Bringing Innovation to Transportation in Virginia-VDOT’s Research Program

Jose Gomez, Ph.D., P.E.
Director of Research

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Transportation Research???
VCTIR Leadership Team

- Commissioner of Highways
- Chief Deputy Commissioner
- Director of Research

- Business Manager
- Knowledge Management Officer
- Implementation Coordinator

- Associate Director Materials
- Associate Director Environment, Planning and Economics
- Associate Director Safety, Operations and Traffic Engineering
- Associate Director Structural, Pavement and Geotechnical Engineering

Research Teams
Core Functions

• Develop and deliver an applied research program that supports the VDOT mission
• Provide expert consultation to VDOT Operations
• Provide post-research implementation support
• Provide technical oversight of university contract research
• Provide educational opportunities for future professionals through graduate assistantship program
Staffing

- In house staff (50 Full time employees)
- 34 scientists
- 7 technicians
- 9 Admin & Library staff
- Faculty, GRAs, and undergraduate students through contract research projects conducted with universities
Universities Play Key Role

• Expansion of the research program
• Partnerships to leverage resources, attract grants for collaborative research
• Shared laboratories
• Effective access to faculty and students
Benefits of University Partnerships to VDOT

- Effective balance of very practical and academic approaches
- Graduate research assistants contribute to projects and get hands-on practical experience understanding transportation in Virginia—future VDOT/private professionals
- Broad array of subject matter expertise coupled with extensive practical knowledge of transportation in VA
VCTIR’s Research Methodology
Research Advisory Committees
Guide the Programs

- Asphalt
- Concrete
- Environmental
- Structure and Bridge
- Geotechnical
- Pavements
- System Operations
- Traffic and Safety
- Transportation Planning
Technical Review Panels Guide the Projects

• Function of the TRP:
  – Guide the research project from initiation to implementation
  – Provide peer review of the proposed methodology/expected deliverables

❖ Prior to submission to TRP we conduct an in-house peer review of the project proposal to insure the scientific approach is valid
Who sits on of the TRP?

- **The Champion**: Recognized for his/her role, responsibilities, and authority within VDOT Organizational structure
- Technical experts from the field (within VDOT and external)
- Technical experts within VCTIR
Process

• Project kickoff meeting (scope, schedule, deliverables)

• Key attendees:
  – Champion
  – Principal Investigator(s)
  – Associate Director and Director
  – Implementation Coordinator

• TRP members as their schedules allow
Process

• Project completion meeting (focusing on deliverables)
• All key attendees identified previously
• TRP members
• Others (know the business!)
• Implementation discussion
Environment, Planning, and Economics Team

Amy A. O’Leary, Ph.D.
Associate Director
VCTIR Environment, Planning, and Economics Team

Amy A. O’Leary, Ph. D.
Associate Director
Special Studies

James S. Gillespie
Senior Research Scientist
Economics, Finance, Special Studies

John S. Miller, Ph. D., P.E.
Associate Principal Research Scientist
Planning, Traffic

Bridget M. Donaldson
Senior Research Scientist
Environmental

Peter B. Ohlms, AICP
Research Scientist
Multimodal, Planning, Systems Operations

Ilona O. Kastenhofer
Senior Research Scientist
Planning

Ann L. Miller
Senior Research Scientist
History, Cultural Resources

G. Michael Fitch, Ph. D.
Associate Principal Research Scientist
Environmental, Special Studies

Roger W. Howe
Associate Research Scientist
Planning

Audrey K. Moruza
Research Scientist
Economics, Finance, Special Studies
The Team’s Research Areas: Diverse

• For the environment and history areas they include:
  – Air quality
  – Water quality
  – Stormwater management
  – Waste management
  – Endangered species
  – Mitigating animal-vehicle collisions
  – Historic bridges
  – Cultural resource management
Research Areas, cont.

- In the planning and multimodal areas:
  - Access management
  - Land development risk
  - Linking safety with the planning process
  - Trip generation methods
  - Socioeconomic and land use forecasting
  - Transit and rail studies
  - Public involvement
Research Areas, cont.

• For economics, finance, and special studies (“red phone studies”)
  – Life cycle costing and cost benefit analysis
  – Transportation finance and funding options
  – Studies for the Va. General Assembly
  – Other special studies for the Secretary of Transportation, VDOT Commissioner, or other VDOT executives
Knowledge Management at VDOT

Knowledge Management Office

Maureen L. Hammer
VDOT Knowledge Management Officer

Katherine S. Clark
Senior Program Manager

Gene T. Shin
Senior Program Manager

Kenneth A. Winter
Library Director

Gale Smith
Associate Librarian

W. Rhudy Renfro
Quality Assurance Analyst

Edward J. Deasy
Webmaster

Penny Y. Via
Library Assistant

Barbara J. Neyman
Library Assistant

Lauren O. Ortiz
Student Clerk

Library Director

Office Assistant
Knowledge Management at VDOT

KM Program Areas:
• Knowledge Sharing, Transfer and Collaboration
• Business Process Management
• Strategic Planning
• Program Evaluation
• Organizational Change Management
• Succession Planning
• Knowledge Portal
Knowledge Management at VDOT

Library Services:
• Circulation of Print Collection

• Access to online full-text resources

• Interlibrary loan

• Document Deliver

• Research Assistance

• Research Synthesis Bibliographies
Safety and Mobility Issues

Safety
• 33,963 deaths/year (2009)
• 5,800,000 crashes/year
• Leading cause of death for ages 4 to 34

Mobility
• 4.2 billion hours of travel delay
• $78 billion cost of urban congestion

Environment
• 2.9 billion gallons of wasted fuel

*Slide adapted from USDOT
Traffic Signal Control: Current Practice

• Traffic signal timings are currently set based on historic traffic counts
• Timing plans developed for different days of the week and times of day
• Drawbacks:
  – Regular retiming is necessary to deal with changes in traffic patterns
  – Cannot adapt well to unexpected changes (crashes, special events, etc.)
Adaptive Traffic Signal Control

• Adaptive traffic signals use advanced computing to optimize signals on the fly at individual intersections or along a route

• No fixed timing plans

• Can adapt to variations in flow
  – Seasonal variations (shopping, recreational traffic)
  – Crashes or incidents
Connected Vehicles
Opportunities for Safer Driving

➢ **Greater situational awareness**
  – Your vehicle can “see” nearby vehicles and knows roadway conditions you can’t see

➢ **Reduce or even eliminate crashes thru:**
  – Driver Advisories
  – Driver Warnings
  – Vehicle Control

*IntelliDrive has the potential to address 82% of the vehicle crash scenarios involving unimpaired drivers*

*Slide adapted from USDOT*
Opportunities for Enhanced Mobility

Real-time Data Capture and Management

- Vehicle Status Data
  - 65 mph
  - brakes on
  - two passengers
- Infrastructure Status Data
- Weather Data
- Truck Data
- Transit Data
- Location Data

Data Environment

Dynamic Mobility Applications

- Reduce Speed 35 MPH
- Transit Signal Priority
- Weather Application
- Real-Time Travel Info
- Fleet Management/Dynamic Route Guidance
- Signal Phase & Timing Adjusts Real-Time Conditions
- Safety Alerts and Warnings

Adapted from USDOT
VCTIR Materials Team

Michael M. Sprinkel
Associate Director
Materials

H. Celik Ozyildirim
Principal Research Scientist
Concrete

Michael W. Burton
Engineering Technician III
Concrete Lab Manager

Donald W. Dodds
Engineering Technician III
Asphalt Binder Lab Manager

D. Stephen Lane
Associate Principal Research Scientist
Petrography, Asphalt, Concrete

Andrew J. Mills
Engineering Technician III
Concrete

Arthur W. Ordel III
Engineering Technician II
Corrosion and Non-destructive Evaluation

Kevin K. McGhee
Associate Principal Research Scientist
Road Surfaces, Asphalt, Concrete

Stacy D. Defenderfer
Research Scientist Senior
Asphalt

Harikrishnan Krishnankutty
Research Scientist
Asphalt, Concrete

Stephen R. Sharp
Research Scientist
Corrosion, Non-destructive Evaluation

Troy H. Deeds
Engineering Technician III
Asphalt Lab Manager

Benjamin J. Earl
Engineering Technician II
Asphalt Binders

Lewis N. Lloyd
Engineering Technician II
Concrete
High RAP Mixtures in Virginia

- Currently VDOT allows up to 30% RAP in HMA
- VDOT is interested in increasing RAP usage.
- Lack of understanding of how the binder in the RAP affects the virgin binder is a limiting factor on RAP use.
- Will compare no RAP, 25%, 40%, and 100% RAP
- Lab Performance - modulus, fatigue, rut potential, and permeability
Warm Mix Asphalt (WMA)

- WMA: Allows the production of asphalt mixtures at temperatures significantly below those of Hot Mix Asphalt
- WMA technologies
  - Foaming
  - Chemical modifiers
  - Wax modifiers
Warm Mix Asphalt (WMA)

• VDOT benefits
  – Improved compaction and density
  – Longer material life
  – Reduced emissions
  – Longer paving season
  – Lower material costs
  – Increased competition

• Contractor benefits
  – Fuel savings
  – Increased workability
  – Longer paving season
  – Larger market area
High Performance Lightweight Concrete
On Route 33

Over Pamunkey River

Over Mattaponi River
Ultra High Performance Concrete on Route 624 over Cat Point Creek

UHPC Girder

Steel Fibers in UHPC Girder

30,000 psi. vs. 8,000 psi
Roller Compacted Concrete Pavement

Benefits
• Carry heavy/slow moving trucks
• Durable
• Open to traffic quicker than conventional concrete

Special Considerations
• Smoothness
• Unreinforced

Projects
• Staffordboro Commuter lot
• Craney Island Expansion

8/6/2013
VCTIR Structural, Pavement, and Geotechnical Engineering Team

Michael C. Brown, Ph.D., P.E.
Associate Director
Structural, Pavement and Geotechnical Engineering

- VACANT
  Research Scientist Pavements

- Brian K. Defenderfer
  Senior Research Scientist Pavements

- Richard T. Childs
  Engineering Technician II

- Edward J. Hoppe
  Senior Research Scientist Geotechnical

- M. Shabbir Hossain
  Senior Research Scientist Geotechnical

- Linda L. DeGrasse
  Engineering Technician III

- Steven B. Chase
  Faculty Research Associate Structures

- Soundar S.G. Balakumaran
  Research Scientist Structures

- Bernard L. Kassner
  Research Scientist Structures

- Richard E. Weyers
  Senior Research Scientist Structures
Corrosion Testing and Physical Sampling
Non-Destructive Testing and Evaluation

Coring
USW
Impact Echo
GPR
Electrical Resistivity
Next Generation Inspection
Pavement Recycling

Full-depth reclamation

Cold central plant (CCPR)

Cold in-place recycling (CIR)

Activities:
- Characterize materials properties
- Develop pavement-design input values
- Implement specifications and guidelines

Goal is pavement recycling as a standard pavement rehabilitation option
Interferometric Synthetic Aperture Radar (InSAR)
InSAR Applications

- Image analysis methods for detecting significant events (movement of a rockslide, subsidence due to a potential sinkhole, settlement of a structure.)

Irregular bridge settlement detected.
Average yearly settlement = 1.3 cm; settlement during last 3 months = 3.7 cm
Innovative Structural Systems

- Integral and Semi-integral Abutments
- HPC and LWC Prestressed beams
- Full-depth precast decks
- Geosynthetic Reinforced Soil Abutments
- FRP Composite Deck/Superstructure systems
Geosynthetic Reinforced Soil Integrated Bridge System

GRS-IBS Abutments feature:

• Reduced construction cost (25 -60%)
• Reduced construction time
• Construction less dependent on weather conditions
• Flexible design - easily field modified for unforeseen site conditions (e.g. obstructions, utilities, different site conditions)
• Easier to maintain (fewer bridge parts)

Designing for use on Towlston Road over Rocky Run in Fairfax County

8/6/2013

Full-scale testing by Virginia Tech
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