2008 LTRC Peer Exchange
Regional Cooperation

Review of LTRC Capabilities
LTRC University Employees

Engineering Materials Characterization
Dr. Louay Mohammad, LSU

Geosynthetic Laboratory,
Dr. Murad Abu-Farsakh, LSU

Accelerated Research Facility;
Dr. Zhong Wu, LSU
Laboratory Materials Characterization
Superpave Asphalt Binder Testing Equipment

[BBR] [RV] [DSR]

[DTT]
Blue Boxes

Larger Samples
Less boundary issues.
Heavy Reaction Frame
Geotextile Testing
Strain & Pressure Gauges
Direct Shear
Pluviator
Fabrics & Geotextile Storage
Large Quantity Soil Storage
Repeated Loading Cyclic Plate Test Lab Tests
Louisiana Pavement Research Facility (PRF)

- PRF - Located in Port Allen, LA
  - Six-acre land with space for construction of 10 full-scale test sections
- Accelerated Loading Facility (ALF)
  - Approximately 100-ft long and 55-ton
  - One half of a single axle
  - Load adjustable from
    » 9,750 lbs ~ 18,950 lbs
  - Simulate traffic wander
    » Speed - 10.5 mile per hour
- ALF is one of only three of its kind in the nation
In-Situ Test Devices
Mobile Asphalt Laboratory
Engineering Materials Characterization Research Facility

- Experimental Capability
- Modeling and Numerical Simulation
Asphalt Laboratory is AMRL Certified
GPC Data for PAV Aged Samples

<table>
<thead>
<tr>
<th>POLYMER Region</th>
<th>ASPHALT Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>PMAC</td>
<td></td>
</tr>
<tr>
<td>PMAC 1PAV</td>
<td></td>
</tr>
<tr>
<td>PMAC 3PAV</td>
<td></td>
</tr>
</tbody>
</table>

Elution Volume, ml

MW 52.4K
MW 96.0K
MW 4.9K
MW 9.9K

ΔRI (rel)
Aggregate Testing

FAA

F & E

Micro Duval

Source

Receiver

Infra red surface analyzer

SS Detect

Infrarad surface analyzer

2 L H2O

1 hr

200 rpm

95-120 minutes

200 rpm

95-120 minutes
Asphalt Laboratory Compactors
Concrete Testing Laboratory

10,000 psi = f′c
2.75 inch diameter
Smaller Grain Sizes

Direct Shear

Geotechnical Lab;

12 inch square box
Aggregates, Tire Chips, etc
Performance
Lab Mixture Characterization Tests

- Indirect Tensile Strength Test, 25C
- Indirect Tensile Resilient Modulus Test, 5-, 25-, 40C
- Indirect Tensile Creep Test, 40C
- Axial Creep Test, 40C
- Frequency Sweep at Constant Height Test, 60C
- Repeated Shear at Constant Height Test, 60C

Permanent Deformation
Fatigue Cracking
Semi Circular Bend Test
Fracture Resistance, Jc
Mechanistic Tests

- Material Test System
Dissipated Creep Strain Energy

![Image of concrete samples and strain graphs.](image-url)
Loaded Wheel Tracking
SPT Sample Preparation
**Dynamic Modulus |E*| Test**

- IPC UTM-25
- AASHTO TP-62
- Sinusoidal axial compressive stress is applied to a specimen – temperature and frequency

\[ |E^*| = \frac{\sigma_0}{\varepsilon_0} \]

\[ \phi = \omega t_i \]

<table>
<thead>
<tr>
<th>Frequency (HZ)</th>
<th>25, 10, 5, 1, 0.5, 0.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temp. (°C)</td>
<td>-10, 4.4, 25, 38, 54.4</td>
</tr>
</tbody>
</table>
Repeated Load Permanent Deformation Test – $F_N$

- IPC UTM-25
- A haversine axial compressive stress is applied
  - Loading: 0.1 Second
  - Rest Period: 0.9 Second
  - 54.4°C
- $F_N$: Number of cycles
  - Tertiary Failure
  - 10,000 cycles
  - Related to Strength
Frequency Sweep Test at Constant Height

- AASHTO TP-7
- A sinusoidal horizontal shear strain and axial stress are applied
  - temperature and frequency
- \( G^* \) and \( \delta \)

<table>
<thead>
<tr>
<th>Frequency, HZ</th>
<th>10, 5, 2, 1, 0.5, 0.2, 0.1, 0.05, 0.02, 0.01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temp. (°C)</td>
<td>48, 60</td>
</tr>
</tbody>
</table>

Apply repeated controlled shearing strain...

Apply repeated axial stress to keep specimen height constant.
MTS System (Repeated Load Triaxial Test) Soil Resilient Modulus & Permanent Deformation
Direct Shear Test

Shear Stress vs Displacement
Test Temperature 55°C

Shear Stress (kPa)

Displacement (mm)
Characterization of Tack Coat Quality

- Developed equipment
  - NCHRP Project 9-40
  - Tack coat quality -- residual
  - Tension
- User friendly
- Easy to use
- Laboratory and field
Interface Bond Strength Test

- Developed equipment
  - NCHRP Project 9-40
  - Louisiana Interlayer Shear Strength Tester (LISST)
  - Interface Bond Strength
  - Shear

- Easy to use
- Portable
- Adoptable to exiting load frames
- Reasonable cost
- Accommodate both 100 and 150-mm sample diameter
In-Situ Test Devices
FWD & LFWD

LFWD - PRIMA 100 model
Carl Bro Company, Denmark
Comparison B/W Tests
FWD and LFWD

R\(^2\) = 0.87
R\(^2\) = 0.82

FWD Deflection (mil)

LFWD Deformation Modulus (ksi)
Performance

Laboratory Mixture Characterization
Field Accelerated Loading Evaluation (ALF)
Louisiana Accelerated Loading Facility

- Full-scale Accelerated Loading Facility
- Simulates pavement response to real loading at vehicle speed
- Responses of pavement sensors allow advanced pavement modeling of test lanes
- Findings of three experiments were successfully implemented by DOTD
- Cost to Benefit Ratio = 5.3: 1
Repeated Loading Cyclic Plate Test
Field Tests
Advanced Imaging

X-ray Computerized Tomography

Optical Imaging

SGI Workstation

PM 675 Infrared Imaging

Cordin M550 Speed Imaging System
Computational capability

- Several high end processor based PCs
- Two Sun workstation
  - equipped with ABAQUS
  - commercial finite element program.
Thank You!