Research and Development Overview

North Carolina
DEPARTMENT OF TRANSPORTATION

Neil Mastin, PE
Research and Development Manager
Spring 2015

Research and Development Functions

Develop an Annual Research Program

Provide implementation and technology transfer support of local and national research for business units

Rapid turnaround, 80 hour Technical Assistance Projects

Research and Development Functions (2)

Distribute research results locally and nationally

Research Library services

Engage NCDOT personnel in national research programs: TRB, NCHRP, Pooled Fund, SHRP, LTPP etc

Provide Research Management Services – Administer contracts for Branches/Divisions/Units working with Universities

Annual Research Program

Match NCDOT research needs with expertise at universities and transportation research centers

Initiate **~20 - 25** new projects per year

Manage ~**80** active research projects

Nearly all NCDOT activities are eligible

Research Program Goals

Improve NCDOT Planning, Engineering and Business Practices

Support NCDOT Operations and Maintenance Activities

Conduct research that can be implemented quickly and efficiently

Develop relationships with researchers so they understand the needs and operations of NCDOT to maximize research benefits

Annual Program FAQ

Who typically submits Research Needs to the R&D Unit?

- Anyone at NCDOT, with manager approval
- University researchers in coordination with DOT business units

Do the Universities decide what research will be done?

No.

NCDOT does, starting with customer ideas

How long does it take for an Idea to become a project?

Typically 1 year from close of solicitation period

Annual Program FAQ

How long do Research Projects Last?

Variable

2 years is typical, can be as short as 6 months or as long as 3 years

What types of Projects are common?

- Laboratory / Field Testing and analysis
- Policy / Practice / Design Analysis
- Best Practice Synthesis
- Etc, etc.

How are Projects managed?

- Research Unit handles fiscal and contract portion
- Steering Committee reviews technical content
- Committee Chair is often the idea submitter

Research Program Annual Timeline

May-July
Solicit Research Needs

August-October
Partner Universities Develop Pre-proposals

November
Selected Pre-proposals developed into one or more Full Proposals

December-January
Research Committees Recommend Full Proposals

February-March
Executive Committee Reviews and Approves Work Program

March-April
FHWA Reviews Final Program Authorizations Signed

May-July
Program Implementation
Projects Start by August 1

Past and Present University Participants

Appalachian State*
Duke
East Carolina*
Elizabeth City State
NC A&T*
NC Central*
NC State*
UNC-Asheville*
UNC-Chapel Hill*

UNC-Charlotte*
UNC-Greensboro
UNC-Wilmington
Indiana State*
Michigan State*
Virginia Tech*
Central Florida*
Illinois
Auburn

* Master Agreements

Current Research

Research Funding Mechanisms

Federal Aid
SPR Part 2 Funds
(80-20 match)

Federal Discretionary Funds
(100 % Fed)

NCHRP Studies

AASHTO Pooled Fund Program

Project Funds for Project Specific Work

National Involvement

Long-Term Pavement Performance Study

Pooled Fund – NCDOT Manager

National Representative

Research Advisory Committee Representative

Coordinator for NCHRP Pooled Funds

Research Library Services

- Completely revamped and reorganized library
- On-staff Librarian provides Research Services - Has access to national databases
- Many engineering and transportation related books, journals, specs and other documents
- Historical information to the 1920s
- Board of Transportation Minutes

Online Catalog: http://catalog.ncdcr.gov/

One research project can have a large impact in sveral areas: Material Performance, Safety, Environmental Management, Congestion Management, Project selection, Policy Goals etc.

Recent Successes

Stormwater and Roadside

- NPDES Permit Support
- Stormwater Best Management Practices Toolbox and training
- Vegetative treatment of runoff
- Revised EPA guidelines
- Improved sediment and erosion control
- Herbicide and wildflower optimization

Environmental Research Projects

Multi-sensor Precipitation Alert and Visualization Tool

The State Climatic Office (SCO) of North Carolina developed a Multi-sensor Precipitation Estimate (MPE) website for the NCDOT - Highway Stormwater Program.

Enables engineers to closely monitor estimated precipitation amounts at NCDOT construction and operation related sites

User can identify their own lat/long monitoring sites and receive an email and text message alert when precipitation has exceeded a particular threshold within 24 hours.

Allows rainfall data to be overlaid with other data layers such as county lines, cities, NCDOT primary and secondary roads, and water features.

The rainfall monitoring and alert tool has been estimated to save in excess of 113,000 man-hours per year.

http//www.nc-climate.ncsu.edu/dot

Select Layers:

MPE:

- [x] Precip estimate
- [ ] My Project Sites

Geographic:

- [x] County lines
- [ ] Cities
- [ ] Rivers and Streams
- [ ] Shaded relief

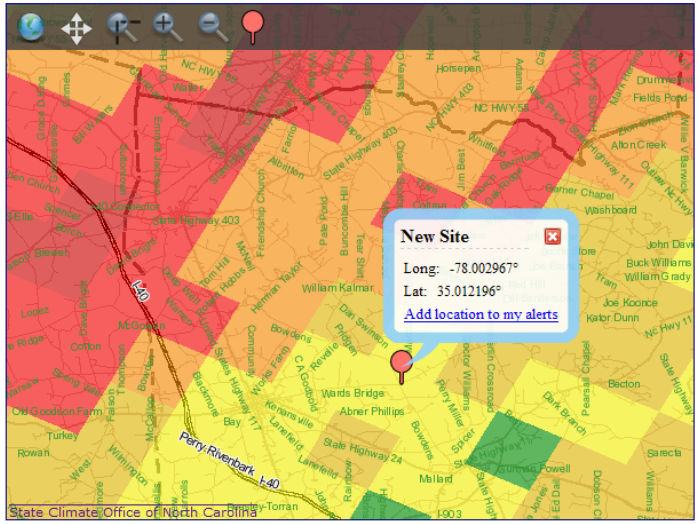
Transportation:

- [x] Interstates
- [x] Primary Roads
- [x] Secondary Roads

Special Layers:

- [x] Land Mask

Make PDF



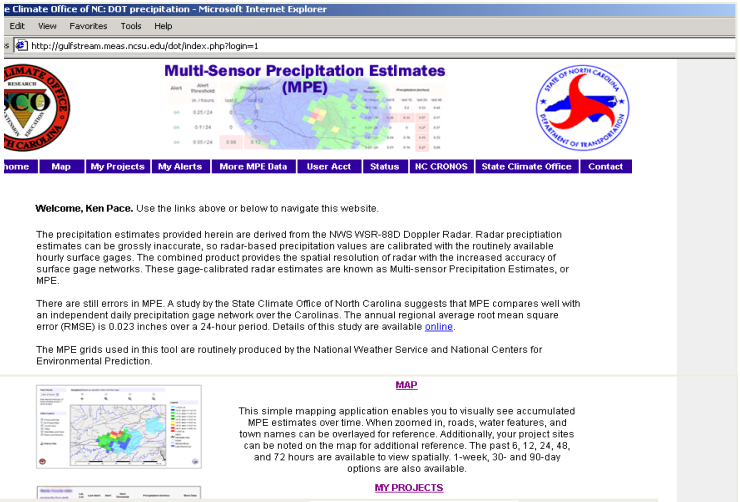
Time Period:

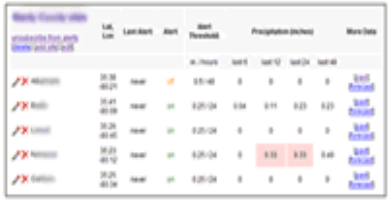
Last 72 hours

Map depicts previous 72 hours ending at 7am on Feb 20, 2008, EST using the 6-hour files.

Legend:

- <= 0.2 in.
- 0.2 - 0.4 in.
- 0.4 - 0.6 in.
- 0.6 - 0.8 in.
- 0.8 - 1 in.
- 1 - 1.2 in.
- 1.2 - 1.4 in.
- 1.4 - 1.6 in.
- 1.6 - 1.8 in.
- 1.8 - 2 in.
- 2 - 2.2 in.
- 2.2 - 2.4 in.
- 2.4 - 2.6 in.
- > 2.6 in.
- Interstate Hwy
- Primary Road
- Secondary Road
- County Lines





MY PROJECTS

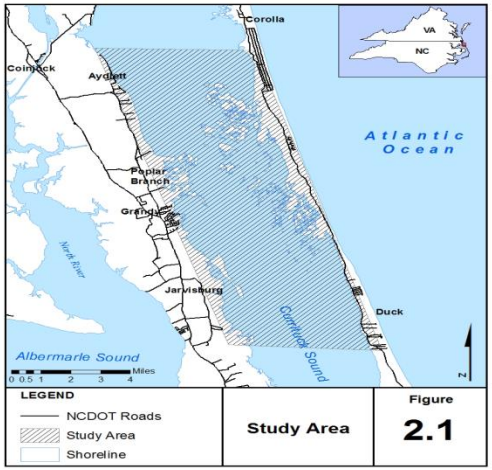
This page shows a list of all projects that you are subscribed to receive precipitation alerts from. Each project has a list of associated sites. Accumulated MPE values are listed for all sites in text format. You can also view all projects.

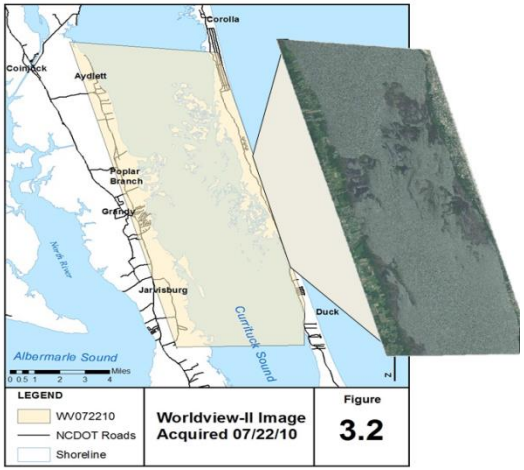
Environmental Research Project **2010-14**

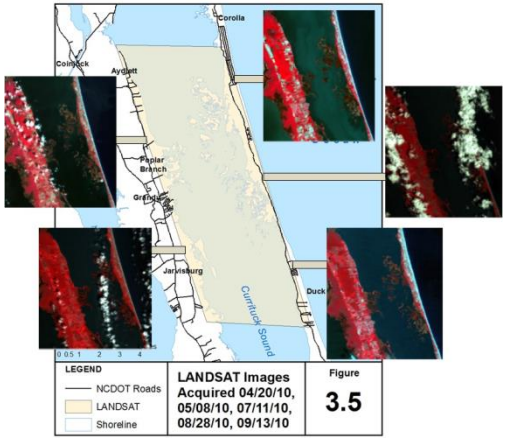
NCDOT Required to Address Submerged Aquatic Vegetation (SAV)

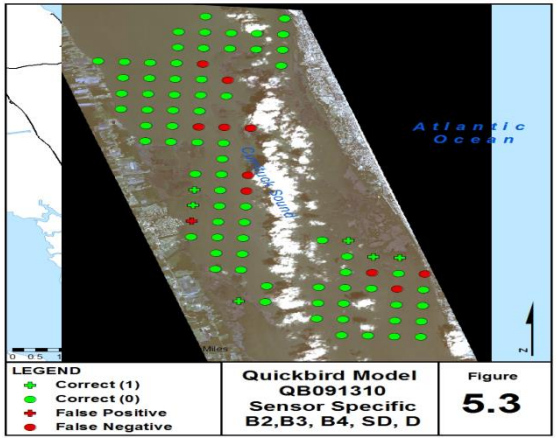
Currituck Sound in the Albemarle-Pamlico Estuary System: 13x5 Mile Area

Reduce Labor-Intensive SAV Mapping: Use High Resolution Satellite Imaging

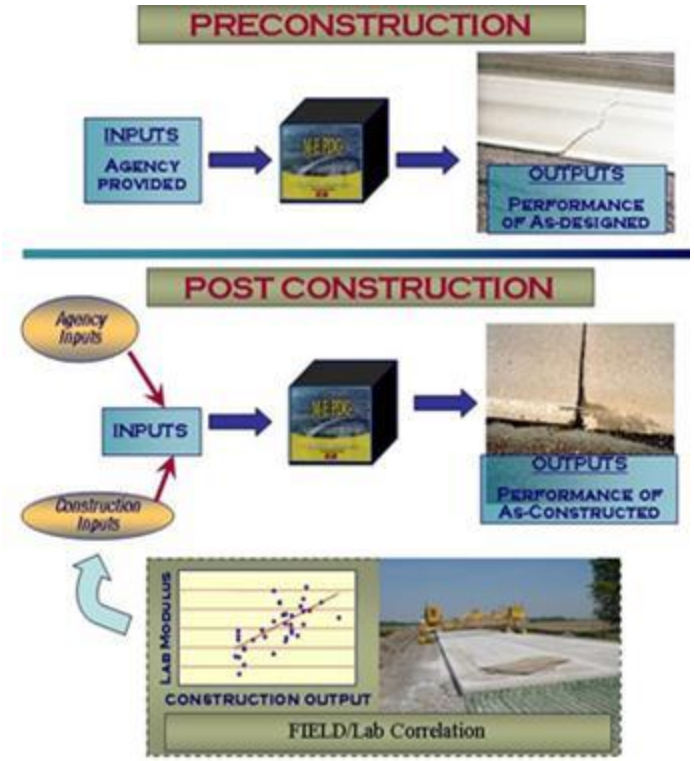








Pavement Research - Design



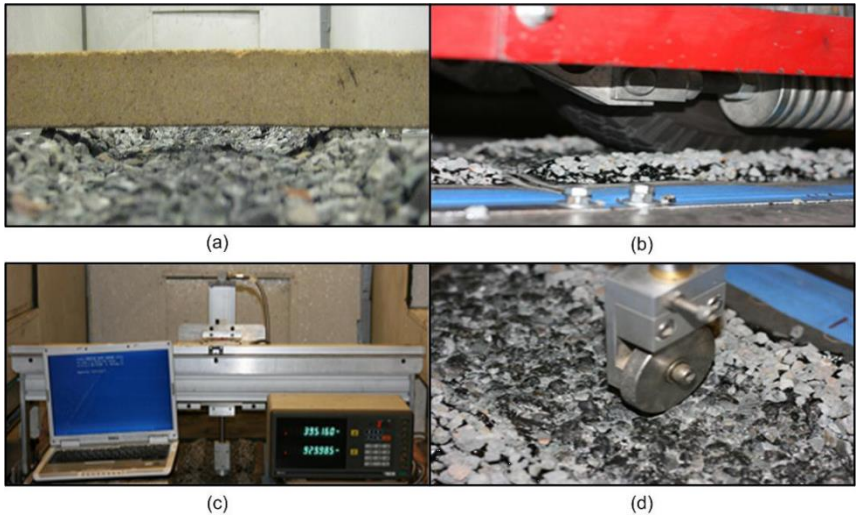
- Local Calibration of the MEPDG for Flexible Pavement Design
- Development of Traffic Data Input Resources for the MEPDG Process
- MEPDG Inputs for Warm Mix Asphalts
- Improved Climatic Data for the MEPDG

Pavement Research – Chip Seals

Optimizing Gradations for Surface Treatments

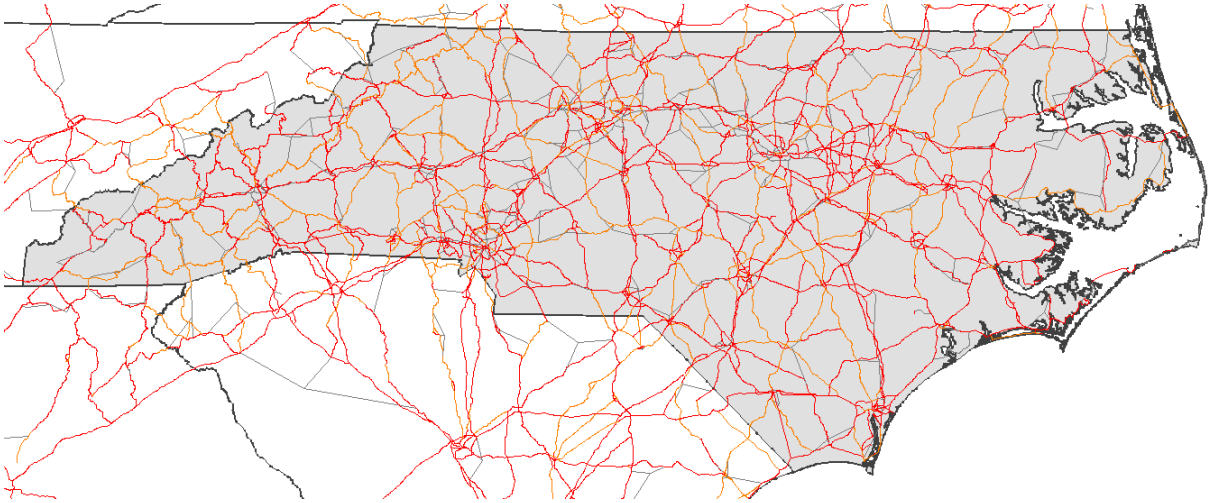
Quantifying the Benefits of Improved Rolling of Chip Seals

Performance-Based Analysis of Polymer-Modified Emulsions in Bituminous Surface Treatments



Seal Improvement Research

North Carolina Statewide Transportation Model



Agile approach: Built to incorporate future analysis "add-ons"

Multi-Layered: Works at national, statewide, and urban levels

Statewide & Regional Tier Roadways (~15,000 CL Miles)

Simulate Truck Trips

2009 Base year – Future Years (2020 & 2040)

Research Project No. 2012-09

Crack Free Mass Concrete Footings on Bridges in Coastal Environments

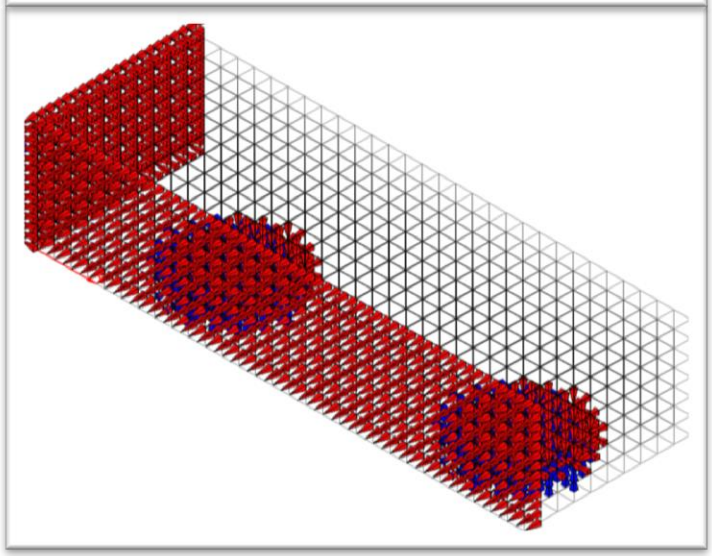
Proposed some specific additions and revisions to the current NCDOT mass concrete specifications:

Revision to material specifications allowing the use of granulated slag replacement of cement

Revision to construction methods/curing procedures

Requirement for immediate remedial actions from the contractor if the temperature differentials are exceeded

Additional requirements for Special Case “Massive” Mass Concrete (Minimum Dimension = 14 ft.):



Research Project No. 2007-11

Subgrade Stabilization Alternatives to Lime and Cement

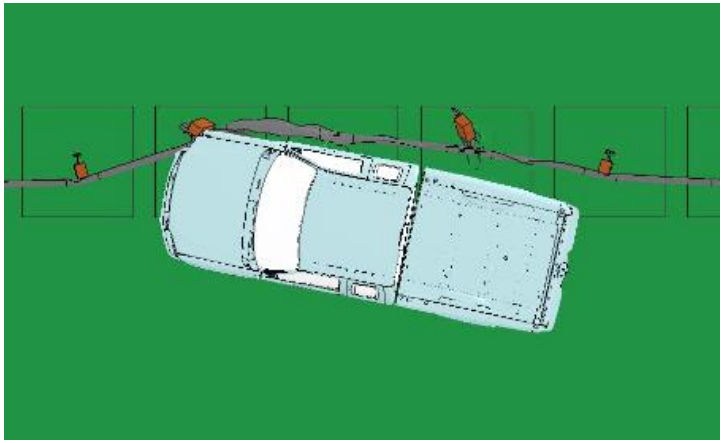
Developed a computer application using a model to make predictions of subgrade temperatures and cured strength.

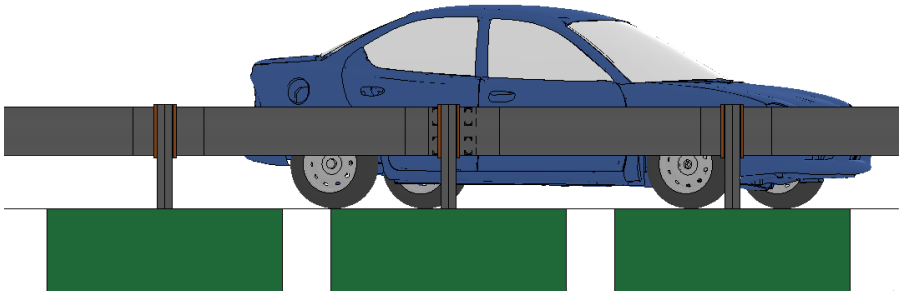
Thermal diffusivity of both lime and cement-stabilized subgrades were incorporated into a model that relates air and soil temperatures.

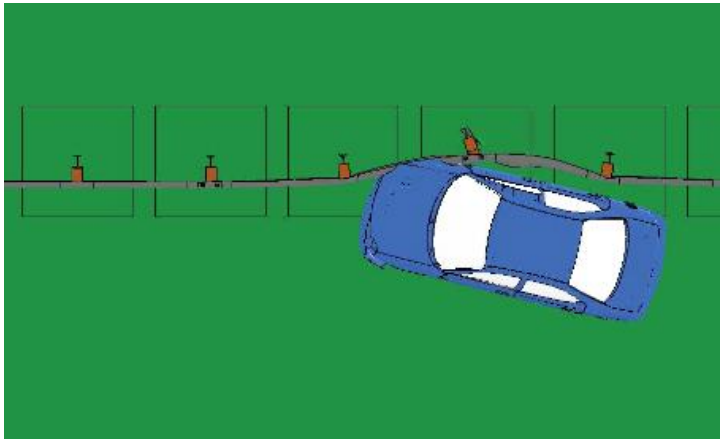
Software relates forecasted air temperatures to likely subgrade temperatures. May be used to inform case by case decisions as to whether cold weather exceptions can be made.

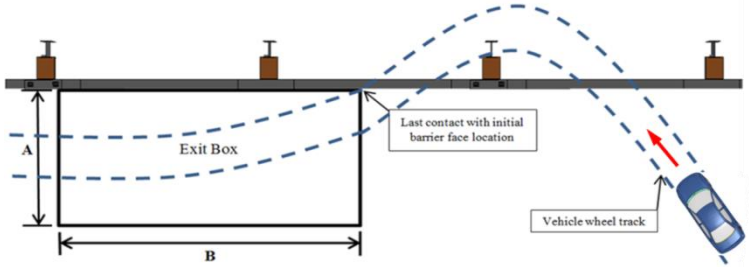
Suggests that CaCl2 modification of soil-cement is not a mature enough approach to serve as a method for mitigating the effects of low temperatures on strength gain. Additional data needed.

Safety: Finite Element Analysis of Guardrail Vehicle Impact



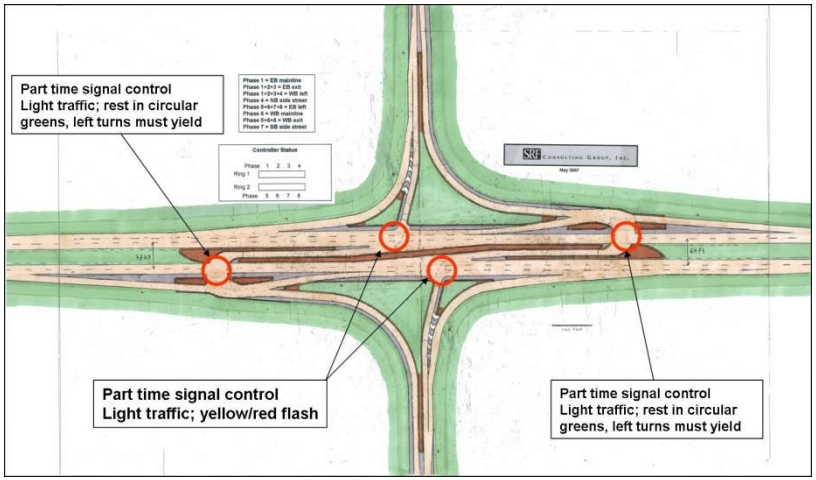






Are guardrail designs safe for different types of vehicles?

Superstreet Benefits and Capacities



Superstreet outperformed the conventional intersection at each location

Reduced overall average travel time per vehicle traveling through the intersection.

Un-signalized superstreets showed a significant reduction in total, angle and right turn, and left turn collisions in all analyses.

Analyses also showed a significant reduction in fatal and injury collisions as well.

NCDOT Research Supports Federal, State and Local Agencies

Getting Involved

Submit Research Needs Statements	• The Research and Development Unit is available to assist • Forms are available on our website
Review Active AASHTO and FHWA Pooled Funds	• www.pooledfund.org • Are there any with which think NCDOT should participate?
Submit NCHRP Proposals	• Projects that are large, national issues • R&D can assist or connect you to the right people that can
Targeted research using Branch/Division/Unit funds and Master Agreements with Universities	• These agreements are low overhead • Projects can be established quickly
Surveys: Need information on practices in other states?	• We can distribute survey requests to all 50 states + AASHTO

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Research Connect Page (for Forms and Other Info):
https://connect.ncdot.gov/projects/planning/Pages/ResearchAnalysis.aspx

Research Directory Page:
https://apps.dot.state.nc.us/dot/directory/authenticated/UnitPage.aspx?id=8781