
<td>(ADT &lt;= 750)</td>
<td></td>
</tr>
<tr>
<td>One-way Streets with ADT &gt; 3500</td>
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<td></td>
</tr>
</tbody>
</table>

**Traffic Factor ESAL Coefficients**

<table>
<thead>
<tr>
<th>Class</th>
<th>Csu</th>
<th>Cmu</th>
<th>Csu</th>
<th>Cmu</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>143.78</td>
<td>856.24</td>
<td>132.50</td>
<td>482.53</td>
</tr>
<tr>
<td>II</td>
<td>135.78</td>
<td>587.21</td>
<td>112.06</td>
<td>385.44</td>
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<tr>
<td>III</td>
<td>129.58</td>
<td>562.47</td>
<td>109.14</td>
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<tr>
<td>IV</td>
<td>129.58</td>
<td>562.47</td>
<td>109.14</td>
<td>384.35</td>
</tr>
</tbody>
</table>

**DESIGN LANE DISTRIBUTION FACTORS FOR STRUCTURAL DESIGN TRAFFIC (Fig. 54-2.B)**

<table>
<thead>
<tr>
<th>Number of Lanes</th>
<th>Rural</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Lane Ramp</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>2 or 3</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>4</td>
<td>32%</td>
<td>45%</td>
</tr>
<tr>
<td>6 or more</td>
<td>20%</td>
<td>40%</td>
</tr>
</tbody>
</table>
**PROJECT AND TRAFFIC INPUTS**

**Route:** IL 171 (Archer Avenue)  
**Comments:** Tollway Project to reconfigure the interchange  
**BDE Coordination Required**

**County:** Cook  
**Design Date:** 02/04/2019

**Location:** at US 45 and at I-294  
**Modify Date:**

**Current ADT:** 43,200  
**Year:** 2015

**Future ADT:** 45,100  
**Year:** 2040

**Number of Lanes = 4**

### FLEXIBLE PAVEMENT

| Cpv = 0.15 | Cpv = 0.15 |
| Csu = 132.5 | Csu = 143.81 |
| Cmu = 482.53 | Cmu = 696.42 |

**TF flexible (Actual) = 19.78** (Actual ADT)

**TF flexible (Min) = 3.56** (Min ADT Fig. 54-2.C)

### RIGID PAVEMENT

| Cpv = 0.15 | Cpv = 0.15 |
| Csu = 132.5 | Csu = 143.81 |
| Cmu = 482.53 | Cmu = 696.42 |

**TF rigid (Actual) = 26.63** (Actual ADT)

**TF rigid (Min) = 5.02** (Min ADT Fig. 54-2.C)

### NEW CONSTRUCTION / RECONSTRUCTION PAVEMENT DESIGN CALCULATIONS

- **Full-Depth HMA Pavement**
  - Use TF flexible = 19.78
  - PG Grade Lower Binder Lifts = PG 64-22 (Fig. 53-4.R)
  - HMA Mixture Temp. = 75.0 deg. F (Fig. 54-5.C)
  - Design HMA Mixture Modulus (E(100)) = 690 ksi (Fig. 54-5.D)
  - Design HMA Strain (k(100)) = 51 (Fig. 54-5.E)
  - Full Depth HMA Design Thickness = 14.00 in. (Fig. 54-5.F)
  - Limiting Strain Criterion Thickness = 14.75 in. (Fig. 54-5.I)
  - Use Full-Depth HMA Thickness = 14.00 inches

- **JPC Pavement**
  - Use TF rigid = 26.63
  - Edge Support = Tied Shoulder or C.&G.

- **CRC Pavement**
  - Use TF rigid = 26.63
  - IBR value = 3

**Use HMA Overlay Thickness = 999.00 inches**

### DESIGN TABLES FROM BDE MANUAL CHAPTER 54 - PAVEMENT DESIGN

#### Class I Roads

<table>
<thead>
<tr>
<th>Class I Roads</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 lanes or more</td>
</tr>
<tr>
<td>Part of a future 4 lanes or more</td>
</tr>
</tbody>
</table>

#### Class II Roads

<table>
<thead>
<tr>
<th>Class II Roads</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Lanes (ADT 750 -2000)</td>
</tr>
<tr>
<td>Class IV Roads</td>
</tr>
<tr>
<td>2 Lanes (ADT &lt; 750)</td>
</tr>
</tbody>
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#### Facility Type

<table>
<thead>
<tr>
<th>Facility Type</th>
</tr>
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<tbody>
<tr>
<td>Interstate or Freeway</td>
</tr>
<tr>
<td>Other Marked State Route</td>
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<tr>
<td>Unmarked State Route</td>
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#### Traffic Factor ESAL Coefficients

<table>
<thead>
<tr>
<th>Class</th>
<th>Csu</th>
<th>Cmu</th>
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<tbody>
<tr>
<td>I</td>
<td>143.81</td>
<td>898.42</td>
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<tr>
<td>II</td>
<td>135.78</td>
<td>567.21</td>
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<tr>
<td>IV</td>
<td>129.58</td>
<td>562.47</td>
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#### Design Lane Distribution Factors For Structural Design Traffic (Fig. 54-2.B)

<table>
<thead>
<tr>
<th>Number of Lanes</th>
<th>Rural</th>
<th>Urban</th>
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<tr>
<td>1 Lane Ramp</td>
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<td>50%</td>
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<tr>
<td>4</td>
<td>32%</td>
<td>45%</td>
</tr>
<tr>
<td>6 or more</td>
<td>20%</td>
<td>40%</td>
</tr>
</tbody>
</table>

**TF MUST BE > 60 FOR CRCP**

**CONTACT BMPR FOR ASSISTANCE**