Utilization of the High Velocity Impact Method

Alaska Asphalt Pavement Summit
October 31, 2011
Dena’ina Center
Anchorage, Alaska
Gary A. Billiard

The High Velocity Impact Method
The FAA AC 150/5320-12c definition:

Employs the principle of throwing abrasive particles at a very high velocity at the runway pavement surface. Additionally, the machinery that performs this operation can be adjusted to produce the desired surface texture.

STEEL ABRASIVE MATERIAL
HVIM
QUALITY PRODUCTION SURFACE ABRADING FOR OVER 30 YEARS

› Concrete & Asphalt Surface Preparation
› Highway Texturing for Asphalt and PCC Pavements
› Runway Texturing for Asphalt and PCC Runway

SURFACE PREPARATION

For bridges bridge deck overlays, highway thin bonded overlays, skid enhancement for applications of sealers and rejuvenators, curing compound removal and slurry removal
VERIFIABLE REMOVAL

ASTM-E-965
SAND PATCH TEST

ASTM-E-2380-05
OUTFLOW METER STANDARD
WHY TEXTURING?

Need for Friction? 1920's

Pavement Slipperiness - The Horse Era
Miles traveled by a horse on American pavements before an accident occurs (1906-1939)

<table>
<thead>
<tr>
<th>Kind of Pavement</th>
<th>Falls on Knees</th>
<th>Falls or Launches</th>
<th>Complete Fall</th>
<th>Accidents of any kind</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt Artifical Sherd</td>
<td>1234</td>
<td>2160</td>
<td>1047</td>
<td>293</td>
</tr>
<tr>
<td>Granite Block</td>
<td>510</td>
<td>5934</td>
<td>3472</td>
<td>413</td>
</tr>
<tr>
<td>Wood</td>
<td>408</td>
<td>983</td>
<td>4901</td>
<td>272</td>
</tr>
</tbody>
</table>

Miles traveled by a horse on London pavements before an accident occurs (1933-1934)

<table>
<thead>
<tr>
<th>Kind of Pavement</th>
<th>Dry weather</th>
<th>Damp weather</th>
<th>Wet weather</th>
<th>Accidents of any kind</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt Limestone</td>
<td>223</td>
<td>125</td>
<td>192</td>
<td>191</td>
</tr>
<tr>
<td>Granite Block</td>
<td>78</td>
<td>142</td>
<td>572</td>
<td>133</td>
</tr>
<tr>
<td>Rectangular Wood Blocks</td>
<td>646</td>
<td>193</td>
<td>432</td>
<td>330</td>
</tr>
</tbody>
</table>

Slipperiness Alleviation: Asphalt - Sprinkle coarse sand on surface
Wood - Sprinkle pebbles on surface
Why is Friction Important?

For a vehicle travelling at $V_{mph} = 70$ mph ...

Braking Distance $= \frac{V_{mph}^2}{30(f + g)}$

Apply Brake

Complete Stop

Pavement with FN = 25 (or $f = 0.25$) and $g = 0$

653 feet

Pavement with FN = 40 (or $f = 0.4$) and $g = 0$

408 feet

Roadway Texture

- **Macrotexture**
  - Large scale texture (> 0.5mm to 50mm)
  - Water drainage

- **Microtexture**
  - Small scale texture (< 0.5 mm)
  - Surface irregularities on individual aggregates
  - Provides majority of adhesion at low speeds
# Friction Number Guidelines

<table>
<thead>
<tr>
<th>Posted Speed Limit</th>
<th>ALL HIGHWAY SECTION SURFACES</th>
<th>Questionable¹</th>
<th>Review²</th>
<th>Desired³</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;= 45 MPH</td>
<td>FN 40</td>
<td>FN 40</td>
<td>FN 40</td>
<td></td>
</tr>
<tr>
<td>&gt;45 MPH</td>
<td>25</td>
<td>26-28</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

1. **Existing Pavements** - Warrants investigation to determine if corrective action is necessary. Review percent of wet weather accidents, surface conditions, traffic density, drainage, etc.

2. **Existing Pavements** - Warrants review to determine if section appears on 25% or 50% wet weather crash list. If on list, investigate as outlined in Note 1.

3. Desired values for new pavement surfaces

| TABLE 1, APPENDIX E-1, HIGHWAY SAFETY IMPROVEMENT PROGRAM GUIDELINE |

---

## Projects over 250,000 to 1,800,000 Square Yards

**Asphalt and PCC Highway Texturing**

- I-20 Louisiana PCC
- I-20 Louisiana Asphalt
- I-10 Louisiana PCC
- Lake Ponchatrain Causeway Bridge PCC
- I-635 Texas PCC
- I-30 Texas PCC
- I-20 Texas PCC
- I-45 Texas PCC and Asphalt
- I-35 Texas PCC and Asphalt
- Rt 67 Texas PCC and Asphalt
- Rt 59 Texas PCC
- I-80 Wyoming PCC
- I-15 Utah PCC
- I-84 Utah PCC
- I-40 Montreal PCC
- I-15 Montreal, PCC
- New York City Holland and Lincoln Tunnels Asphalt
- Manhattan Expressway PCC
- I-5 California PCC
- I-5 Washington State PCC
- I-10 Arizona PCC
- I-15 Arizona Asphalt
- I-10 Arizona Asphalt
- Rt 1 New Jersey PCC and Asphalt

---

## Lake Ponchatrain Causeway

**Wearing Surface Restoration**

- 800,000 Square Yards, PCC
- 23 Work Day Completion
Test Results North and South Bound Bridges

<table>
<thead>
<tr>
<th></th>
<th>No. of Tests</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outflow Meter</td>
<td>2350</td>
<td>4.04 secs</td>
</tr>
<tr>
<td>ASTM-2380-05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand patch</td>
<td>843</td>
<td>0.054 in</td>
</tr>
<tr>
<td>ASTM-E-965</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASTM – E524</td>
<td>96</td>
<td>43.52 sn</td>
</tr>
<tr>
<td>(Skid test blank tire)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASTM – E501</td>
<td>96</td>
<td>50.46 sn</td>
</tr>
<tr>
<td>(Skid test treads tire)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

60 MPH Skid Test Results E-501 Treaded Tire

Before After 48 Months
60 MPH Skid Test Results E-524 Bald Tire

Louisiana Department of Transportation

PROJECT # I-10-450-06-0053

- PORTLAND CEMENT CONCRETE
- 500,664 SQUARE YARDS

ACCIDENT REDUCTION AFTER 36 MONTHS
58.1 PERCENT

Louisiana Department of Transportation

Project # I-20-451-06-0107

- Asphaltic Concrete On Limestone
- 190,000 Square Yards
11/10/2011

60 MPH Skid Test Results
ASTM- E-501 TREADED TIRE

Before | After | 24 hr. Later
60 MPH Skid Test Results
ASTM-E-524 BALD TIRE

- Total tests: 636/av. 3.66
- Outside lane: 166/av. 3.79
- Inside lane: 470/av. 3.53
- Percentage Improvement:
  - Outside lane: 537%
  - Inside Lane: 457%
- Based on 636 tests, average improvement is 497%

ASTM-2380-05
Outflow Test Results West Bound Lanes

- Total tests: 636/av. 3.66
- Outside lane: 166/av. 3.79
- Inside lane: 470/av. 3.53
- Percentage Improvement:
  - Outside lane: 537%
  - Inside Lane: 457%
- Based on 636 tests, average improvement is 497%
Louisiana Department of Transportation
Project # 451-06-0107

ACCIDENT REDUCTION AFTER 36 MONTHS
38.9 PERCENT

Runway Applications
- Where and how long it has been used
- Friction Guidelines
- Types of Pavements Textured
- FOD (Foreign Object Debris)
- Space Shuttle Runway Project
- Conclusions
FOR THIS, HVIM CAN HELP

PROVEN FRICTION RESTORATION ON THE WORLD’S LARGEST AIRPORT RUNWAYS

1. PCC AND ASPHALT RUNWAYS
2. GROOVED AND NON-GROOVED RUNWAYS
3. BI-DIRECTIONAL ABRASION FOR UNIFORM TEXTURE ON GROOVED SURFACES
4. ENVIRONMENTALLY AND “FOD” CLEAN
5. HIGH PRODUCTION FOR LIMITED WINDOWS

AIRPORT RUNWAY TEXTURING PROVEN FRICTION RESTORATION ON SOME OF THE WORLD’S LARGEST RUNWAYS

- Atlanta Hartsfield
- Boston
- Chicago O’Hare
- Cincinnati
- Dallas-Ft.Worth
- Denver
- Houston George Bush
- Minneapolis-St.Paul
- New York - JFK
- New York - LaGuardia
- Newark Inter.
- Oklahoma City
- Portland Inter
- Salt Lake City
- Seattle Sea-Tac
- Calgary Inter
- Edmonton Inter
- Montreal Trudeau
- Toronto Pearson
- Andrews AFB
- Charleston AFB
- Grand Fork AFB
- Boggartville AFB
- Trenton AFB
- Greenwood AFB
- Kennedy Shuttle Facility
Airport Runway Friction Evaluation

<table>
<thead>
<tr>
<th>CFME</th>
<th>Minimum Mu</th>
<th>Maintenance Planning</th>
<th>New Design/Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynatest RFT</td>
<td>.50</td>
<td>.60</td>
<td>.82</td>
</tr>
</tbody>
</table>

MAIN LANDING GEAR ON 747

Friction Measuring Trailers
- IMAG Variable/Fixed Slip
- Runar Variable/Fixed Slip
- Grip/Tester Fixed Slip
- BV-11 Skiddometer
- Mu-meter
- E-274 Skid Trailer
FACTS ABOUT HVIM

(1) High Production Machinery
(2) Equally Efficient on PCC and Asphalt Surfaces
(3) Bi-Directional Texturing for unequaled uniformity
(4) Proven Accident Reduction
(5) Environmentally Clean
(6) Self-contained for Day and Nighttime Operations
(7) High Production Means Fewer Traffic Disruptions
(8) Cost Effective When Compared To Alternatives
On Time, on Budget, and According to Specifications
Questions?

SKIDABRADER
THE WORLD'S PRODUCTION AND QUALITY LEADER
IN SURFACE ABRADING FOR OVER 25 YEARS!

- HIGHWAY TEXTURING FOR ASPHALT AND PCC
- CONCRETE SURFACE PREPARATION
- HIGHEST PRODUCTION MACHINE IN THE WORLD
- EQUALLY EFFICIENT ON CONCRETE OR ASPHALT
- BI-DIRECTIONAL TEXTURING FOR UN-EQUALIZED UNIFORMITY
- PROVEN WET WEATHER ACCIDENT REDUCTION
- ENVIRONMENTALLY CLEAN
- SELF-CONTAINED FOR DAY OR NIGHT OPERATIONS
- MOST COST EFFECTIVE ALTERNATIVE TO RESURFACING
- MINIMAL TRAFFIC DISRUPTIONS / MOVING MOT!
HVIM
applications for and advantages for

- PORTLAND CEMENT HIGHWAYS
- ASPHALTIC CONCRETE HIGHWAYS
- SIGNIFICANT WET WEATHER ACCIDENT REDUCTION
- NO ADVERSE TIRE NOISE EFFECT
- MINIMAL TRAFFIC DISRUPTIONS
- NO ON-SITE TRANSFER OF ABRADED MATERIALS
- SELF-CONTAINED FOR DAY AND NIGHTTIME OPERATIONS

![Graphs showing bond strength tests on I-295](image)

Courtesy of The Virginia Transportation Research Council

![Image of Skidabrader](image)

SKIDABRADER
ON TIME, ON BUDGET, AND ACCORDING TO SPECIFICATION