Pavements, Potholes and Preservation: Who should pay for energy development costs?

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Pavement preservation

"Pavement Preservation is a cost-effective set of practices that extend pavement life and improve safety and motorist satisfaction while saving public tax dollars."

--- National Center for Pavement Preservation
www.pavementpreservation.org

Good roads are important

- Able to handle the loads throughout the year
- Cost substantially less to drive on
- Cost less to maintain
- Foster economic development
- Enhance property values

But how do we preserve and protect our roads when heavy traffic comes along?

Design by experience

- Very few local roads are "engineered"
- Design by experience works when ---
  - Daily traffic volumes are low (50-400 ADT)
  - Traffic growth rate is minimal
  - Small number of heavy trucks
  - Long experience with using the same materials
  - The life expectancy of the pavement can be anticipated
- But what about a sudden burst of heavy, unanticipated traffic?
  - It can use up a large amount of the road life

How do we allocate the extra costs due to damage caused by unanticipated heavy weight trucks?

Wind-driven generators
Natural gas wells

One thing in common: hauling equipment in and out

Policy issues

- The road was built by the community to last a given period of time (i.e., number of load repetitions) based on historical traffic levels and experience.
- Typically the road should last 10-15 years, or even longer
- A few months of heavy weight traffic is unplanned for and may substantially foreshorten the life of the road

Policy issues

- The taxpayers will not actually get the full life of the road, due to the unexpected heavy traffic
- Should the taxpayers pay for the lost life, or should the road user pay for it?
- When and how much should the road user pay?
  - The "cumulative damage" concept is the key

Regulatory measures
Municipal authority

- Authority is conveyed to municipalities via several state laws
  - Municipal Home Rule Law §10: allows towns, villages and cities power to adopt local laws relating to "the management and use of its highways, roads, streets and property."
  - Town Law §130: authorizes Town Board to establish permit system allowing work in right-of-way to construct various types of improvements (including pipelines); also authorizes permits to allow driveway/access road entrances from private property

- V&T Law §1640 (City Councils and Village Boards) and V&T Law §1660 (Town Boards) by local law, ordinance, etc., to set weight limits, designate truck routes, and set hours of operation of such vehicles

Roads deteriorate over time

Road performance

Condition
- Very good
- Good
- Fair
- Poor
- Very poor

Minor pavement distress
Major pavement distress
Reconstruct

Repair cost increases as road deteriorates

Time, years
Good Condition

Fair Condition

Very Poor Condition

Impact on road user cost

Effect of unexpected heavy trucks

Steps to preserve the road system

1. Establish traffic volume "trigger points"
2. Develop road use agreements
3. Benchmark the existing road conditions
4. Upgrade certain roads, if needed, to support heavy trucks, and designate certain routes for heavy weight traffic
5. Load zone weak roads to protect them from damage
6. Establish local laws to regulate heavy trucks (weights, routes, height-length-width, hours of operation)
Heavy loads will do minimal damage to this pavement.

Pavements are often thin and seasonally weak.

~110,000 miles of road in NYS
- ~95,000 miles administered by local governments
  - ~1,600 local governments
    - Towns (929), counties (57/62), cities (61), and villages (556)
- ~45,000 miles are seasonally weak and do not meet the structural needs of commercial traffic
  - Most are rural, low-volume roads
  - Costly to drive on (per vehicle-mile)
  - Many are a limiting factor in economic development

Road network in NYS

Strong and weak roads

Agricultural Land Use

State Forest

Village

Residential Land Use

State

Town

County
Some basic engineering principles

What causes road failure?
- Heavy loads
- Lots of traffic
- Seasonally weak materials
- Poor drainage
- Passage of time – cumulative damage

Vehicle loads bend the roads

Heavy loads cause big deflections

The paper clip analogy

Bend it repeatedly and it breaks

Bend the clips through an angle until they break – plot the results

Fatigue damage

Start with a dozen clips

45°

90°

135°
Cumulative damage

Let's bend one paper clip 10 times at 90° and 22 times at 45° -- will it break?

78% cumulative damage – usually it wouldn’t break.

Principle applied to roads

- With a knowledge of past traffic and seasonal pavement response (deflection), the percent of life used to date can be determined (benchmarking)
- The damage from adding more than normal heavy traffic can be predicted
- This enables allocation of costs due to the added traffic

Road strength is not constant throughout the year

Spring thaw reduces road strength to a minimum

Such roads will deteriorate rapidly due to heavy weight traffic.

Seasonality of road strength

All roads are stronger when frozen and weaker during thaw.
Seasonality of road strength

So ...
- The damage per pass of one truck is not the same on strong pavements versus weak local roads.
- The damage per pass of one truck on any highway is not the same at different times of the year.
- Thus cost allocation based on the number of truck passes is a flawed approach.

Implementation

Steps to preserve the road system
1. Establish traffic volume "trigger points".
2. Develop road use agreements.
3. Benchmark the existing road conditions.
4. Upgrade certain roads, if needed, to support heavy trucks, and designate certain routes for heavy weight traffic.
5. Load zone weak roads to protect them from damage.
6. Establish local laws to regulate heavy trucks (weights, routes, height-length-width, hours of operation).

Pavement evaluation (benchmarking)
- Assess the functional condition
  - Quantify extent and severity of distresses
  - Can be done with municipal forces
- Assess the structural condition
  - Measure the response to dynamic load
  - Predict remaining life at current traffic levels
  - Calculate expected damage due to heavy loads
  - Calculate the required strengthening
  - Requires engineering expertise

Functional evaluation
- Assess the extent and severity of visible distress
Note

- Functional ratings alone are not sufficient to predict cumulative damage and allocate costs
- Functional ratings are very useful to locate weak links in the road network

Strong and weak roads

Structural evaluation

- Determination of engineering properties of the pavement layers
- Prediction of remaining life
- Calculation of required strengthening (overlay thickness)
- Allocation of costs due to cumulative damage by unexpected heavy weight vehicles

Structural evaluation (deflection testing)

Review - What should you do?

- Establish a road use agreement
- Benchmark your roads
- Identify the strong and weak portions of your road system
- Post reasonable load limits for the roads that would be materially injured by a substantial increase in heavy trucks
- Identify acceptable truck routes that utilize the strong portion of your road system
  - If necessary, strengthen some roads
Questions? …