Sustainability in Roadway Construction

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Sustainable Roadway Construction Practices

Best Practices

1) Recycled Asphalt Pavement (RAP)

2) Warm Mix Technology

3) Incorporation of Recycled Waste Products (Tire + Plastic)

4) Pigmented Asphalt Pavement

5) Synthetic Asphalt Binder
Sustainable Street Resurfacing

Recycled Asphalt

- NYCDOT is a national leader in the use of recycled asphalt pavement (RAP).
- By incorporating recycled content, the City saves on new material and the costs associated with transport and landfill fees.
- The milled material is reprocessed and reconstituted with new materials before use in subsequent paving.
- The new Harper Street Asphalt Plant will allow DOT to increase its use of RAP from 30% to 50%.
- By producing more recycled asphalt, the City will avoid two million miles of annual truck trips that are used to carry milled asphalt to landfills – reducing congestion, pollution and wear and tear on our streets.
- Reduction of approximately 13,200 to 15,400 metric tons of carbon dioxide annually
NYCDOT owns and operates two Asphalt Plants

- Hamilton Avenue
  - New plant - Rebuild 2014
  - Annual production of >450K tons
  - 45% RAP = More than 200K tons annually

- Harper Street
  - >30 years old plant
  - Annual production of > 280 K tons
  - 30% RAP = 84K tons annually
  - Up for capital renovation in 2023
  - Increase of recycling capacity to 50-55%
  - Increase annual recycling to 250K tons
Warm Mix Technology

Warm Mix

- Warm mix asphalt is used during winter cold weather months.
- Lower production temperature by 50°F
- Reduction of energy amount needed for asphalt production
- Warm-mix asphalt a reliable approach to decrease carbon emissions
- Extended paving season
- It would allow for consistent use of RAP through out the year – Especially cold winter months.
- A longer paving seasons with warm mix technology means better roads, quicker response time for pothole repair.
Use of recycled waste tires in production of Rubberized mixes

Pros:
- Roadways with heavy traffic loads
- Increases the durability/longevity of the pavement.
- Reduction of traffic noise.
- Decreases the amount and severity of pothole formation during the freeze/thaw cycle.
- Environmentally responsible approach
- Approximately 2,000 used tires for every mile of asphalt road paved thereby reducing the footprint of tire disposals.

Cons:
- Cost increase associated with production and plant modification.
- Comes at the expense of using RAP
Recycled Waste Plastic Technology

Waste Plastic

- The use of plastic additives derived from plastic waste has the potential to solve our growing plastic waste problem.
- Improving the overall performance of conventional Hot Mixed Asphalt.
- Substitution for virgin polymers and liquid asphalt cement.
- Recycling plastic waste without impact to RAP usage.
- Approximately 6,960 pounds of waste plastic, 92,459 of plastic bottles for lane mile of asphalt road paved thereby reducing the footprint of plastic disposals.
- Reduction of approximately 10,798 pound of Carbon dioxide (CO2) per lane mile.
Synthetic Asphalt – Colorless Binders

Pigmented Asphalt

- Pigmented asphalt conventional AC
- Synthetic Asphalt binder from non-crude oil-based resin blend.
- Idea for Pigmented asphalt
- Possible substitution to conventional asphalt cement

Challenges:
- Sourcing
- Quality
Thank You!

Questions?
QUICK BUILD TO PERMANENT BIKE SEPARATION, AND EVERYTHING IN BETWEEN

2023 NACTO DESIGNING CITIES (DENVER)
ERIC HU, PRINCIPAL TRANSPORTATION ENGINEER
Where is Fremont?
LAND USE MAP

Current/Planned Class IV Bikeways
IMPLEMENTATION CHALLENGES

- Long Network Distance
- Diverse Land Use Context (Commercial, TOD, and Residential)
- Limited Budget (~$400K to $500K per year)
- Accommodate Access for Street Maintenance, Fire Department, and Garbage Service
- What’s Good Enough?
BALANCING GAME

Distance Coverage

Durability, Quality, and Aesthetics
# Separation Devices Compared

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Implementation Cost</th>
<th>Ease of Implementation</th>
<th>Durability</th>
<th>AAA User Comfort/Safety</th>
<th>Drainage Redesign Needed</th>
<th>Maintenance</th>
<th>Aesthetics (Context Sensitive)</th>
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<tbody>
<tr>
<td>Channelizers</td>
<td>Low</td>
<td>Fast</td>
<td>Low</td>
<td>Low</td>
<td>No</td>
<td>High</td>
<td>Low</td>
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<td>K71 Bollards</td>
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<td>Fast</td>
<td>Low</td>
<td>Low</td>
<td>No</td>
<td>High</td>
<td>Low</td>
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<tr>
<td>Tuff Curb</td>
<td>Low</td>
<td>Fast</td>
<td>Low/Moderate</td>
<td>Low/Moderate</td>
<td>No</td>
<td>High/Moderate</td>
<td>Low/Moderate</td>
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<td>Armadillo</td>
<td>Low</td>
<td>Fast</td>
<td>Moderate/High</td>
<td>Low/Moderate</td>
<td>No</td>
<td>Moderate/Low</td>
<td>Low/Moderate</td>
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<tr>
<td>Portable Planter Boxes</td>
<td>Medium/High</td>
<td>Moderate</td>
<td>Low</td>
<td>Moderate</td>
<td>No</td>
<td>Moderate/Low</td>
<td>High</td>
</tr>
<tr>
<td>Precast Concrete Curb</td>
<td>Medium</td>
<td>Moderate/Fast</td>
<td>Moderate/High</td>
<td>Moderate/High</td>
<td>No</td>
<td>TBD</td>
<td>Moderate</td>
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<tr>
<td>Traditional Concrete Island</td>
<td>High</td>
<td>Slow</td>
<td>High</td>
<td>High</td>
<td>Maybe</td>
<td>Low</td>
<td>Moderate/High</td>
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<tr>
<td>Grade Separation</td>
<td>High</td>
<td>Slow</td>
<td>High</td>
<td>High</td>
<td>Yes</td>
<td>Low</td>
<td>Moderate/High</td>
</tr>
</tbody>
</table>

Quick Build Applications
Semi-Permanent/Permanent Treatments
Permanent Design, usually part of roadway redesign projects
DEVICES EVALUATION CRITERIA

Roadway Factors
- ADT
- Traffic Speeds
- Bike Buffer Widths
- Street Lighting Level
- Need for accommodation for street sweeping, Fire access, and curb side garbage pickup.

Context Factors
- Surrounding Land Use (Downtown vs. TOD vs. Sub-Urban Commercial Strip vs. Residential)
- Aesthetics
- Potential for Vandalism

Device Factors
- Overall Visibility (Daytime vs. Nighttime)
- Durability (knockdown vs. vandalism)
- Consider pairing of different device types to complement pros and cons of different devices.
PHASED IMPLEMENTATION APPROACH

Phase 1 - Reprioritizing Roadway Widths
- Through the annual pavement maintenance project.
- Narrower vehicle lanes.
- Road diets
- Stripe buffered bike lanes as much as possible (maximize buffer widths).

Phase 2 – Upgrade Class II to Class IV
- Through separate bikeway improvement project and annual pavement maintenance project.
- Utilize lower cost/faster implementation devices (e.g. channelizers and K71 bollards)
- Continue restripe roadways through annual pavement maintenance project.

Phase 3 – Improve Quality of Separation Devices
- Supplement existing lower cost devices with more permanent/durable options (e.g. pre-cast concrete curbs).
- Look at sub-phases within this phase due to high implementation cost (e.g. start with larger spacing gaps between devices and densify in future budget cycles)

Continue to Develop/Construct High Quality Separation Facilities separately from these three-phase bikeway enhancement effort through major capital projects (e.g. concrete island separated bikeways, grade separated bikeways, protected intersections, signal upgrades, trails).
SAMPLE BIKEWAY PHOTOS
(BI-DIRECTIONAL CYCLE TRACK NEXT TO META CAMPUS)
SAMPLE BIKEWAY PHOTOS
(BI-DIRECTIONAL CYCLE TRACK NEXT TO AMERICAN HIGH SCHOOL)
SAMPLE BIKEWAY PHOTOS
(HIGH SPEED ARTERIAL ROADWAY & HIGH ADT)

Just K71
(after 6 months)

Combine K71 w/ Armadillo and Pavement Reflectors
(after 6 months)
SAMPLE BIKEWAY PHOTOS
(UPCOMING BIKEWAY SEPARATION ENHANCEMENT)
(SUMMER 2023)
ANY QUESTIONS?
10th and 11th Street Frontage Lane
Context Map
Previous Configuration
Existing Challenges

- 5-Year Crash History
  - 4 Fatalities
    - 2 pedestrian
  - 11 Severe Injuries
    - 3 pedestrian, 1 bicycle

- Speeding
  - 34 mph 85th
  - 30 mph posted

- Double Parking, Stopping to Load, Driving and Garbage Bins in Buffered Bike Lane
- Added Bus Services
- High Parking Demand
- Frequent Driveways
Three Design Ideas

Couplet Conversion
Plus Roundabouts

Frontage Lane
Bike & Parking

Upgrades to Existing
Frontage Lane Access Alternatives

**ALT 1A: HYBRID DESIGN - ALL ACCESS**
Frontage Lane Conflicts = 8

**ALT 1B: HYBRID DESIGN - RT ONLY ACCESS FROM SIDE STREET**
Frontage Lane Conflicts = 5

**ALT 2: ON-RAMP OFF-RAMP DESIGN**
Frontage Lane Conflicts = 6
Frontage Lane Access Alternatives

ALT 1A: HYBRID DESIGN - ALL ACCESS
FRONTAGE LANE CONFLICTS = 19

ALT 1B: HYBRID DESIGN - RT ONLY ACCESS FROM SIDE STREET
FRONTAGE LANE CONFLICTS = 6

ALT 2: ON-RAMP OFF-RAMP DESIGN
FRONTAGE LANE CONFLICTS = 4
Outreach

How to Make a Right Turn
Separator Details

DETAIL B1
PRECAST CONCRETE ISLAND PLAN VIEW

NOTE:
1. INCLUDE OPENINGS FOR FAFULTY. SEE DETAIL B5.
2. ADD METAL SURFACE MARKER. SEE DETAIL BS.
3. EACH PRECAST ISLAND SHALL HAVE 2 OPENINGS.
   WITH LENGTH NOT TO EXCEED 30".

DETAIL B2
PRECAST CONCRETE ISLAND SCORING

DETAIL B3
PRECAST CONCRETE ISLAND CROSS SECTION

DETAIL B4
PRECAST CONCRETE ISLAND ELEVATION VIEW

NACTO

CITY OF SAN JOSE
CAPITAL OF SILICON VALLEY
Phase 1 Construction – Extruded Curbs
Phase 1 Construction – Extruded Curbs
Phase 2 Construction – 16 Bus Boarding Islands
Challenges During Construction
2020 Cost Comparison/Breakdown

Extruded Concrete

Phase 1 Total Cost: $700K
- Extruded Curb Cost: $494K (71%)
- Personal Services: $143K (20%)
- City-wide Overhead: $35K (5%)
- PW Cap: $26K (4%)

Flexible Delineators

- Assume 2.3 miles, 20 ft spacing
- $40 Material
- $44.13/Hr Labor, assume 3 workers
- Assume 8-Year Cycle, 50% replacement rate

Initial Cost: $65K
Replacement Cost: $33K
Total Estimate: $98K

Transit Boarding Islands

Phase 2 Total Cost: $1.5 Million
- 16 Bus Boarding Islands (13 on 10th and 11th St)
- Bulb-outs at 25 intersections
Lessons Learned

• Cast-in-place is highly effective for longer corridors
• Street redesign slowed down traffic - from 34 mph to 33 mph
• TBI handrail breakaways
• Strategic use of separators to prevent maintenance and sweeping challenges
• Landscape bulb-out challenges
Biking in a Material World
FLEXIBLE MATERIALS
PROCUREMENT AND MAINTENANCE

BLANKET/SUPPLY&INSTALL CONTRACTS

PROACTIVE INSPECTION AND MAINTENANCE IN-HOUSE VS. CONTRACTING (OR BOTH)

THE HEAVIER THE MATERIAL, THE MORE IMPORTANT IT IS TO MAINTAIN

EXPERIMENT AND THEN SELECT A MATERIAL PALLETTE AND SCALE
PERM. MATERIALS
PROCUREMENT AND MAINTENANCE

CONSTRUCTION TENDERS

BUNDLE WITH ROAD/WATER WORKS

INSPECTIONS MATTER!

THE DETAIL DETAILS

DEVELOP SPECIFICATIONS
INTERIM MATERIALS
PROCUREMENT AND MAINTENANCE

CONSTRUCTION ROSTER

BLANKET CONTRACTS/IDIQ

EXPERIMENT, BUT THEN ADOPT SPECIFICATIONS/STANDARDS

DRAINAGE
CONTEXT MATTERS

Raising the cycle track here may look good, but falls below the guidance for multi-lane, high speed arterial. The setback from motor vehicle traffic is more important than the material itself. So don't be swayed simply by aesthetic.
When folks in your Division are concerned about new standards or designs, it could be because there is a lack of detail. And the detail details matter. We applied a new bevel curb standard on a bull-nose median island and honestly the standard was cumbersome to implement. Being apart of the construction will make you a better practitioner.
Have a plan to upgrade, where it matters

If you are scaling up your flexible material projects, develop a plan for upgrades to improve safety, accessibility and reduce maintenance needs. Accessibility features and intersections are a key locations to consider.
Material Success

CONTEXT
Materials should be determined by motor vehicle speed and volume.

THE DETAIL DETAILS
Developing specifications and being apart of construction will make you a stronger practitioner.

HAVE A PLAN FOR MAINTENANCE AND UPGRADES
If you are scaling up use of flexible materials, have a plan to upgrade

INVEST WHERE IT COUNTS
Interim projects have a lot of merit, invest in accessibility, safety and to resolve maintenance issues.
### Thank you!
#### Photos and Specifications

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<thead>
<tr>
<th></th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Shaw at Essex</td>
</tr>
<tr>
<td>2</td>
<td>Yonge at Walker, Danforth Ave at Luttrell</td>
</tr>
<tr>
<td>3</td>
<td>Scarlett at the Humber Trail entrance</td>
</tr>
<tr>
<td>4</td>
<td>Sherbourne St, Bloor St, Murray Ross Pkwy, Cummer Ave, Bathurst at Adelaide</td>
</tr>
<tr>
<td>5</td>
<td>Six Points Intersection</td>
</tr>
<tr>
<td>6</td>
<td>Lake Shore Boulevard, Gerrard St, Woodfield, Danforth at Kelvin, Argyle St.</td>
</tr>
<tr>
<td>7</td>
<td>Danforth at Kelvin, City Standards</td>
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<tr>
<td>8</td>
<td>Six Points Intersection</td>
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<td>9</td>
<td>Woodfield at Gerrard</td>
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<td>10</td>
<td>Richmond at Brant, Cherry at Mill</td>
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<td>11</td>
<td>York U Accessibility Site Visits</td>
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<tr>
<td>12</td>
<td>Murray Ross Pkwy</td>
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