30-30 Nuts and Bolts

Robert Hale
29 August 2021
Regional rail and maintenance

• Need to run intense service all day
• Today, maintenance tends to happen in the midday, on weekdays
• Today NYP-NHV express: 1:40.
• Today GCT-NHV zone local: 2:10.
Maintenance productivity on Metro-North lags

- Maintenance productivity elsewhere enables most work to happen at night

<table>
<thead>
<tr>
<th></th>
<th>Current MN Practice</th>
<th>Modern Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Track</td>
<td>Rail &amp; ties replaced separately during the day 3.8% of ties, 0.55% of rail replaced in 2021</td>
<td>Both rails and ties replaced at night ~0.6 mi/h working speed</td>
</tr>
<tr>
<td>Catenary</td>
<td>220 track miles over 30 years, select poles, daytime shutdowns $1 billion</td>
<td>110 track miles in 5.5 years, wire and poles, nighttime work $350 million</td>
</tr>
<tr>
<td>Ballast regulation</td>
<td>12% of track miles in 2021</td>
<td>~2 mi/h</td>
</tr>
<tr>
<td>Ballast undercutting/track lowering</td>
<td>Several weeks of continuous outage for few miles</td>
<td>980 yd³ ballast per hour typically maps to ~0.4 mi/h</td>
</tr>
</tbody>
</table>
Infrastructure expenditure

- LIRR, MNR, NJT: looked at National Transit Database
- Some is capital, some is operating; have to exclude rolling stock & expansion
- Amtrak NEC: looked on Wayback Machine in annual reports, NEC Commission data
- Compared to Amtrak steady-state estimate from Amtrak OIG Report 92809, UIC 2015 Lasting Infrastructure Cost Benchmarking report
New York-Wide problem

Greater NYC Infrastructure Expenditures per Track-Mile (Constant 2020 USD)
…and a NEC-wide problem
Speeds on curves

- Cant deficiency: difference between actual superelevation and that needed to cancel out all centrifugal force at a given speed
- $E_a$: actual elevation of top rail above bottom rail
- $E_u$: permitted cant deficiency
- Metro-North: $E_u = 3"$ (75 mm)
- Amtrak-controlled NEC and elsewhere: $E_u = 6"$ (150 mm) without tilt, $E_u = 9"$ (225 mm) with tilt
- Spiral: used to smooth change in curvature
Current vs. possible speed on curves

- AREMA spiral length: \( L = 1.66 \times E_u \times V \)
  - Effectively 23 mm \( \Delta E_a/s \)
- Euronorm spiral length: Take the maximum computed from these four formulas:
  - 50 mm \( \Delta E_a/s \) for nontilting trains
  - 55 mm \( \Delta E_u/s \) for nontilting trains
  - 70 mm \( \Delta E_a/s \) for tilting trains
  - 79 mm \( \Delta E_u/s \) for tilting trains

45% speed increase (31% travel time reduction) with zero trackwork
Possible speeds

• At Port Chester:
  • 44% increase (45 to 65 mi/h) in speed just by allowing $E_u = 6''$
  • 68% increase (45 to 75 mi/h) with slightly longer spiral and 6” superelevation