Unplanned Heavy Usage on Local Roads
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There are 115,000 miles of road in NYS
Except for new subdivisions, very little new road is being built
• The state is fully "roaded"
Most paving is done to correct roughness as the road wears out

Functional Classes in NYS

Responsibility for NYS Roads

Functional Classes and Responsibility

NYSDOT is responsible for 13,000 miles of road
• The majority of this is Interstate and arterial roads
Counties are responsible for 19,800 miles of road
• The majority of this is arterial and collector roads
Municipalities are responsible for 75,400 miles of road
• Most of this is classified as local roads
Cost Consideration

When a road is rehabilitated the taxpayers are paying for an expected life which depends on predicted traffic, quality of materials, and quality of construction.

Principles of Pavement Design

- Pavement performance (desired life)
- Traffic
- Roadbed soil (subgrade)
- Materials of construction (base and surface)
- Environment
- Drainage
- Reliability (uncertainty of life)

Pavement Performance

<table>
<thead>
<tr>
<th>Condition</th>
<th>Minor pavement distress</th>
<th>Major pavement distress</th>
<th>Reconstruct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very good</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td></td>
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<td></td>
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<tr>
<td>Fair</td>
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<td></td>
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<tr>
<td>Poor</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Very poor</td>
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</tbody>
</table>

Road User Costs

<table>
<thead>
<tr>
<th>Condition</th>
<th>Road user cost (Cents/vehicle-mile)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very good</td>
<td></td>
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<tr>
<td>Good</td>
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<tr>
<td>Fair</td>
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<tr>
<td>Poor</td>
<td></td>
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<tr>
<td>Very poor</td>
<td></td>
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Two Approaches to Pavement Design

- Engineered design
  - Based on AASHTO design guides
- Design by experience
  - Based on observation of what worked last time
- Most local governments use design by experience
  - This works because traffic growth rates are quite low (1% to 2% per year)

What is an Axle Load?

- The sum of the loads on all of the tires on a given axle.
  - Both ends of the axle
- Single axle: a steering axle (two tires) or an isolated axle (typically four tires on a truck)
- Tandem axle: any two axles within 10 ft. on center
- Dual tires: two tires on one end of an axle
Effect of Traffic Growth

- Given a 2" overlay that lasted 20 years under the prevailing traffic
  - With a 1% growth rate the traffic will increase by 22% in the next 20 years
  - The life of a new 2" overlay would be 22% shorter, and it could be expected to last 16 years

What is an ESAL?

- Equivalent single axle load
- The number of 18,000# axle single loads that would do the same amount of damage to a pavement as a given axle load.

Legal Loads in NYS

- Single axle load: 22,400# max
- Tandem axle load:
  - 36,000# (< 6 ft. between axles)
  - 40,000# (8 to 10 ft. between axles)
- Gross vehicle weight limit:
  - 34,000# plus 1000# per ft from center of front to center of rear axle (bridge formula)
- GVW Maximum: 71,000#

ESALs – Damage per Truck Trip
Depends on Axle Load and Configuration

<table>
<thead>
<tr>
<th>Axle Load pounds</th>
<th>Single Axle ESALs per pass</th>
<th>Tandem Axle ESALs per pass</th>
</tr>
</thead>
<tbody>
<tr>
<td>18,000</td>
<td>1.0</td>
<td>0.1</td>
</tr>
<tr>
<td>22,400</td>
<td>2.1*</td>
<td>0.2</td>
</tr>
<tr>
<td>40,000</td>
<td>22.5**</td>
<td>2.0*</td>
</tr>
</tbody>
</table>

* Maximum Legal  ** Illegal

ESAL Factors
Damage per Pass

Single Versus Tandem Axles

- A tandem axle loaded to 40,000# does the same damage per pass as a 22,400# single axle
- REASON: Two axles close together support each other and lessen the damage
Importance of ESALs
- ESALs are additive: One 5-axle truck with 5 ESALs does the same amount of pavement damage as ten 2-axle trucks with 0.5 ESALs per truck.
- It is the cumulative number of ESALs NOT the number of truck passes that determines the life of the pavement.

Evaluating Construction Materials
- When design by experience is used, we have an unquantified knowledge of the materials quality:
  - What is "Item 47"?
  - It has not been in the state specifications since 1973
  - Use NYSDOT Specification 667, Type B instead
- The most useful way to evaluate materials is using a pulse-loading device directly on the road.
- Lab tests can be used, but they are expensive.

The Deflection Basin

Unplanned Heavy Usage on Local Roads
- Short-term, unplanned usage of a road foreshortens the life of the road and the taxpayers don't get the years of life that they paid for.

How to Deal With Unplanned Heavy Usage
1. Draft local laws that provide for application procedures and fees and road user agreements.
2. Decide how much damage is required to trigger the need for extensive analysis:
   - 5% of total pavement life is suggested.
   - This avoids the need to analyze very small projects.
How to Deal with Unplanned Heavy Usage (2)

3. The percent of life consumed by the project is based on the ESALs from the project and the ESALs in the pavement life
   \[ \% \text{life consumed} = \frac{\text{ESALs in the project}}{\text{ESALs in pavement lifetime}} \]

4. If above the trigger level, determine the dollar value used by the project
   \[ \text{Cost of road user agreement} = \text{cost to build the road} \times \% \text{life consumed} \]

Seasonality and Drainage Considerations

- The materials properties fluctuate during the course of a year
  - Weakest during spring thaw
  - Strongest when frozen
- This needs to be considered for short-term projects
- Drainage quality affects materials properties
  - Poor/fair drainage weakens dirty materials during wet seasons

Seasonal Adjustment of Materials Properties

<table>
<thead>
<tr>
<th>Percentile by Season</th>
<th>Summer / Normal</th>
<th>Winter</th>
<th>Thaw</th>
<th>Spring</th>
<th>Freezing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>100%</td>
<td>160%</td>
<td>52%</td>
<td>85%</td>
<td>120%</td>
</tr>
<tr>
<td>Fair</td>
<td>100%</td>
<td>250%</td>
<td>27%</td>
<td>45%</td>
<td>147%</td>
</tr>
</tbody>
</table>

Typical Months
- July – November
- January
- February
- March
- April
- May
- June
- December

Summary

- Short-term usage by unanticipated traffic consumes a disproportionate amount of pavement life
- Establish procedures for project permits and road use agreements
- Use ESALs to determine the percent of life consumed by a project

Summary (2)

- Consider seasonality and drainage for short-term projects
- Use in situ pulse loading tests for greatest accuracy in pavement evaluation
- A qualified engineer should assist in making the calculations
References