Traffic In Pavement Design: Where we stand with M - E Pavement Design Guide

Leslie Ann Myers, Ph.D., P.E.
FHWA HQ Office of Pavement Technology
Washington DC
What’s New and Different

NCHRP 1-37A is an Analysis Program

Models to predict change in distress and smoothness over time
Implications for Traffic Data

To get time series distress data, you’ve got to have time series traffic loading data.

20 year design ESALs won’t cut it.
## Hierarchical Input Levels

<table>
<thead>
<tr>
<th>Level</th>
<th>Source</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three</td>
<td>Defaults</td>
<td>(Routine projects)</td>
</tr>
<tr>
<td>Two</td>
<td>Correlations</td>
<td>(Routine significant projects)</td>
</tr>
<tr>
<td>One</td>
<td>Project specific data</td>
<td>(Research, forensics and high level projects)</td>
</tr>
</tbody>
</table>
Design Inputs - Hierarchical Levels

Input levels can be mixed and matched

Damage calculations are exactly the same regardless of design input level
Climatic Data
ENHANCED INTERGRADED CLIMATIC MODEL

EICM used to predict
- Hourly temperature profile
- Monthly moisture gradient
Hourly Temperature Profile: AC

- Depth = 0 in.
- Depth = 3 in.
- Depth = 6 in.

TIME

6/15/94  6/15/95  6/14/96  6/14/97  6/14/98  6/14/99
Concrete Slab Temperature and Moisture Gradients

Curling

Warping

Slab wetter on top

Slab dryer on top
TRAFFIC INPUTS
Traffic Hierarchical Input Levels

1 – AADTT with site specific AVC & WIM
2 – AADTT with Regional/Statewide data
3 – AADT & % trucks with TTC Group
Traffic Loading Variability

Normal Distribution

Mean Value
Hierarchical Inputs

Level 3
Hierarchical Inputs

Level 2
Hierarchical Inputs

Level 1
The Traffic Differences

1993 Guide
ESALs - Truck Equivalency Factors
M-E Pavement Design Guide
Axle Load Spectra
Traffic Requirements

Hourly axle loads ... by load group
Stratified By

- Axle type
- Direction
- Design lane
- Lane location
- Month of the year
- Year of analysis
# Traffic Module Output Files

## (Load Spectra)

<table>
<thead>
<tr>
<th>Year</th>
<th>Month</th>
<th>Hour</th>
<th>Axle Type</th>
<th>Load Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0-2</td>
</tr>
<tr>
<td>i</td>
<td>j</td>
<td>k</td>
<td>Single</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Tandem</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Tridem</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Quad</td>
<td></td>
</tr>
</tbody>
</table>

The matrix for a 20 year design will have:

5760 hours = 20 years x 12 Months x 24 Hours
Model Traffic Input Categories

1. Volume adjustment factors
2. Axle load distribution factors
3. General traffic information

What traffic inputs are needed for design?
## Traffic Module Inputs

### Input Parameters

<table>
<thead>
<tr>
<th>Inputs Required to Compute AADTT</th>
<th>Input Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>AADTT for Base Year</td>
<td>√</td>
</tr>
<tr>
<td>AADT and Percent Trucks for Base Year</td>
<td>√</td>
</tr>
<tr>
<td>Directional Distribution Factor</td>
<td>√</td>
</tr>
<tr>
<td>Lane Distribution Factor</td>
<td>√</td>
</tr>
</tbody>
</table>

- **Input Level 1**: √
- **Input Level 2**: √
- **Input Level 3**: √

M-E Pavement Design Guide
Truck and Axle Load Distribution Factors

Use Truck Traffic Classification (TTC):

- Select one of the 17 Groups
- TTC Selection is based on functional classification and overall distribution of the major truck classes (buses, single unit trucks, single-trailer trucks, and multi-trailer trucks)
- Defaults derived from LTPP Data
## Traffic Module Inputs

<table>
<thead>
<tr>
<th>Input Parameters</th>
<th>Input Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Truck Traffic Volume Adjustment Factors</strong></td>
<td>1</td>
</tr>
<tr>
<td>Distribution Factors-Base YR</td>
<td>✓</td>
</tr>
<tr>
<td>Axle Load Distribution Factors</td>
<td>✓</td>
</tr>
<tr>
<td>Monthly Distribution Factors</td>
<td>✓</td>
</tr>
<tr>
<td>Hourly Distribution Factors</td>
<td>✓</td>
</tr>
<tr>
<td>Truck Traffic Growth Function/Factor</td>
<td>✓</td>
</tr>
</tbody>
</table>

The table above shows the input parameters and their corresponding input levels for the Traffic Module. The ✓ symbol indicates that the parameter is included in the specified input level.
# Traffic Module Inputs

## Input Parameters

<table>
<thead>
<tr>
<th></th>
<th>Input Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Axle Load Distribution Factors</strong></td>
<td></td>
</tr>
<tr>
<td>Axle Load Distribution Factors</td>
<td>✓</td>
</tr>
<tr>
<td>Truck Traffic Classification (TTC) Factor</td>
<td></td>
</tr>
</tbody>
</table>

## General Traffic Information

<table>
<thead>
<tr>
<th></th>
<th>Input Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Axle Types per Truck Class</td>
<td>✓</td>
</tr>
<tr>
<td>Axle Spacing</td>
<td>✓</td>
</tr>
<tr>
<td>Axle Load Groups</td>
<td>✓</td>
</tr>
<tr>
<td>Tire Spacing/Axle Configuration</td>
<td>✓</td>
</tr>
<tr>
<td>Tire Pressure</td>
<td>✓</td>
</tr>
</tbody>
</table>
Axle Configuration Parameters

Wheel Base Width

Tire Pressure

Axle Spacing

Dual Tire Spacing

Axle Width
Traffic Wander

Used to calculate pavement responses & the number of axle load applications over a point for predicting distress & performance.

- Mean wheel location = 18 in.
- Standard deviation = 10 in.
- Design lane width.
Traffic Data Collection, Analysis and Forecasting for Mechanistic Design

- Developed Software, TrafLoad
  - Reads C-card and W-card data
  - Manipulates data into 1-37A format
  - Intended to supply the traffic needs of 1-37A

- Report just out this Spring
Traffic Module Summary

- Extensive computations within traffic module for incremental damage accumulation
- Module is flexible, allowing the user to use other default values
- Default values based on LTPP data collected over time
- Historical traffic data are required, but this is consistent with requirements from LTPP and FHWA
Upcoming Traffic Workshops

2006

• Austin, Texas May 17 & 18

• Rocky Hill, CT September 18
  ▪ Webcast

• New Brunswick, NJ TBD
Traffic Data for M-E Pavement Design

Questions?