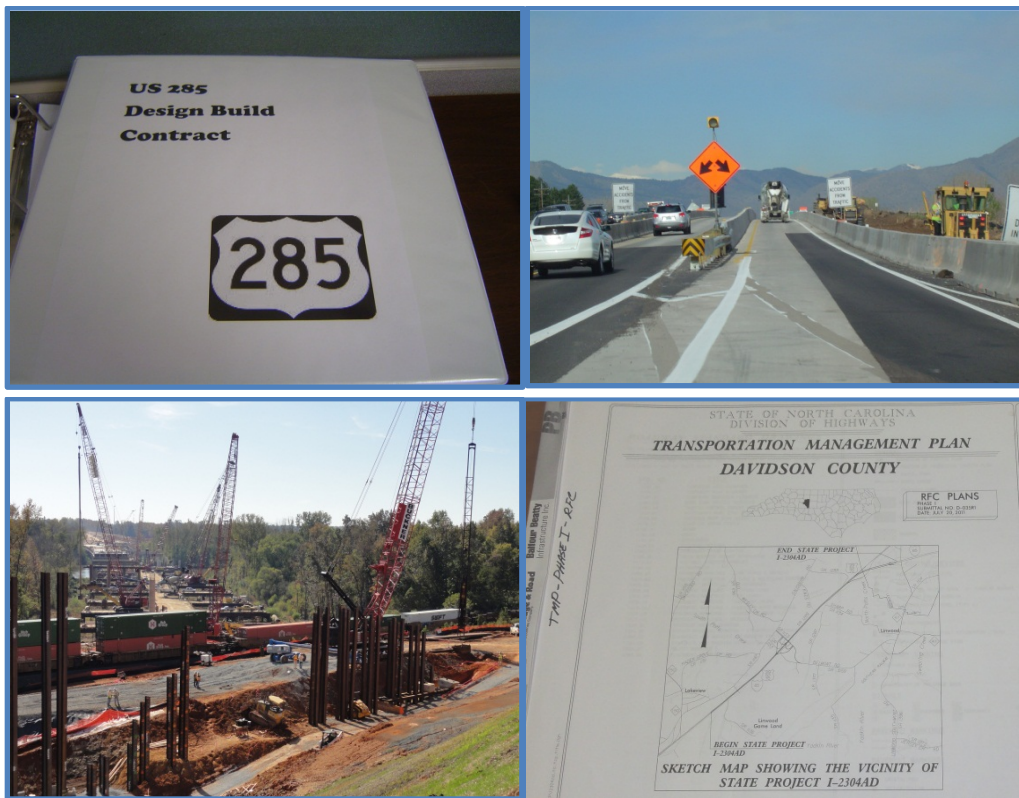


## APPLYING THE PRINCIPLES OF THE WORK ZONE SAFETY AND MOBILITY RULE TO DESIGN-BUILD PROJECTS

### TWO CASE STUDIES



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## Executive Summary

The Work Zone Safety and Mobility Rule (the Rule), published in September 2004, applies to all Federal-aid highway projects and affects agencies receiving such funding. The overarching goal of the Rule is to reduce crashes and congestion in and around work zones. The Rule aims to bring this about through greater consideration and understanding of work zone impacts throughout project development; minimization of those impacts where possible through scheduling, coordination, design, and staging decisions; and better management of remaining impacts during construction.

The principles advocated by the Rule and its provisions apply to design-build projects, but they may need to be applied somewhat differently to address the differences in process between design-build and traditional design-bid-build processes. Design-build projects are becoming more prevalent as agencies seek to speed up projects to leverage resources, so the Federal Highway Administration (FHWA) identified the need to examine how the Rule can best be applied to design-build projects. The purpose of this case study report is to describe how the good work zone planning, design, and management principles of the Rule were applied to two design-build projects, the US 285 Design-Build Project in Colorado and the I-85 Corridor Improvement Project in North Carolina, and how application of these principles differed from applying these principles to traditional design-bid-build projects.

Lessons learned from the two case studies and other research will be used to identify tips, guidance, and other resources that may be helpful to agencies and design-builders to facilitate application of the principles of the Rule to design-build projects.

## Highlights of Lessons Learned

Key lessons learned from these case studies about applying the Rule to design-build projects include:

- **Overall**
  - Recognize that the Agency has other types of risk in a design-build project and a key part to managing them is to develop a good RFP.
  - Make project safety a priority right from the start.
  - Value-added elements are a great benefit of design-build projects.
  - Encouraging contractor innovation can be a major benefit to design-build projects.
- **RFP Development and Proposal Evaluation**
  - Agency work zone traffic control staff should be involved in RFP development and proposal evaluation and selection.
  - Proposal evaluation criteria and scoring are very important and should reflect the level of traffic management on the project.
  - Value-based contractor selection that includes criteria for work zone traffic management is important to successful work zone safety and mobility on a project.
  - Use project specific guidance in the RFP.
  - Provisions should be included in the RFP to require that work zone traffic control issues are addressed in a timely manner.
  - Performance-based specifications in the RFP require measureable data for verification.

- **TMP Development and Implementation**
  - Direct involvement by the Agency in reviewing TMPs may be more effective in reflecting Agency needs and expectations.
  - Make sure all parties are informed.
  - In monitoring TMP performance, recognize potential data sources and collaborate closely with them throughout the project.
  
- **Quality Management**
  - Successful implementation of a Quality Management Plan can save money.
  
- **Team Capabilities**
  - Agency staff needs to have knowledge and recognize the value of the Rule.
  - Contractors need to be familiar with the Rule.
  - A trained Traffic Control Supervisor with knowledge on local guidelines and processes is beneficial.
  
- **Coordination and Partnership**
  - Collaboration and good partnership are keys to project efficiency and success.
  - The design-build delivery method promotes coordination and collaboration and builds strong sense of ownership for all parties involved.
  - Key stakeholders should be brought in early on.



## 1. Introduction

The Work Zone Safety and Mobility Rule (the Rule), issued by the Federal Highway Administration (FHWA) in 2004, applies to all Federal-aid highway projects and affects agencies receiving such funding. The Rule aims to bring about greater consideration and understanding of work zone impacts throughout project development; minimization of those impacts where possible through scheduling, coordination, design, and staging decisions; and better management of remaining impacts during construction. Design-build projects are becoming more prevalent as agencies seek to speed up projects to leverage resources through growing use of accelerated project timelines, public-private partnerships, and contracting out design work. The principles advocated by the Rule and its provisions, such as impacts analysis and transportation management plans (TMPs), apply to design-build projects, but may need to be applied somewhat differently to address the differences between design-build and traditional design-bid-build. Because of these differences in project development and implementation processes and roles and responsibilities, FHWA identified the need to examine how the Rule can best be applied to design-build projects.

### Purpose of this Document

The purpose of this case study report is to describe how the good work zone planning, design, and management principles of the Rule were applied to two design-build projects, the US 285 Design-Build Project in Colorado and the I-85 Corridor Improvement Project in North Carolina, and how application of these principles differed from applying these principles to traditional design-bid-build projects. The lessons learned from these case studies, and other research, will be used to identify tips, guidance, and other resources that may be helpful to agencies and design-builders to facilitate application of the principles of the Rule to design-build projects.

### Overview of the Rule

FHWA's updated Work Zone Safety and Mobility Rule applies to all state and local governments that receive federal-aid highway funding. The Rule was published in the *Federal Register* on September 9, 2004, and as of October 12, 2007 transportation agencies are required to comply with its provisions. The overarching goal of the Rule is to reduce crashes and congestion in and around work zones. Provisions in support of this goal encourage agencies to consider work zone safety and mobility impacts both early on and throughout the project delivery process and to expand work zone planning beyond the project work zone itself to address corridor, network, and regional issues. The Rule also advocates expanding work zone management beyond traffic safety and control to encompass broader solutions that address the need for continued mobility during road construction.

Three primary components of the Rule:

- Policy-level provisions for State/Local Agencies to implement an overall work zone safety and mobility policy for the systematic consideration and management of work zone impacts.
- Agency-level processes and procedures to help State/Local Agencies implement and sustain their respective work zone policies.

- Project-level procedures that help State/Local Agencies assess and manage the work zone impacts of individual projects.

In the Rule, there are eight *key aspects* that need to be applied by State/Local Agencies:

**Key Aspect #1 – Work zone assessment and management procedures:** Agencies should develop and implement systematic procedures to assess work zone impacts in project development, and to manage safety and mobility during project implementation.

**Key Aspect #2 – Work zone data collection and analysis:** At the *project level*, Agencies shall use field observations, available work zone crash data, and operational information to manage work zone impacts for specific projects. At the *agency level*, Agencies shall continually pursue improvement of work zone safety and mobility by analyzing work zone crash and operational data from multiple projects to improve Agency processes and procedures.

**Key Aspect #3 – Training:** Agencies shall require that personnel involved in the development, design, implementation, operation, inspection and enforcement of work zone related transportation management and traffic control be trained, appropriate to the job decisions each individual is required to make.

**Key Aspect #4 – Process review:** Agencies shall perform a process review at least every two years. Appropriate personnel who represent the different project development stages and offices within the State/Local Agency and the FHWA should participate.

**Key Aspect #5 – Transportation Management Plan:** Agencies must develop and implement a transportation management plan (TMP) for each project, in consultation with appropriate stakeholders.

**Key Aspect #6 – Plans, Specifications & Estimates (PS&E) shall include the TMP or provisions for contractors to create a TMP:** A TMP can be created by the Agency and the applicable elements included in the PS&Es, or the Contractor will develop it subject to the approval of the Agency prior to implementation.

**Key Aspect #7 – Pay Item Provisions – Method or Performance Based:** Pay item provisions for implementing the TMP shall be included in the PS&Es. For method-based specifications, individual pay items, lump sum payment, or a combination thereof may be used. For performance-based specifications, applicable performance criteria and standards may be used.

**Key Aspect #8 – Designated Trained Person:** The Agency and the Contractor shall each designate a trained person at the project level who has the primary responsibility and sufficient authority for implementing the TMP and other safety and mobility aspects of the project.

All of these aspects have some effect on projects. Most of these aspects are applied at the project level, such as assessing the safety and mobility impacts of an upcoming project, developing a TMP for the project, and collecting data to monitor TMP performance in the field during construction. Training requirements may apply to personnel who work on multiple projects, but the contract for a given project may require specific training or certification for personnel working on the project or acting as the designated person. While process reviews generally look at some statewide data (e.g., work zone crashes) that covers all projects, in-depth review is generally done on a subset of all projects.

Because the various stakeholders have different roles and responsibilities in design-build projects than in the traditional design-bid-build project delivery method, and project activities may be sequenced differently, issues can arise when these eight aspects are applied to design-build projects. Some aspects may need to be applied to design-build projects in a different manner than how they are applied to design-bid-build projects.

## Organization of the Document

The following provides a brief description of each section in the report.

- **Section 1 - Introduction.** This section describes the contents of the case study report, and provides the purpose of the document and background of the FHWA Rule.
- **Section 2 – Comparison of Two Project Delivery Methods.** This section explains the conventional design-bid-build (DBB), design-build (DB), and other project delivery methods. It also compares the design-bid-build and design-build methods and how the differences can affect the application of the Rule.
- **Section 3 – State Implementation of the Rule.** This section presents information on Colorado Department of Transportation (CDOT) and North Carolina Department of Transportation (NCDOT) work zone safety and mobility policies, procedures, and guidelines, and explains CDOT's and NCDOT's approaches to implementing the Rule.
- **Section 4 – Colorado US 285 Design-Build Project.** This section describes the US 285 Design-Build project, including the location and development of the project, and provides a description of the key stakeholders, schedule, request for proposal (RFP), and project implementation. This section also presents successes, issues, and challenges when applying the Rule during the project development and implementation phases.
- **Section 5 – North Carolina I-85 Corridor Improvement Project.** This section describes the I-85 Design-Build project, including the location and development of the project, and provides a description of the key stakeholders, schedule, RFP, and project implementation. This section also presents successes, issues, and challenges when applying the Rule during the project development and implementation phases.

- **Section 6 – Other North Carolina Design-Build Projects.** This section describes North Carolina DOT’s experience on other design-build projects and some of its successes, issues, and challenges when applying the Rule to these projects.
- **Section 7 – Lessons Learned and Opportunities.** This section describes lessons learned from the case studies and provides methods and tips that can be used to address and/or avoid issues and challenges that may arise for similar projects.

## 2. Comparison of Project Delivery Methods

For the past century, design-bid-build was the project delivery method of choice for the majority of transportation projects. Recently, other types of project delivery methods have come into use by departments of transportation and other facility owners around the country. Though not a new idea, design-build is gaining popularity among the public sector, as many see it as a means to a faster and cheaper project delivery method. This section highlights the design-bid-build and design-build project delivery methods, as well as a few others that are used more infrequently. The Work Zone Safety and Mobility Rule was primarily developed with design-bid-build projects in mind. The last part of this section explains how the differences between the design-bid-build and design-build methods may affect the application of the Rule.

### Design-Bid-Build

Design-bid-build is the traditional method for delivering transportation projects. The owner (or a consultant for the owner) prepares the design and a PS&E package that includes both construction and transportation management plans. Contractors engage in a competitive low-bid process to follow the specifics of the owner supplied plans and specifications. The lowest responsive, and in most cases prequalified bidder, is rewarded the project once the owner has determined that sufficient funding exists. Under the design-bid-build delivery process, the owner assumes the risk, guaranteeing to the Contractor that the PS&Es are error-free.

### Design-Build

With design-build contracting, prospective proposers receive an RFP which includes the preliminary design (technical requirements for designing and constructing the project), and explains the scoring process and selection criteria. Both the engineering and construction services are included in the RFP and will be performed by the winning team under one contract. Generally the bid process is based on best value (price, schedule, and proposal score), but some agencies use a version of low-bid design-build. In contrast to design-bid-build, design-build relies on a single point of responsibility contract and is used to minimize risks for the project owner and to reduce the delivery schedule by overlapping the design phase and construction phase of a project. One of the benefits of a design-build project is that it allows the design-builder to be innovative in their method of designing and constructing a facility because the project is not fixed to an already-developed PS&E package, and this innovation can lead to project efficiencies. Because the design-builder has a significant amount of flexibility, the owner faces a different type of risk. There is reduced control over what the final product will look like and how it will be built because what is not specified in the RFP has variability.

### Other Approaches

In addition to design-bid-build and design-build, there are several other delivery methods that are used for transportation projects. These include:

- Construction Management/ General Contractor (CM/GC) – What sets this type of project delivery method apart is that instead of the Contractor taking on all the risk, each member of the team – the public agency, the designer, and the general contractor – has defined contractual obligations. This delivery method uses a qualification-based RFP process.

- Public Private Partnership (PPP) – Overall, a PPP is a project in which there is an agreement formed between a public agency and a private firm that allows the private sector to assume more risk and responsibility in the financing and delivery of a transportation project. With this type of project, the public agency gets a new or upgraded facility that it might otherwise not have the funding to build at present. The private firm is an investing partner and in exchange for its investment in building a new or upgraded facility it gains a business opportunity and long-term revenue sources.
- Build/Operate/Transfer – This is a type of PPP where construction and the initial operation of a facility are privately done for the term of the contract, prior to turning ownership over to the public agency at a set time in the future (e.g., 50 years).

These other delivery methods were not part of this case study.

### **How Differences between Design-Bid-Build and Design-Build May Affect Rule Application**

Two of the major differences between the design-bid-build and design-build project delivery methods are who assumes the risk during the project and how the roles and responsibilities are handled. Because of these factors, the key aspects of the Rule may need to be applied to a design-bid-build project differently than they do a design-build project. Table 2-1 illustrates the different roles and responsibilities for the Owner/Agency and the Contractor in both project delivery methods. For a design-bid-build project, the Contractor is the construction firm building the facility and any subcontractors assisting, such as traffic control providers. For a design-build, the Contractor is the entire design-build team (designers, construction firms, subcontractors, consultants).

Another major difference between the design-bid-build and design-build project delivery methods is how the owner's requirements are presented to the Contractor or design builder. In a design-bid-build project, the construction documents (i.e., PS&Es) specifically identify what the Contractor is supposed to build, where they should build it, what they should build it with, and what phasing, staging, and traffic control are to be used while constructing the project. In a design-build project, the owner identifies the project requirements and specifications in the RFP, and allows the design-builder to choose the methods to create the construction plans and build the project. This allows the Contractor much greater flexibility to use its own innovations and efficiencies in building the job. For design-build projects, owners must make sure that they produce an RFP that is very strong on non-negotiable items, milestones, and safety, quality, and mobility elements, but leaves enough room for the proposer to create a solid proposal with value added elements and innovative ideas.

**Table 2-1. Comparison of Roles and Responsibilities in Project Delivery Methods**

Design-Bid-Build Method	Design-Build Method
<p><b><u>Owner/Agency</u></b></p> <ul style="list-style-type: none"> <li>• Develop plans and specifications</li> <li>• Identify and estimate work zone impacts</li> <li>• Identify appropriate transportation management strategies:               <ul style="list-style-type: none"> <li>▪ Temporary traffic control</li> <li>▪ Traffic operations</li> <li>▪ Public information</li> </ul> </li> <li>• Identify coordination issues (e.g., utilities, enforcement, emergency response, community) and conduct upfront coordination</li> <li>• Develop TMP, including Traffic Control Plan (TCP)</li> <li>• Include in the PS&amp;E those TMP items that will be implemented by the Contractor</li> <li>• Develop and implement public information plan</li> <li>• Implement TMP, except those components included in the contract</li> <li>• Perform quality assurance, control, and verification, including for maintenance of traffic</li> <li>• Monitor and manage work zone impacts during construction - has greater ownership than does the Contractor</li> </ul>	<p><b><u>Owner/Agency</u></b></p> <ul style="list-style-type: none"> <li>• Define requirements for work zone impacts assessment and allowable impacts during construction</li> <li>• Define requirements for transportation management strategies:               <ul style="list-style-type: none"> <li>▪ Temporary traffic control</li> <li>▪ Traffic operations</li> <li>▪ Public information</li> </ul> </li> <li>• Identify coordination issues (e.g., utilities, enforcement, emergency response, community)</li> <li>• Develop RFP that outlines project requirements</li> <li>• Assist with public outreach and interagency coordination</li> <li>• Perform quality verification, including for maintenance of traffic</li> <li>• Provide oversight over monitoring and management of work zone impacts during construction</li> </ul>
<p><b><u>Contractor</u></b></p> <ul style="list-style-type: none"> <li>• Construct the project in accordance with the Owner/Agency plans and specifications</li> <li>• Implement the components of the TMP that were included in the contract</li> <li>• Coordinate with utilities on field work</li> <li>• Provide a safe worksite</li> <li>• Monitor and manage work zone impacts during construction, if included in the contract</li> </ul>	<p><b><u>Contractor</u></b></p> <ul style="list-style-type: none"> <li>• Design plans</li> <li>• Assess work zone impacts per contract requirements</li> <li>• Develop the TMP (including TCP)</li> <li>• Construct the project based on the Contractor completed design and TMP</li> <li>• Implement TMP</li> <li>• Develop and implement public information plan – may share responsibility for public outreach with the Owner/Agency</li> <li>• Coordinate with utilities both upfront and during field work</li> <li>• Provide a safe worksite</li> <li>• Monitor and manage work zone impacts during construction</li> <li>• Perform quality control and quality assurance, including for maintenance of traffic</li> </ul>

### 3. State Implementation of the Rule

The Rule requires each Agency to implement a policy and procedures for the consideration of work zone safety and mobility impacts across project development stages, and the use of strategies to help manage these impacts during construction for federally funded transportation projects.

#### Colorado

CDOT has several policy and guidance documents that guide the Agency in implementing the key aspects of the Rule. CDOT has created its own procedures document, as well as several guidelines for dealing with safety and mobility related issues. Key documents CDOT has created and uses to implement the Rule are summarized below.

#### CDOT Safety and Mobility Rule Procedures

CDOT has created its own *Safety and Mobility Rule Procedures Document*<sup>1</sup>, which describes its approach to implementing the Rule and provides guidance for the development of a TMP. Each of the eight Rule aspects identified above is included in the CDOT procedural document. The document describes the TMP as being made up of strategies that address the management of the work zone impacts of a project. These impacts need to be assessed during the preliminary design phases of the project, and then strategies and their associated costs are identified. The document explains all the elements of a TMP, including traffic control plans (TCPs), a public information plan (PIP), and transportation operations (TO) strategies. The document also identifies quality assurance (QA) requirements and training required for project personnel.

Though the design-build project delivery method is mentioned in this CDOT document, the procedures are more oriented at how the Rule is applied to design-bid-build projects.

#### Other Colorado Safety and Mobility Guidelines

CDOT has several other guidelines that assist with the implementation of the Rule and provide guidance for work zone safety and mobility. These documents are summarized below:

##### 1. Lane Closure Strategies

Each CDOT region has its own lane closure strategy that specifies when lanes can be closed. While the CDOT methodology used to determine lane closure impacts is applied uniformly across all regions, the criteria and policies for closing lanes are region-specific.

##### 2. Positive Protection

One of the CDOT documents to assist in the planning of TMPs and work zones is the *Colorado Guidelines for the Use of Positive Protection in Work Zones (2010)*<sup>2</sup>. This document supplements the *Work Zone and Safety Mobility Policy* and complies with 23 CFR 630 Subpart K. The

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<sup>1</sup> [http://www.coloradodot.info/library/traffic/traffic-manuals-guidelines/lane-close-work-zone-safety/work-zone-safety-mobility/WZSM\\_Procedures.pdf/view](http://www.coloradodot.info/library/traffic/traffic-manuals-guidelines/lane-close-work-zone-safety/work-zone-safety-mobility/WZSM_Procedures.pdf/view). Last accessed on November 17, 2011.

<sup>2</sup> [http://www.coloradodot.info/library/traffic/traffic-manuals-guidelines/lane-close-work-zone-safety/work-zone-safety-mobility/CO\\_Guidelines\\_Positive\\_Protection\\_122809.pdf/view](http://www.coloradodot.info/library/traffic/traffic-manuals-guidelines/lane-close-work-zone-safety/work-zone-safety-mobility/CO_Guidelines_Positive_Protection_122809.pdf/view). Last accessed on November 17, 2011.



document provides guidelines regarding when it is appropriate and cost effective to use positive protection measures that prevent the chance of vehicular intrusion into work zones.

### 3. Incident Management

CDOT published *Guidelines for Developing Traffic Incident Management Plans for Work Zones*<sup>3</sup> in 2008. This document offers guidelines, examples, considerations, and other tools to assist CDOT project staff and contractors working on CDOT projects with developing Incident Management Plans for work zones.

4. **The Colorado Work Zone Best Practices Safety Guide (2008)** is a document created by CDOT with the input of many different stakeholders, private contractors, insurance and risk management groups, law enforcement agencies, trade groups and federal agencies. The document is intended to provide CDOT personnel and contractors with information and tools needed to create safer work zones and instill an ethic where safety is number one and impacts to traveler mobility are reduced.

## North Carolina

NCDOT has created its own implementation guidelines document, and has a work zone training and qualifications program. NCDOT conducts one day training courses called “Work Zone Traffic Control Rodeos” that cover different subjects related to work zone safety.

### NCDOT Guidelines for Implementation of the Rule

NCDOT’s *Guidelines for the Implementation of the Work Zone Safety and Mobility Policy* document<sup>4</sup> describes its goals, objectives, and strategies for implementing the Work Zone Safety and Mobility Rule. This document identifies seven goals that should be considered for each project. Each of these goals has several objectives and a few strategies that can be used to help meet the goals. The guidelines also present processes for each objective and list the lead unit of NCDOT and other units affected by the objective. The final part of the document has other guidelines and tools such as the criteria for determining significant projects, evaluation procedures, and decision making procedures including activity worksheets. The seven goals are:

- Implement requirements of the Work Zone Safety and Mobility Policy
- Promote an agency culture committed to Work Zone Safety and Mobility
- Provide safe work zones for workers and road users
- Consider mobility and access in work zones to minimize impact to users
- Advocate innovative thinking in work zone planning, design, and management
- Improve credibility/compliance of work zones
- Continuously assess and improve work zone strategies, practices, and procedures

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<sup>3</sup> [http://www.coloradodot.info/library/traffic/traffic-manuals-guidelines/lane-close-work-zone-safety/work-zone-booklets-guidelines/Incident\\_Management\\_Guidelines\\_20080922.pdf/view](http://www.coloradodot.info/library/traffic/traffic-manuals-guidelines/lane-close-work-zone-safety/work-zone-booklets-guidelines/Incident_Management_Guidelines_20080922.pdf/view). Last Access on November 17, 2011.

<sup>4</sup> [https://connect.ncdot.gov/projects/WZTC/Documents/WZSafetyAndMobilityDraftGuidelines07\\_23\\_2007.pdf](https://connect.ncdot.gov/projects/WZTC/Documents/WZSafetyAndMobilityDraftGuidelines07_23_2007.pdf). Last accessed on March 7, 2013.

### **Other North Carolina Safety and Mobility Guidelines**

NCDOT has established a Work Zone Traffic Control (WZTC) Qualification and Training Program. The program states that personnel involved in all facets of work zone planning, design, and operation must be appropriately trained. The program identifies several different training levels. A list of sources for training of the various knowledge levels is provided on the program's web page at <https://connect.ncdot.gov/projects/WZTC/Pages/default.aspx>. Any agency or contractor dealing with temporary traffic control operations inside highway right-of-way must have certified staff, from supervisors to flaggers. There is a new training level that began in 2012 for work zone designers and personnel in charge of TMP, TCP, or PIP development. Training for Work Zone Supervisors and Work Zone Designers includes passing a written test to qualify and regular recertification.

## 4. Colorado US 285 Design-Build Project

This section presents an overview of the US 285 project and observations and findings from the case study. It identifies successes, issues, and challenges when applying the Rule during the project development and implementation phases.

### Background and Specifications

The US 285 Design-Build Project is a \$40 million safety and mobility project on US 285 (Hampden Avenue) in the southwestern part of the Denver Metropolitan area. The project area covers the jurisdictions of the City and County of Denver, the City of Sheridan, the City of Lakewood, and unincorporated Jefferson County. Figure 4-1 shows the project location. The project covers four miles of a mostly four-lane limited access facility that includes one signal controlled intersection. The primary elements of the project are reconstruction and/or resurfacing of the highway, replacement and rehabilitation of bridges, and safety and drainage improvements.

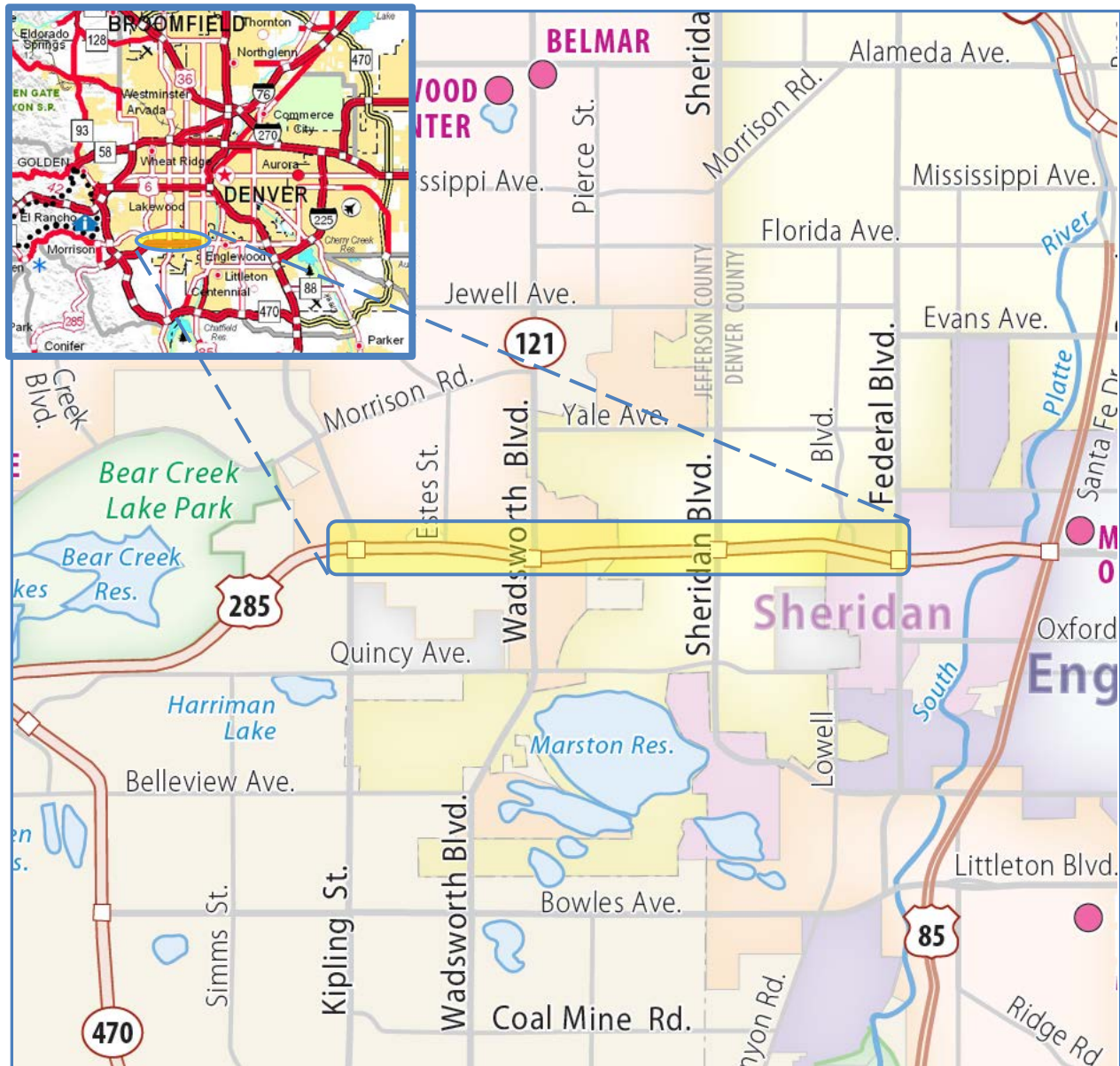
The original scope of the \$40 million project included:

- Reconstruction of US 285/Hampden Avenue from Federal Boulevard to Wadsworth Boulevard.
- Replacement of three bridges at Wadsworth Boulevard, Pierce Street, and Federal Boulevard.
- Rehabilitation of the bridge decks at Sheridan Boulevard, Estes Street, Raleigh Street, and Bear Creek.
- Reconstruction of the Wadsworth Boulevard Interchange including the addition of a third lane on Wadsworth Boulevard under US 285.

The US 285 Design-Build Project addressed several needs. The project replaced three structurally deficient bridges and reconstructed a four-mile portion of US 285 that was in poor condition. The project also includes the rehabilitation of four bridges, the reconstruction of one interchange, improvement in drainage and water quality, and the addition of a third lane to an arterial street under the corridor. In addition, Knox/Lowell, an at-grade intersection within this part of the corridor, will undergo a slight geometry change and get additional turn lanes in order to improve safety.

This project began as a \$10 million design-bid-build bridge replacement project. Then additional elements were incorporated and the scope exploded. CDOT developed a new scope for the US 285 project and released the RFP as part of a “Modified Design-Build” (MDB) project. All the bids CDOT received for the MDB RFP were much higher than estimated, and none of the bids were accepted.

CDOT again put out an RFP for the project, but this time it would be a value-based design-build. There are several references to the Rule in the RFP, and there is material that is based on seven of the eight key Rule aspects mentioned earlier. CDOT made safety, quality, and mobility a priority, and awarded a significant amount of points for those portions of the proposals. CDOT’s RFP included value-based selection safety criteria. CDOT thought the value based selection criteria were essential to getting proposers to maximize safety.



Source: CDOT and URS Group, Inc.

**Figure 4-1. US 285 Design-Build Project Location**

When the project was awarded, it had become a \$40 million reconstruction, funded using Federal, State, and Municipal money for different elements of the project. According to CDOT, the winning proposal included superior safety elements to any of the other proposers (one example is the use of positive protection as opposed to cones and barrels). The winning proposer and one other proposer had good quality management and were close on many elements, but the winning proposer figured out how to use both concrete and asphalt to stretch the resources that got them an extra mile of reconstruction to Kipling Street. The other proposers bid all concrete on the job which did not allow for the extra mile of pavement.

Some of the value-added elements that the design-builder worked into their scope included:

- An additional mile of road reconstruction from Wadsworth Boulevard to Kipling Street.
- Wider shoulders from Federal Boulevard to Wadsworth Boulevard; this is a safety and mobility enhancement.
- The use of clear-span bridges which minimizes construction impacts; this is also a safety enhancement, removing bridge piers and improving sight lines.
- The use of positive protection (pre-cast portable barrier) in lieu of barrels and cones.
- Operational improvements at the Knox/Lowell intersection.
- Improved pedestrian facilities on the Federal Boulevard and Pierce Street underpasses.

CDOT used the design-build delivery method because they felt it was the best way to leverage staff resources. They did not have enough designers (50% of the project manager's spots were unfilled), and realized that design-build was a good way to get the project completed faster with their limited staff.

The project was planned for construction in three phases over a 19 month period beginning January 2010. Construction began in the median, pushing traffic to the outside through the corridor. Then traffic was shifted to the outside and Phases 2 and 3 used the new pavement in the median while the north and then south sides of the corridor were constructed. Construction was completed in the Fall of 2011, a few months later than expected, partially due to unexpected stormwater and environmental issues.

The following paragraphs summarize the different plans that were created as part of the project, identify some characteristics that were part of the project coordination, and highlight some of the quality, safety, and mobility related accomplishments of the project.

### **Project Specific Documentation and Planning**

- Quality Management Plan (QMP)

The RFP required that a Quality Management Plan be completed and accepted prior to the first notice to proceed (NTP1). Both CDOT and the Contractor felt that it was valuable to have the QMP in place prior to the design phase. However, there were concerns that this delayed the start of design, and perhaps certain elements of the QMP could be accepted in order to avoid time lost while beginning design.

The QMP consisted of the Quality Assurance (QA) process which includes a list of questions that guide the assessment of TCP development. The QA process is in place to also confirm that complete construction phasing and traffic control plans are included in the correct roadway plans, and that the plans have been prepared by a certified Traffic Control Supervisor and reviewed by the correct personnel. The Quality Control (QC) element of the QMP verifies that the correct Method of Handling Traffic (MHT) and TCP plans are being implemented in the field.

- Public Information Plan (PIP)

The PIP identifies goals and strategies used to ensure honest and effective two-way communication between CDOT and the design-build team, and all stakeholders including the

public. It was very valuable to the project to have an effective public information (PI) team. This proved to be integral in maintaining safe and high quality construction, as up-to-date information on staging, work zone conditions and upcoming closures could be provided to the public, law enforcement, emergency responders, and other stakeholders. For the PI portion of the project, the Contractor used a subcontractor that had significant experience from T-REX, Colorado's first major design-build project, a \$2 billion multimodal effort in the early 2000s.

- Incident Management Plan (IMP)

One of the technical requirements of the RFP was that an IMP was developed as a companion to the TMP in compliance with CDOT's Incident Management Plan guidelines. The IMP include many components such as a PIP, incident detection and response, how to inform motorists and emergency services of incidents, and the use of Courtesy Patrol among others. The IMP was completed during the initial design phase prior to NTP2.

### **Project Coordination**

- Partnering and coordination were strengths of this project. A task force was created for each specialty (traffic, drainage, structures, environmental) that included CDOT and contractor staff. The task forces held weekly meetings that helped assess and resolve issues early. For example, any issues or complaints received that related to traffic were discussed and evaluated at a weekly Wednesday meeting.
- Co-location was identified as an element of the project that led to strengthened communication and partnering. Because this was a smaller design-build project, the design-build team decided that it did not make sense to co-locate all the project staff. The project required co-location of the core partners, from the owner to construction to quality assurance. Management and construction personnel were co-located, while the designers were located at their offices, not far from the project office. Frequent design coordination meetings substituted for that element of co-location. The Contractor indicated that they would have liked to get design subconsultants some space in the designer's office to improve communication, but it was not economical.

### **Project Accomplishments**

- Quality – The fast-paced nature of design-build projects, and the short time between design of plans for a certain segment, review of those plans, and construction of those plans, has the potential to make document control difficult. A unique method of document control was implemented successfully on this project. All draft plan sheets were printed on white paper, while the Released for Construction (RFC) sets were printed on yellow paper (or printed on white with the word "YELLOW" clearly displayed if yellow paper was unavailable). This reduced potential errors and assured that construction crews were working with the correct and most up-to-date plan set.
- Safety - Safety was the #1 priority for this project and the Contractor made that clear by instilling an ethic of safety. Every morning in the field began with a tail gate talk and then group calisthenics while the equipment was warming up. The Contractor included many safety related

elements as value-added components of its proposal that were not required in the RFP. These included the use of positive protection, 12 foot inside shoulders for over half of the project where 8 foot shoulders were required, maintaining two extra lanes through the at-grade intersection during construction, the use of clear-span bridges to maximize visibility and safety (see Figures 4-2 and 4-3), and additional pedestrian facilities. With a design-build contract, the owner can include value-based criteria in the proposal scoring that give credit for work zone safety and mobility elements. This mechanism is not part of a design-bid-build type of contract that is awarded based on low bid.



*Source: CDOT*

**Figure 4-2. US 285 Bridge over Wadsworth Boulevard before Construction**



*Source: CDOT*

**Figure 4-3. Schematic of the new Clear Span Bridge over Wadsworth Boulevard**

- Mobility – The RFP required that 2 lanes remain open in each direction during peak hours, but allowed nighttime and weekend closures. Single lane closures were permitted during weekdays in off-peak times. The project team used variable message signs, a telephone hotline, a project website, and frequent emails to registered users to inform the public of upcoming lane closures.

## **Application of the Work Zone Safety and Mobility Rule**

This section examines each of the eight key Rule aspects identified earlier, and discusses successes and challenges in applying each aspect to the US 285 project.

### **Key Aspect #1 – Work Zone Assessment and Management Procedures**

*This aspect encourages States to develop and implement systematic procedures to assess work zone impacts in project development and manage safety and mobility during project implementation.*

#### **Successes**

- In the Instructions to Proposers portion of the RFP, Section 1.5, CDOT stated that the four project goals were *safety, quality, managing mobility impacts, and maximizing the scope within the budget*. The evaluation structure allocated 35 percent of the points to safety, mobility, and quality. The result of this emphasis was that the Contractor made safety a top priority throughout the project. Examples of their efforts to manage safety and mobility include:
  - The Project Partnering Charter (See Figure 4-4)
  - Reducing the duration of lane/ramp closures and the overall project schedule
  - A safety orientation program for all personnel involved in the project and anyone entering the workspace
  - The use of positive protection (pre-cast portable barrier) in lieu of barrels and cones.
- As part of developing its lane closure strategy for each region, CDOT analyzes its major corridors to determine when lanes can be closed and the resulting impacts to traffic will be acceptable. CDOT relied on that analysis and did not conduct special modeling before letting this project. In the RFP, Section 16 on MOT, CDOT specified that lane closures had to be in accordance with the Region 6 lane closure strategy. Any time the Contractor wanted an MOT variance from contract requirements, the Contractor was required to analyze the traffic impacts and submit a Variance Request. The analysis was based on volumes and looked at expected queues, generally using Synchro for intersections or using peak hour volume-to-capacity analysis for effects on the mainline from strategies like reduced speed limits. In cases where a reduced speed limit was requested by the Contractor, they could perform a simpler volume-capacity analysis with peak hour volumes to assess traffic impacts. One example of the design-build team managing safety and mobility during project implementation is when the designer collected traffic volume data and used the results of capacity analysis for staging decisions in a maintenance of traffic (MOT) variance situation. They modeled traffic to assess queues at the Knox/Lowell and Wadsworth Boulevard intersections. Results from the modeling analysis were used to determine the best geometry and signal timing to maximize the operation of these signalized intersections that had previously experienced excessive delay and long queues.



US HIGHWAY 285-FEDERAL TO KIPLING PROJECT  
PARTNERING CHARTER

Mission Statement

Through cooperative and proactive planning, communication and coordination, the US 285 Team commits to deliver a safe, quality project on time, within budget by effectively managing stakeholder impacts while defining the standard for future Design Build projects.

Charter Objectives

Our Team Will:

- Make safety our top priority
- Effectively plan processes to ensure safety, quality and production
- Manage impacts to the public
- Manage environmental impacts by avoidance, minimization, mitigation
- Achieve financial success and meet the schedule for the US 285 Team
- Streamline and follow the conflict resolution process
- Maintain open and respectful communications
- Maintain a quality system that is continuous and dynamic
- Proactively share information among shareholders
- Benefit from stakeholders' expertise and innovation
- Design-Build a project that will be recognized as a leading example



Source: URS Group, Inc.

Figure 4-4. US 285 Project Partnering Charter

- By gaining a better understanding of the traffic mix, the Contractor was able to factor that into temporary pavement design, reducing cost (or maximizing value) of the project. Temporary pavement was used for staging and traffic control purposes, often to transition roadway lanes from existing pavement which had yet to be removed onto the new constructed roadway surface. Through research the design-build team identified that this corridor had a lower percentage of commercial vehicles than most facilities of this type. The design requirements for temporary pavement were originally based on characteristics regarding expected wear from commercial vehicles. The new information led to modified design requirements for temporary pavement and resulted in cost savings due to less material being used.

### **Issues and Challenges**

- Development of the QMP was both a challenge and an example of how teamwork and partnering overcame the challenge. The Contractor had a difficult time with developing the QMP as required in the RFP due to the magnitude and complexity. With guidance from CDOT, the Contractor and CDOT worked closely to overcome this challenge by exchanging ideas and identifying CDOT's desired concept for this element of the project. CDOT and the Contractor demonstrated a strong project partnership and effective coordination, facilitated by it being a design-build project and both partners having strong desires to establish a solid QMP to ensure project success.



### **Key Aspect #2 – Work Zone Data Collection and Analysis**

*At the project level, States are required to use field observations, available work zone crash data, and operational information to manage work zone impacts for specific projects. At the agency level, States are required to continually pursue improvement of work zone safety and mobility by analyzing work zone crash and operational data from multiple projects to improve State processes and procedures over time.*

### **Successes**

Because this case study is oriented to one particular project, this element looks at the project level of this key aspect. The US 285 Project incorporated many data collection methods, by both the Agency and the Contractor. Some of the ways key aspect #2 was applied to the project include:

- The Contractor maintained a Traffic Management Incident Journal. This journal recorded any time the courtesy patrol (further described in Aspect #5) responded to an incident, identified the location and type of incident, and how the patrol assisted the motorist or situation. Such assistance included changing a tire, securing a crash scene, or removing debris from the road. A sample of the US 285 Traffic Management Incident Journal is illustrated in Figure 4-5.
- One instance where data collection and analysis improved safety and mobility during the project was during demolition of the Wadsworth Bridge. Wadsworth Blvd. had to be closed for two different time periods. The first time, there were severe backups and extensive delay. Because of feedback and observations (data collection) made by the Contractor, the signal timing was adjusted for the second overnight closure. This resulted in less delay and better operation of the intersection.

		<b>US 285 TRAFFIC MANAGEMENT INCIDENT JOURNAL</b>			
<i>Date</i>	<i>Time</i>	<i>Incident Desc. &amp; Location</i>	<i>CEI Response</i>		
15-Apr	8:50	Truck broke down On ramp to EB 285	Gave a gallon of gas		
15-Apr	3:00	Car broke down EB 285 West of Wadsworth	Gave a gallon of gas.		
18-Apr	8:15	Car broke down on ramp from wadsworth to E 285	Towed off highway		
19-Apr	7:30	Car broke down EB 285 at Sheridan	Gallon of gas		
19-Apr	8:00	Car broke down WB 285 at Lowell	Gallon of gas		
19-Apr	9:00	Truck broke down WB 285 Wadsworth	Gallon of gas		
19-Apr	2:45	Car broke down SB Wadsworth North of 285	Towed off highway		
19-Apr	3:30	Car broke down WB 285 near Platte River	Towed off highway		
19-Apr	5:00	Truck broke down EB 285 West of Wadsworth	Changed Tire on Trailer		
19-Apr	5:50	Truck broke down WB 285 at Sheridan	Protected scene called for private tow		
20-Apr	8:00	2 car Injury accident SB Federal at 285	Protected Scene and cleaned up debris		
20-Apr	4:00	Car broke down SB Sheridan at 285	Gallon of gas		
20-Apr	5:45	Car broke down WB 285 at Platte River	Gallon of gas		
21-Apr	3:45	Motorcycle broke down EB 285 at Kipling	Gallon of gas		
21-Apr	4:15	Car broke down EB 285 at Federal	Gave gallon gas		
21-Apr	5:35	Debris in Lanes #1 and #2 EB 285 East of Kipling	Moved to the shoulder		
22-Apr	8:15	Car broke down WB 285 East of Lowell	Tire change		
22-Apr	8:50	Truck broke down EB 285 at Wadsworth	Gallon of gas		

*Source: CDOT*

**Figure 4-5. US 285 Traffic Management Incident Journal**

### Issues and Challenges

One challenge for this project was the lack of existing intelligent transportation systems (ITS) such as cameras, VMS and vehicle detection on the corridor that could be used to monitor work zone traffic conditions. Occasionally, a CDOT staff member performed travel time runs by driving the corridor. However, the information was seldom recorded and it was not distributed to other team members. It could be beneficial if a travel time data collection program is part of the contract requirements, and such information could be valuable to facilitate monitoring and management of work zone mobility performance.

Due to resource limitations, the incident data from the Traffic Management Incident Journal were not used to identify potential causes and remedies for the situations, nor were they used for other safety or operational related analyses. Data collected in the Incident Journal could have been used for safety and operational analyses to assist with improving traffic control and management techniques for this as well as future projects, if it was specified as a requirement in the RFP.

CDOT and the Contractor had a difficult time tracking all of the incidents in the work zone. They stated that several times the only way they knew a crash occurred overnight was by finding barriers that had moved or had evidence of a crash. One of the likely causes of challenging communications regarding crashes in the work zone was that the project was under the jurisdiction of five different law enforcement agencies.

### **Key Aspect #3 – Training**

*States shall require that personnel involved in the development, design, implementation, operation, inspection and enforcement of work zone related transportation management and traffic control be trained, appropriate to the job decisions each individual is required to make.*

Training is an aspect of the Rule that should not differ significantly between design-build and design-bid-build projects. However, since the Contractor may be directly carrying out some responsibilities that it may not typically perform for design-bid-build projects, there may be some additional training needs.

### **Successes**

Some of the successes of this project, according to both CDOT and the Contractor, were the quality control, emphasis on safety, and coordination. Shortly after the contracting agreement was completed, the Contractor created a “Partnering Charter” (Figure 4-4) that was signed by all project staff from the Designer and Contractor (design-build team) and CDOT personnel. The first two objectives listed on the charter were: to make safety their top priority; and effectively plan processes to ensure safety, quality, and production.

The Contractor took the initiative to introduce a two-hour orientation for anyone involved in the project, and anyone who will be in the work area. This orientation, which was not required in the RFP, included environmental, safety, quality, and scope related elements, with a major emphasis on work zone safety. The safety training portion of this orientation included:

- Basic personal protective equipment,
- Work zone safety,
- Working at night,
- Fall protection,
- Demolition,
- Trenches and excavation, and
- Safety tools.

## **Issues and Challenges**

The RFP identified broad training needs in the Quality Management section (Book 2, Section 3), but did not provide detailed requirements. Both CDOT and the Contractor felt that some of the Traffic Control Supervisors (TCS) were not as informed as others. For example, CDOT staff felt that some of the overnight TCS did not have the information and tools they needed to do their job as effectively. This does not necessarily mean that they were not trained appropriately, but that there may have been a disconnect somewhere.

### **Key Aspect #4 – Process Review**

*States shall perform a process review at least every two years. Appropriate personnel who represent the project development stages and the different offices within the State and the FHWA should participate. While this aspect pertains to the agency level, it involves receiving data and feedback from staff on individual projects and doing reviews of a sample of projects.*

Contractors will typically have a limited role in an Agency's process review, so the process review is an aspect of the Rule that should not differ significantly between design-build and design-bid-build projects. The US 285 Design-Build Project was not part of a process review by CDOT during the development of this case study document. However, several different methods of review and audit have been part of the project internally. CDOT performed quarterly internal quality audits on the US 285 Project. The audits dealt with design quality initially and moved to quality inspection on construction and field work. Other forms of internal review were conducted through the regular project management and safety meetings where items and issues related to schedule, QA, traffic control and ongoing safety were reviewed and discussed.

## **Issues and Challenges**

No issues were identified regarding the implementation of this aspect.

### **Key Aspect #5 – Transportation Management Plan**

*States are required to develop and implement a TMP for all Federal-aid projects in consultation with appropriate stakeholders.*

## **Successes**

One success of this project was a requirement in the RFP that a task force be established to assure proper coordination with affected agencies, and to make sure the TMP is in conformance with the requirements of the RFP. This work early on built trust between the task force personnel, and laid the groundwork for a positive working relationship. Another benefit of the task force was to make sure that all stakeholders were being included and considered in the creation of the TMP and IMP. Because this project falls in multiple jurisdictions, with five law enforcement agencies, there were many different parties involved in incident management.

Developing and implementing a TMP and an IMP for a design-build project is a challenge, as the phasing for a design-build project is not set-up during the RFP stage. The US 285 Project TMP and IMP provided

overall strategies and guidance for the project and did not change during construction, with the exception of the points of contact. The project phasing plans remained fairly constant. The TCPs were developed along the way as the project design moved forward. There were a few changes in the TCPs due to unforeseen conditions.

One specific instance where the traffic control plans were changed after completion of initial design was on westbound US 285 at the Kipling Street off-ramp. The project team observed queuing in this area and turbulence in the traffic flow as a result of significant exit of traffic at this interchange. As a result, the off-ramp to Kipling would back up onto US 285, sometimes causing congestion and unsafe conditions. The design-build delivery method allowed the Contractor to provide an innovative solution to this situation. The Contractor introduced a new traffic control strategy which separated the two westbound lanes using concrete barrier, enabling them to move the merge point, reduce merging issues, and improve traffic flow and mobility. This reduced conflicts between through traffic and the vehicles exiting to Kipling Street and also allowed the two lanes to have different elevations, which was helpful to constructability. This innovative traffic control modification improved safety and mobility as well as constructability. Generally the Agency and the Contractor will not be able to quickly issue a change order to allow the use of such an innovative approach in a design-bid-build project. The Contractor has more latitude in a design-build project to make quick alterations in their plans based on problems they encountered in the field. Figure 4-6 illustrates this innovative traffic control strategy.

Another example of an adjustment made along the way, which also demonstrates successful project partnership, was how CDOT worked with the Contractor to find acceptable ways to modify the District 6 Lane Closure Strategies for this project to enable the design-build team to create a better TMP. Some of the mobility requirements in the RFP and included in the Contractor's proposal were not possible to follow during construction. One instance was at the Knox/Lowell intersection where the Contractor stated they would keep three lanes open in each direction during peak hours. However, due to a cross drainage issue that came up after construction started, a large portion of the right-of-way was used to remedy the issue. As a result, there was not enough room for three lanes to remain open in each direction. Subsequently, the contract was modified to change the allowable lane closures, and the Contractor implemented a plan to keep two lanes open in each direction during peak hours.

A benefit of the design-build process is that the Contractor has much more input and control of traffic control and phasing than that on design-bid-build projects. A design-builder can tailor project phasing to accommodate the strengths of their construction process. This in turn reduces the time that lane closures are in place, and saves money for mobilization and traffic control operations. For this project, the Contractor and their traffic control personnel formed a task force with CDOT staff to identify issues and work to resolve differences. CDOT felt that this cooperation and coordination led to higher quality traffic control than they would typically get on a traditional design-bid-build project.



Source: URS Group, Inc.

**Figure 4-6. Barrier Separated Through Lanes on Westbound US 285 (Top: in advance of lane separation; Middle: at separation; Bottom: at Kipling off-ramp)**

As required in the RFP, the Contractor provided a courtesy patrol on the corridor during weekday peak hours. The courtesy patrol provided incident response and towing assistance as well as providing stranded motorists the use of a cell phone and a gallon of gas if needed. CDOT felt that by making the Contractor responsible for incident management, their accountability and attention to incident management increased. As discussed in Aspect #2, the Contractor maintained the Traffic Management Incident Journal to keep a log of all the responses the courtesy patrol made. The incident data were not used to identify potential causes for the incidents or potential improvements to traffic control and management due to resource limitations, but could have been if it was specified as a requirement in the RFP.

One key element of the project, that was not part of the TMP, was the use of photo radar in the work zone by the local law enforcement agencies. Colorado once had a broad photo radar program, which was ended due to legal issues. It had recently been reintroduced for use in work zones. For this project the photo radar program used advance signage with the radar units in vans along the work zone. The result was a 10-mile-per-hour reduction in traffic speeds through the work zone.

### **Issues and Challenges**

There were no issues or challenges identified regarding the implementation of this aspect for this project.

The CDOT project manager did discuss potential challenges with the QA/QC program that could arise in other design-build projects. A concern can arise with specifying what the quality program must include, especially with performance based specifications. One element that was mentioned was the number of people that make up the QA team. Specifying a quantity of persons per dollar value of the project could ensure that a certain level of QA attention will be achieved, and that proposers would not use the quality elements to save on cost. CDOT mentioned that on some past design-build projects, the Contractor had not allocated enough resources to the quality program, and CDOT ended up doing the QA/QC of traffic control for those jobs – something they want to avoid on future projects.

### **Key Aspect #6 – PS&E Shall Include TMP or Provisions for Contractors to Create a TMP**

*A TMP will be created and provided by the State or Agency, or the Contractor will develop it subject to the approval of the State prior to implementation.*

### **Successes**

Unlike a design-bid-build project, there is no typical PS&E developed before bid for a design-build project. The RFP for a design-build project contains the project requirements and specifications, rather than a full PS&E package. The RFP for the US 285 design-build project included several references to the Rule and material related to seven of the eight key Rule aspects, and implemented aspect #6 as written in the Federal Rule and the CDOT Procedures Document. Book 2, Section 16 of the RFP had extensive language about the creation of the TMP. This part of the RFP identified the timeline (required 30 days prior to NTP2) and content requirements, including mention of the PIP. There was also a section describing the requirements of the IMP. The RFP required the establishment of an MOT task force,



which included personnel from both the owner and design-builder. The purpose of this task force was to make sure the TMP was developed in conformance to the RFP, as well as to help create the PIP. The coordination between the task force and the Contractor was a successful partnership, and under the guidance of the task force, a TMP and a PIP were developed and met CDOT's expectations.

CDOT placed safety, quality, and mobility as a priority by inclusion of extensive requirements in the RFP for the US 285 project and awarded a significant amount of points for those portions of the proposals. Such value-based selection safety criteria were essential to getting proposers to maximize safety. The winning proposal not only included superior safety elements but was also able to stretch the resources to an extra mile of reconstruction.

## **Issues and Challenges**

There were no issues or challenges identified regarding the implementation of this aspect.

### **Key Aspect #7 – Pay Item Provisions – Method or Performance Based**

*For method-based specifications, individual pay items, lump sum payment, or a combination thereof may be used. For performance-based specifications, applicable performance criteria and standards may be used.*

Design-bid-build projects give a large degree of control of the design to the Agency and use prescriptive design and specifications, while design-build projects require the Agency to reduce their control to the design-build Contractor and more often use performance-based specifications in the RFPs. The use of performance-based specifications may enable the Contractor to take risks which can affect work zone safety and mobility in positive or negative ways, and schedule delivery and cost. No specific successes, issues, or challenges were identified for the US 285 Project related to implementing this key aspect. However, some observations relevant to this key aspect are summarized below:

- CDOT used performance-based specifications for some elements of the project, such as lane smoothness for the asphalt and concrete pavement, but none of these specifications addressed work zone safety or mobility.
- The TMP and its components were identified as the Traffic Management line item in the Guaranteed Maximum Price Allocation Form of the contract. \$3.2 million was allocated for this task.
- There were no incentives or disincentives for work zone elements on this project, but CDOT did have provisions for a lane rental fee of \$750/hour/lane. This fee was based on road user costs.
- CDOT indicated that they would like to use more performance-based specifications in the future. CDOT would also consider specifying the number of people the Contractor uses for QA/QC, especially QA in regards to traffic control to address the weakness of subcontractors in that area. One idea the Project Manager came up with for future design-build projects was to specify about 1 or 2 personnel per \$10 million of project value. Specifying this in the RFP can “level the playing field” for elements like safety and traffic control that can be more challenging to specifically test the performance of than elements like material quality.

## **Key Aspect #8 – Designated Trained Person**

*The State and the Contractor shall each designate a trained person at the project level who has the primary responsibility and sufficient authority for implementing the TMP and other safety and mobility aspects of the project.*

### **Successes**

The Contractor and CDOT had personnel whose responsibilities included implementing the TMP and other safety and mobility related elements as key aspect #8 requires. However, it is not apparent that these people were formally identified as the “designated person”.

In the Safety Management Plan, a Project Safety Officer (PSO) is identified. The plan states that the PSO reports directly to the design-build project manager and is responsible for:

- Daily on-site project safety
- Documentation of safety plan activities
- Training and orientation.

The Safety Management Plan and PSO were required per the RFP. The PSO had responsibilities that related to the overall safety and mobility of the project, however, they did not necessarily deal with the implementation of the TMP.

### **Issues and Challenges**

This aspect of the Rule is an element of CDOT’s procedures document; however, the requirement was not listed in the RFP. The designated trained person could have been tied to the MOT Task Force, since the RFP required a TCS, superintendent, and a CDOT employee to be members. However, the MOT Task Force seemed more oriented towards the development of the TMP, and not implementation.

An issue that both the Contractor and CDOT agreed on was that the traffic control subcontractor is often the weak link of a design-build project. They stated that one of the daytime TCS working on the US 285 Project was the best they have ever worked with, while some of the others, primarily those working during overnight hours, were not as reliable. Some of the problem might be that the daytime TCS worked with the personnel most knowledgeable about implementing the TMP, while the after-hours and night TCS might not have as much information about the TMP, or oversight and guidance from other staff. This could be because the primary Contractor staff were on site during daytime hours, and a weaker communication channel might exist for getting up-to-date information to those working after hours.

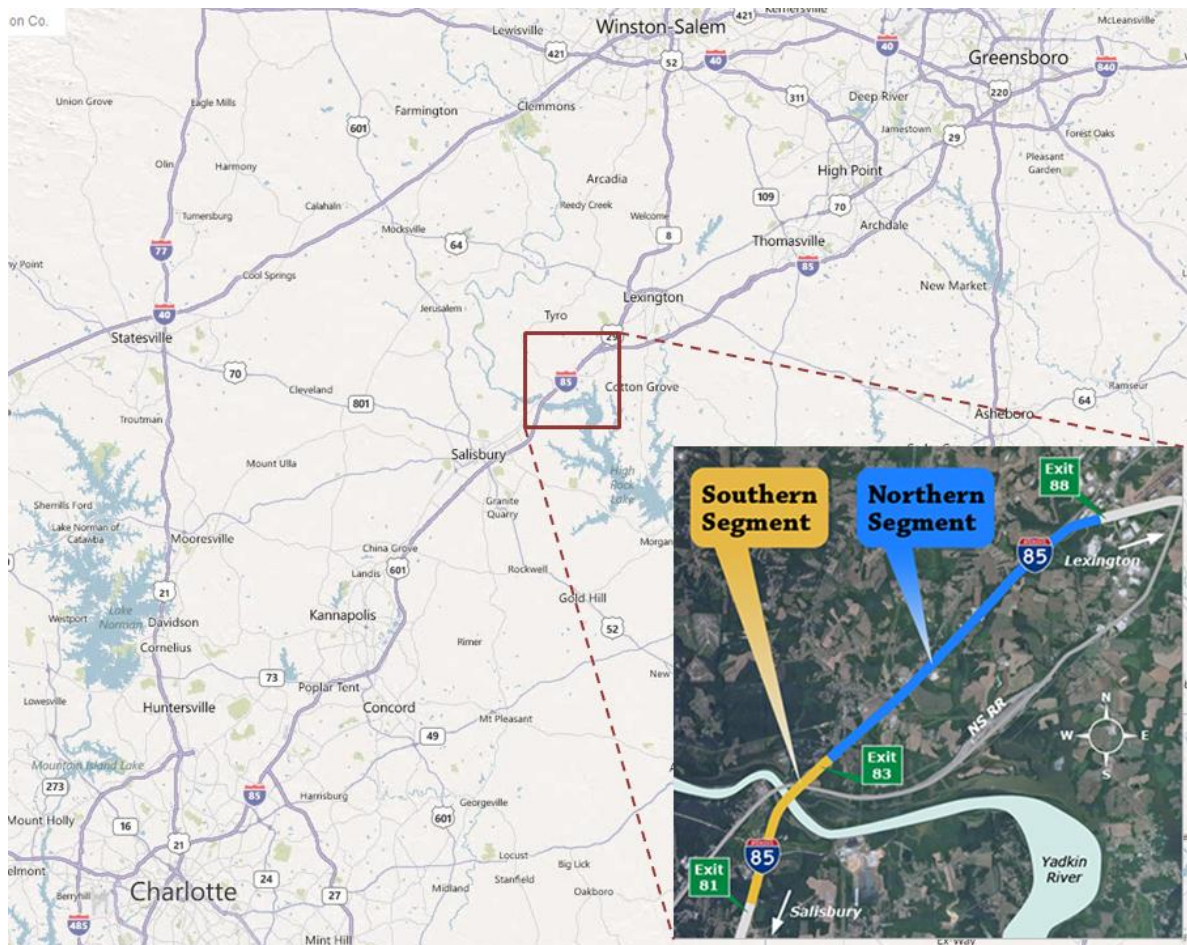
Overall, the requirement for designating a trained person from both the Agency and the Contractor is an aspect of the Rule that should not differ significantly between design-build and design-bid-build projects.

## 5. North Carolina I-85 Corridor Improvement Project

This section presents an overview of the I-85 Corridor Improvement project and observations and findings from the case study. It identifies successes, issues, and challenges when applying the Rule during the project development and implementation phases.

### Background and Specifications

The I-85 Corridor Improvement Project was located in Central North Carolina, half way between Charlotte to the south and Greensboro to the north (see Figure 5-1). The project was split into two segments. Each segment of the project was let as an individual design-build contract, with a different design-build team selected for each segment. The two segments are the I-2304 AC (the southern segment) and I-2304 AD (the northern segment). I-85 is the primary route between Montgomery, Alabama and Atlanta to the south, through Charlotte, Greensboro and Durham, and north to Richmond, Virginia. As it passes through the work zone, I-85 carries about 65,000 vehicles per day (vpd), 25-40% of which are commercial vehicles. The southern segment includes the I-85 Bridge over the Yadkin River, the only major vehicular crossing for many miles. Figure 5-2 illustrates the locations of the I-85 Bridge and other bridges over the Yadkin River.



Source: NCDOT and URS Group, Inc.

Figure 5-1. I-85 Project Location



Source URS Group, Inc.

**Figure 5-2. Locations of Yadkin River Bridges**

The AC project was awarded in April of 2010, and construction began in late September of that same year. Four months later in January of 2011 the AD project was awarded, and construction on the northern segment began in May of 2011. The projects ran concurrently for almost two years, until Spring 2013.

The following were the primary elements of each of the segments:

I-2304 AC – \$136 million southern segment:

- Replacement of the I-85 Bridge over the Yadkin River (bridge #4 in Figure 5-2). The new bridge (bridge #5 in Figure 5-2) has one structure for each direction of traffic.
- Conversion of the Southbound US 29/70 Bridge (bridge #1 in Figure 5-2) to a pedestrian/bicycle bridge.

- Replacement of the Northbound US 29/70 Bridge (bridge #2 in Figure 5-2) with a new single-structure bridge for both direction of travel.
- Widening I-85 from four to eight lanes through the length of the project (about 3.3 miles).
- Reconstructing the I-85 interchange with N.C. 150.
- Removing the I-85 interchange at Clark Road.

I-2304 AD – \$66 million northern segment:

- Widening I-85 from four to eight lanes through the length of the project (about 3.8 miles).
- Reconstructing the I-85 interchange with Belmont Road.
- Reconstructing, realigning, and building secondary roads that support the Interstate and the access roads.

The I-85 Corridor Improvement Project addressed several needs and mitigated problems with the current operation of the facility:

- Previous projects had widened I-85 from four to eight lanes south to Charlotte, and this segment had become a bottleneck.
- Originally designed and constructed in the 1950s, this segment of I-85 had narrow lanes throughout and tight curves entering and exiting the bridge as illustrated in Figure 5-3. Figure 5-4 shows the new straighter bridge alignment.
- The crash rate for I-85 in this area was over 75% higher than the State average for similar roadways.
- The I-85 Bridge over the Yadkin River was rated in poor condition and classified as structurally deficient and functionally obsolete.
- The parallel bridges carrying US 29/70 over the Yadkin River were also in poor condition and structurally deficient. Southbound US 29/70, the Wil-Cox Bridge built in 1922, had been closed and turned over to Davidson County as part of a planned regional greenway system.
- There is a heavily utilized truck stop with scales on the northwest quadrant of the Belmont Road Interchange. The exit ramps were not of modern design and led to heavy vehicles starting their deceleration on the I-85 mainline.



Source: URS Group, Inc.

**Figure 5-3. Existing Bridge Approach**



Source: URS Group, Inc.

**Figure 5-4. New I-85 Alignment from the North**

The segments of the project were originally identified as two separate projects, I-2304 AA and AB. NCDOT was prepared to proceed with the projects in 2004, but budgetary issues prevented the contracts from being executed. After that time, the overall project continued to be viewed as one of the highest priority projects in the State. Funding for the project was finally secured from several sources and the AC project was let in 2010. The funding for the southern AC project came from a Federal TIGER

grant, the State's Transportation Improvement Program, and Grant Anticipation Revenue Vehicles (GARVEE) bonds, which borrow from expected future funds. The northern AD project was the first project funded by the North Carolina Mobility Fund. The winning AD project bid came in at almost half the estimated \$130 million.

The RFPs for each project devoted a high percentage of the evaluation points to the maintenance of traffic and safety plan (MOT), Schedule and Milestones, and Innovation. The AD project had more points for MOT (25 out of 100) than the AC project (15 out of 100) because it involved much more traffic management, traffic control, and work in the right-of-way. Schedule and Milestones was worth 30 points for the AD project and 23 on the AC project, while Innovation was worth eight points for the AC project and four for the AD project. Extra credit was available on both projects for additional warranties or guarantees.

Many different types of meetings created a good partnering environment early on in the projects, and encouraged partnering and positive sharing of ideas as the projects continued. These meetings included:

- Partnering and Conflict Management Meeting, prior to notice to proceed. This was a meeting between the designers on the winning design-build team and NCDOT to discuss and establish quality assurance/quality control (QA/QC) and NCDOT review processes.
- Incident Management Meetings: These meetings were held every four to six weeks with involvement from both of the Contractors, NCDOT WZTC staff, Highway Patrol, local law enforcement and other emergency responders, the Resident Engineers, and Incident Management Assistance Patrol (IMAP) personnel.
- Traffic Safety and Operations Meetings: These meetings were initially held monthly, then changed to quarterly once the AD project was underway. The meetings involved the designers, construction staff, and Resident Engineers for each of the projects, as well at WZTC staff.
- Construction Meetings. Meetings were held weekly. WZTC staff would attend these meetings if there was a traffic shift or detour that needed to be discussed. The NCDOT Public Information Officer also attended the meetings, as needed, to be kept aware of the project progress and status.

These planning and coordination meetings between the two projects helped NCDOT meet its goal of having the public see the two segments as one continual project, even though I-2304 AC and I-2304 AD were different contracts. With good collaboration and cooperation between the two projects and their traffic control and work zones, drivers should not have noticed where the AC project ended and the AD project began. Another way to meet the goal was the joint website for the projects ([www.i-85yadkinriver.com](http://www.i-85yadkinriver.com)).

NCDOT had a website for the I-85 Corridor Improvement Project which was set up by the Contractors. The website explained that the project was being built in two separate phases, and then described the details of each "phase." The home page of the website had a map and brief overview of the project and

then allowed users to choose between the two project segments. Each segment had its own description, but referenced and linked back to the other. The website was initially set up by the AC Contractor, and then when the AD project started it was integrated into the original AC website. There were no provisions in the RFP for the websites to be combined, but both Contractors worked together as they realized the benefit of the public viewing these projects as one. NCDOT noted that for design-bid-build projects the two websites would have been done internally and it would have been difficult to integrate them because of lack of resources and limitations on some capabilities (e.g., video) and formats. NCDOT indicated that the design-build teams were able to provide a better website with more information, as a DOT led website for the project would have been more generic and provided fewer capabilities.

## **Application of the Work Zone Safety and Mobility Rule**

This section examines each of the eight key Rule aspects identified earlier, and discusses successes and challenges in applying each aspect to the I-85 Corridor Improvement project.

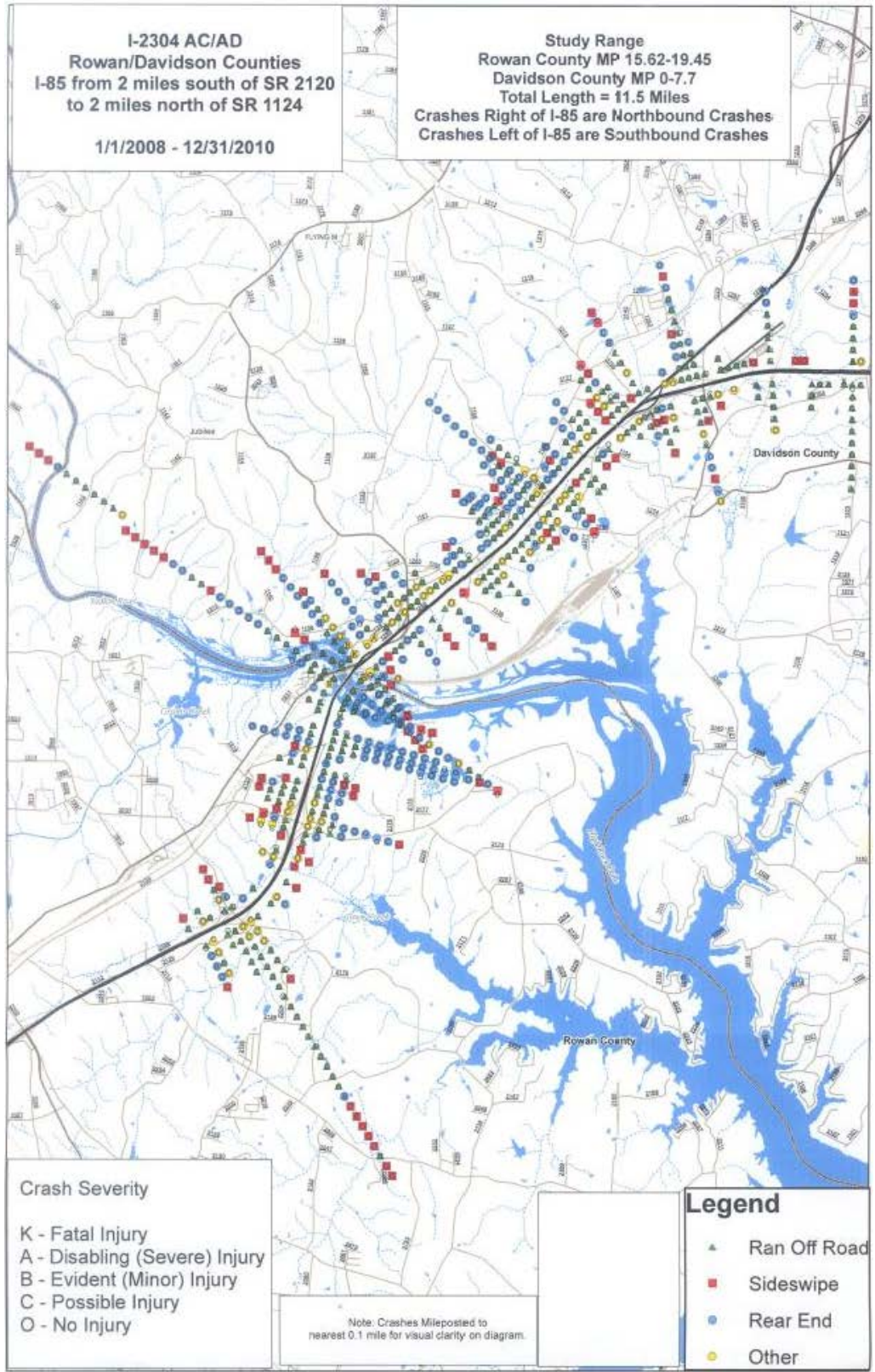
### **Key Aspect #1 – Work Zone Assessment and Management Procedures**

*This aspect encourages States to develop and implement systematic procedures to assess work zone impacts in project development and manage safety and mobility during project implementation.*

#### **Successes**

- Decision-making on work zone traffic control was based on the overall goal of providing for a safe and efficient work zone. NCDOT policies and guidelines, including its *Draft Guidelines for the Implementation of the Work Zone Safety and Mobility Policy*, were applied to the project. The Guidelines establish processes and procedures for work zone traffic control decision making and evaluation. Decisions based on the guidelines were included in the RFP requirements, and the design-builder developed the TMP based on the requirements. During construction, NCDOT monitored the work zone traffic conditions via CCTV cameras on an as needed basis. Portable DMS were used to alert travelers of work zone conditions and incident information. The project was still under construction as of the writing of this case study, and no significant delay or safety impacts had been encountered to date.
- In the three years prior to starting the AC project, the segment of I-85 that both of these projects covered experienced a high rate of crashes. In an 11.5-mile segment extending about two miles beyond the north and south limits of the projects, there were 672 reported crashes from January 1, 2008 to December 31, 2010 (average of 224 per year), including two fatalities. Project designers used this crash information (see Figure 5-5) to help solve issues for the final design. For example, a truck stop was located near the Belmont Road Interchange. The existing off-ramps at this interchange were very short, and resulted in trucks decelerating and often queuing on the I-85 mainline. Crash data showed a high number of rear-end crashes in this area. The Contractor, with input from NCDOT, used the crash information to determine staging and traffic control to maximize the lengths of merge/diverge areas. Because of the limited room in the construction area at the Belmont Road Interchange, some of the staging plans used an alternate interchange for vehicles to access the truck stop and Belmont Road. Though vehicles





Source: NCDOT

Figure 5-5. Pre-project Crash Data (based on 3-year Data)

had to travel a bit farther using the alternate intersection, the safety and mobility of the roadway was improved. In addition, the new design for this interchange provided auxiliary lanes for exiting vehicles and longer off-ramps. The new facility would reduce the number of crashes in the area near this interchange by separating the exiting vehicles from the faster moving through vehicles.

- NCDOT felt that including law enforcement agencies and first responders early in the incident management planning during project development was critical to enhance work zone safety and mobility. While early engagement of incident management stakeholders in the RFP development and design stages for traditional design-bid-build projects is important, it is even more critical for design-build projects because the development of the TMP and incident management plans are turned over to the Contractor prior to completion of the final design plans. For a design-build project, early engagement and participation from incident management stakeholders helps with building goals and expectations into the RFP to ensure the Contractor clearly understands the safety and mobility needs and the expectations of the Agency, and can develop plans that meet project requirements.
- The RFPs required the design-build teams to each designate a Quality Control Manager who is responsible for implementing and monitoring the quality control requirements of the projects. The design-build team was required to describe its compliance with the requirements for quality control of design and construction. NCDOT felt it was very important that the teams' designers followed the quality policies established by the design-build teams, as the NCDOT's review period for work zone and traffic control plans was only 10 days. At the time of the field review of this case study, the NCDOT work zone team had only missed one of the 67 ten day review deadlines. These types of short deadlines for plan review are not a significant factor in design-bid-build projects because the plans are developed under the DOT's direction prior to when the project goes to bid and are reviewed then.
- To manage impacts to motorists, NCDOT has included in its design-build contracts a note that the Contractor cannot install barrier more than two weeks before they will be working in that area.

## Issues and Challenges

No issues were identified regarding the implementation of this aspect.

## Key Aspect #2 – Work Zone Data Collection and Analysis

*At the project level, States are required to use field observations, available work zone crash data, and operational information to manage work zone impacts for specific projects. At the agency level, States are required to continually pursue improvement of work zone safety and mobility by analyzing work zone crash and operational data from multiple projects to improve State processes and procedures over time.*

## Successes

- A good example of partnership and collaboration between the two projects is the monthly Incident management meeting. Attendees at this meeting include members from the design-build team and NCDOT for both projects, NCDOT WZTC staff, North Carolina Highway Patrol, local law enforcement, and first responders from the area. Crash data and history as well as speed enforcement are the major elements reviewed and discussed at these meetings.
- Because NCDOT had good baseline crash data for a period prior to construction, they were able to determine some of the effect the work zones and traffic control had on crashes and the safety of the project corridor. The Highway Patrol emailed NCDOT crash data every one to two weeks. Because it was a design-build project, NCDOT was able to work with the Contractor and used this information to remedy conditions that led to repeat or similar crashes. Figure 5-6 shows crash data for the first seven-plus months during the project. Comparing this data to the crash history of the area showed that the crash rate had not increased with work zones and construction activities, and the severity of the crashes had decreased. This crash analysis was done on an ongoing basis to quickly identify and address work zone crash issues.

## Issues and Challenges

The RFPs did not require the Contractors to collect or analyze operational data to manage work zone impacts. It would be beneficial to include requirements in the RFPs for the Contractors to provide work zone monitoring and/or data collection capabilities (e.g. additional CCTV and portable vehicle detection). For example, a travel time data collection program can be included as a requirements to facilitate monitoring and management of work zone mobility performance.

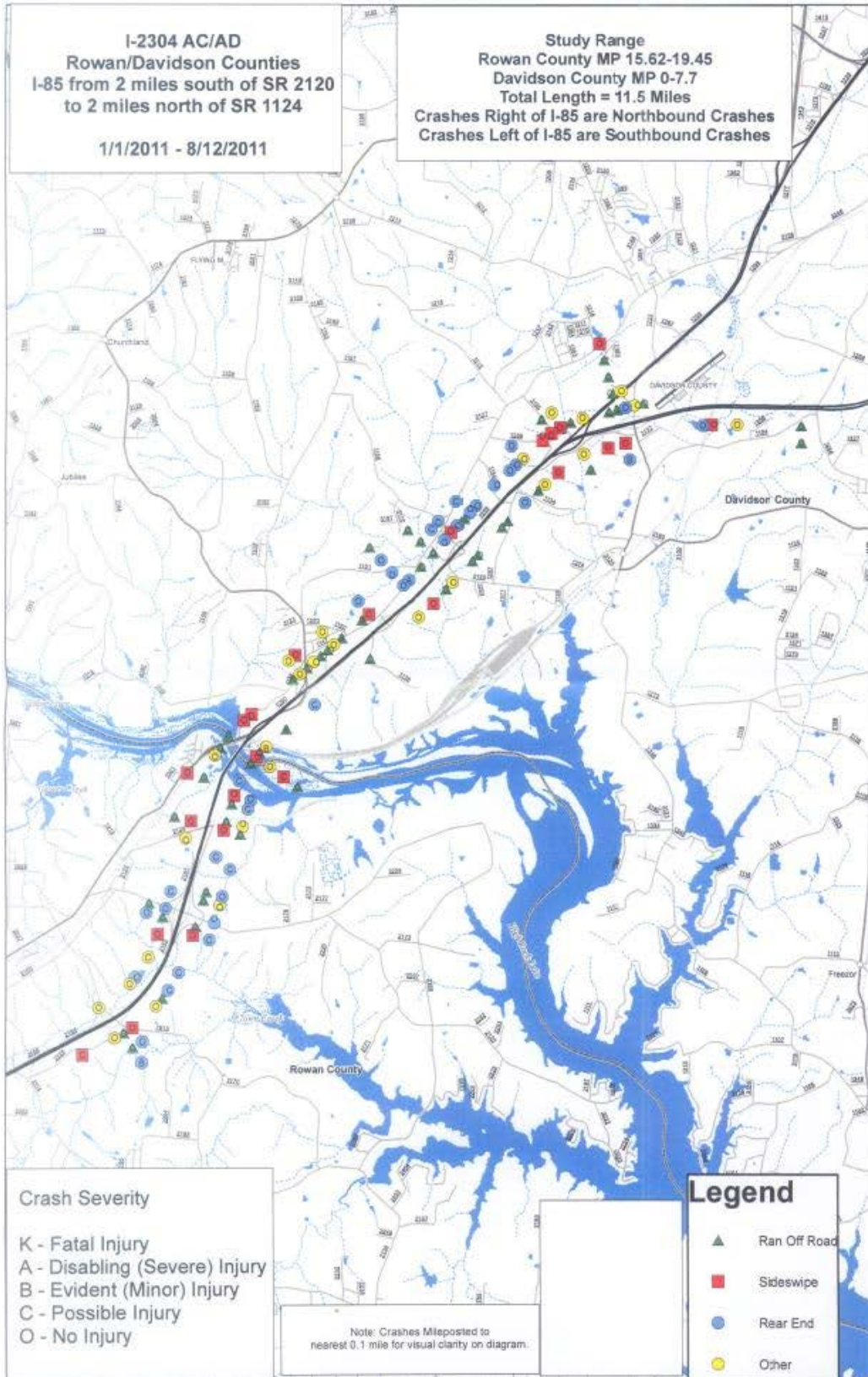
## Key Aspect #3 – Training

*States shall require that personnel involved in the development, design, implementation, operation, inspection and enforcement of work zone related transportation management and traffic control be trained, appropriate to the job decisions each individual is required to make.*

Training is an aspect of the Rule that should not differ significantly between design-build and design-bid-build projects. However, since the Contractor may be directly carrying out some responsibilities that it may not typically perform for design-bid-build projects, there may be some additional training needs.

## Successes

As discussed previously, the NCDOT Work Zone Qualification and Training Program identifies the qualifications, training requirements, and training resources for the different levels of responsibility of traffic control workers. The Contractors for the AC and AD projects conducted necessary training to satisfy all the requirements of the NCDOT training program.



Source: NCDOT

Figure 5-6. Crash Data during Project (based on 7-Month Data)

## **Issues and Challenges**

Applying the Rule to projects can be a major challenge if neither the Agency project team nor Contractor is familiar with the Rule. An issue the NCDOT WZTC group dealt with was recognizing the importance of the Rule within their own Agency. The WZTC group took the initiative to educate NCDOT internally the importance of the Rule so that the appropriate messages were conveyed in specifications and design-build RFPs. The WZTC group recognized that if crucial groups or personnel in the Department did not recognize the significance of the Rule, it hampered NCDOT's ability to develop a good RFP that includes necessary aspects of the Rule. It further limited the Agency's ability to provide guidance and oversight to the Contractor to implement the Rule.

The Contractor's familiarity with the Rule is more critical to work zone safety and mobility in design-build projects because the Contractor bears more responsibilities in work zone management. For example, NCDOT noted that if a design-build team does not have a good understanding of work zone traffic management, it can be difficult for NCDOT to meet the quick turnaround time for reviewing traffic control plans because they may not be well-developed. NCDOT felt that the Contractor did not fully understand the Rule and NCDOT's work zone policy at the beginning of the project, and NCDOT had to regularly provide explanations to the Contractor and sell them on it. It took time for the Contractor to realize the benefits of applying the Rule, but once they did, the response was positive and there was buy-in to its principles. The Contractor realized that more work got done and the project did not suffer setbacks when the work zone was safer and traffic flowed more smoothly.

## **Key Aspect #4 – Process Review**

*States shall perform a process review at least every two years. Appropriate personnel who represent the project development stages and the different offices within the State and the FHWA should participate. While this aspect pertains to the agency level, it involves receiving data and feedback from staff on individual projects and doing reviews of a sample of projects.*

Contractors will typically have a limited role in an Agency's process review, so the process review is an aspect of the Rule that should not differ significantly between design-build and design-bid-build projects.

## **Successes**

The I-85 Yadkin Corridor Improvement Project underwent frequent reviews and/or audits by FHWA as part of TIGER grant oversight, but had not been the subject of a process review as of the writing of this case study. NCDOT felt that the TIGER reviews and audits of the project had produced good results. They attributed successes with these reviews to a strong scope that specified the requirements and specifications of the project in the RFP. They noted that if a project begins with a solid scope that specifies non-negotiables, performance measures and timelines, many concerns and conflicts can be avoided down the road.

## **Issues and Challenges**

No issues were identified regarding the implementation of this aspect.

## **Key Aspect #5 – Transportation Management Plan**

*States are required to develop and implement a TMP for all Federal-aid projects in consultation with appropriate stakeholders.*

### **Successes**

One success observed in this project was that the designer and traffic engineering firm on the design-build team worked closely with the construction Contractor throughout the TMP development process. The design team noted that the design-build process involves many iterations of designing then building, then designing, then building, etc., which brings the design team in regular communication and coordination with each other and with the traffic engineers. This collaboration means that issues can often be identified quickly and addressed. All partners involved in the TMP development (include team members on the design-build team and NCDOT) felt they all had ownership in this project. This is a benefit of the design-build process in the development of TMPs. There is not as strong a sense of mutual ownership in a design-bid-build project because the TMP is developed before the Contractor is involved, and any changes in design and implications to TMP development have to be done through supplemental contract amendments.

NCDOT felt that they have a good WZTC process in place for design-build projects compared to some other states. NCDOT staff reviewed all of the WZTC plans, whereas some states use consultants to review the design-build contractor's work. NCDOT indicated there were two benefits for this review process. First, NCDOT's direct involvement in the review process ensures the plans meet NCDOT's standards, requirements, and expectations, whereas the consultant reviewing the plans on behalf of NCDOT may not be as strict or have the same expectation on certain elements. Secondly, having a consultant reviewing the plans on behalf of NCDOT may bring up the concern of a potential conflict of interest in that the reviewing consultant may have business relationship with the design consultant. The reviewing consultant may not deliver a review that serves NCDOT's best interest.

Intelligent transportation systems (ITS) helped with traffic monitoring and information dissemination in the project area. The RFP for each of the projects required that four portable DMS be supplied by the Contractor for traffic control, work zone condition information, and incident management purposes. The RFPs devoted significant score percentages to work zone safety and mobility and encouraged value added elements and innovations. The AD Contractor, as a value added element to improve safety, provided two temporary cameras. These two cameras and the one permanent CCTV camera in the corridor communicated with the NCDOT TMC in Greensboro, which used GPS based speed data and the CCTV cameras to identify and verify incidents and monitor the work zone.

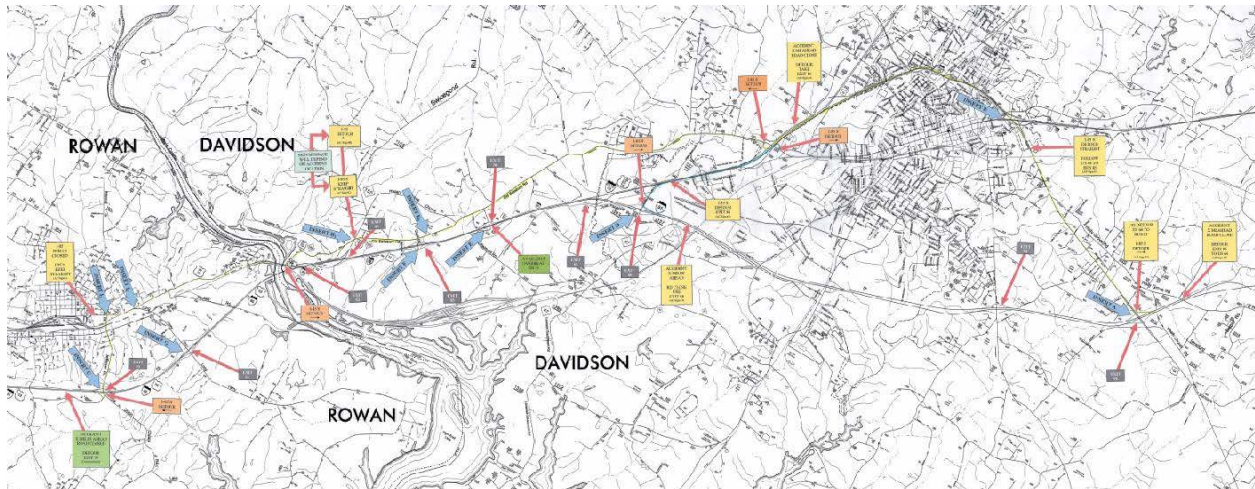
Another success that originated as a challenge involved the incident management plan (IMP). The Yadkin River Bridges are four bridges crossing the Yadkin River in Rowan and Davidson Counties, as illustrated in Figure 5-2. Separated by less than 1,000 feet, the crossings consist of a bridge carrying I-85/US 52, a bridge carrying the Norfolk Southern Railroad, and two bridges carrying US 29/US 70. Because the existing I-85 Bridge has a history of high number of crashes, US 29/US 70 has been used as a detour in the past and was planned as the detour route for this project if incidents were to occur. As

part of the AC project, the east of the two US 29/US 70 bridges, which carries northbound traffic, was being replaced. NCDOT had expected that the west bridge (for southbound US 29/US 70) would carry detoured traffic from the I-85 work zone when needed. The west bridge, known as the Wil-Cox Bridge, was built in 1924. In April 2010, NCDOT deemed the Wil-Cox Bridge structurally deficient and closed it to vehicular traffic.

Closing the Wil-Cox Bridge to vehicular traffic posed a challenge to the development of the incident management plan. The plan had to use the east bridge as the detour which would cause major impact on the AC project schedule due to delay in demolition and reconstruction of the east bridge. It was discovered that the east bridge was partially in railroad right-of-way (the railroad bridge was between the existing I-85 Bridge and the east bridge, referred as bridge #3 in Figure 5-2), and NCDOT and the Contractor had to obtain permission from the railroad to begin any work toward demolition and construction of the east bridge. The process of negotiating and dealing with the railroad took several months with the result that the east bridge could not be demolished and reconstructed based on the original schedule, and therefore it was available to serve as the I-85 detour route. Because it was a design-build project, the Contractor was able to rearrange and devote resources to other activities of the project without experiencing major impacts on project schedule. Making these changes on a design-bid-build project would likely be more complicated, involving Agency re-design work and amendments to the contract, and could increase the duration of the project and associated safety and mobility impacts.

In addition, a new coordinated effort led to a much wider plan for incident management. The design-build teams created an incident management plan (part of which is shown in Figure 5-7) with shielded signs installed both on and off the project area. During incidents the shields would be removed, and the 4 DMS (required in both projects RFPs) would be activated with prescribed messages. This additional effort was not part of the RFP, but came into play after several incident management meetings. Both design-build teams created this plan with NCDOT and did not receive any additional compensation. All parties acknowledged that supplementing the plan and enhancing the safety and mobility of the project area benefits everyone – workers, motorists, and the overall project. Similar to the success with developing the TMP described earlier, this demonstrates a unique benefit of design-build projects due to a sense of mutual ownership to projects and an understanding of the importance of coordination and cooperation among all parties involved.

As part of the incident management effort, law enforcement attended to anyone who pulled over or experienced a break down in the project area. When necessary, law enforcement would notify a rotation of towing companies to remove vehicles from the construction area. This eliminated the need for a Contractor supplied courtesy patrol or dedicated towing operation. NCDOT also had its IMAP (Incident Management Assistance Patrols) trucks patrolling the area. Usually only active on weekdays, NCDOT added a weekend IMAP presence during the duration of the AC and AD projects. The presence of IMAP and tow trucks reduced response time and the duration a stopped vehicle is in the work zone.



Source: NCDOT

**Figure 5-7. Supplemental Incident Management Plan**

The project managers for each design-build team indicated that there were safety policies in place, and for the most part, were required by the Occupational Safety and Health Administration (OSHA) and pertaining laws. There were two full-time safety managers for the AC project and one full-time safety manager for the AD project. Both Contractors extended the idea that everybody on the project is responsible for safety and should look out for safety of their own, their co-workers, and the traveling public. The incentive for the Contractor is the job is completed quicker and the duration of the work zones gets shortened with improved safety and mobility. That benefits all parties.

The RFP for the project allowed for 30-minute closures of I-85 for certain construction operations including girder installation or removal and traffic shifts. These closures were allowed from midnight to 6:00 am, and at the end of the 30-minute period, the closure was to be reopened until the queue was depleted. Upon depletion of the queue, another 30-minute closure could be put in place. In one case for the AC project, there were to be several nights over a period of a week where these types of closures were to be used. The Contractor came to NCDOT and proposed a full closure of the Interstate, using frontage roads and other minor roads in the area for a detour. The Contractor developed this proposal during the project, and the proposed detour route was not in the TMP. The Contractor previewed the detour route, evaluated the pavement condition, proposed using law enforcement rather than flaggers for directing traffic through the detour route, and agreed to maintain the pavement on the detour route between and after the closures. There was a great deal of pre-planning and coordination between NCDOT and the Contractor, including notifying commercial vehicles in the Charlotte and Triad areas to reroute to I-77 and I-40.

During the closures the Contractor drove the detour route, checking on traffic flow and to see if the pavement was holding up with the increased traffic. The end result was considered a success by both the Contractor and NCDOT. They thought that the use of law enforcement (compensated by the Contractor) and their blue lights was more effective than flaggers; the detour route provided a much



safer alternative than intermittent closures; and vehicular mobility was better with the full closure and detour than what was originally planned. One of the most evident benefits of using the full closure and detour route was worker safety, and the fact that the operations were performed without any interference of traffic, and there was no interaction between motorists and construction workers and their equipment.

An example of the Contractor's attention to safety was pointed out by the Resident Engineer of the AC project. During the construction of a new bridge, the barrier on the edge of the bridge had been installed. Because the bridge was not open to the public there were no pedestrian facilities and the railing had not yet been installed. However, to enhance the safety of the workers on the bridge, the Contractor installed a temporary railing on the bridge, as shown in Figure 5-8. On a design-bid-build project, NCDOT would have had to prepare a change order so that the Contractor would get paid for the extra work. In a design-build project, where the Contractor is not getting paid using the same unit price method, a Contractor is more likely to add things or make enhancements that are not in the plans for the benefit of worker safety.



*Source: URS Group, Inc.*

**Figure 5-8. Temporary Bridge Railing**

### **Issues and Challenges**

NCDOT found that with the fast moving nature of design-build projects, if an issue is identified with the implementation of the TMP or a specific traffic control element, by the time the information has gone through the correct channels and been conveyed to the Contractor, the work in that area may have been completed and the work zone changed/removed. Another situation could be that the Contractor receives notification of the issue from the Agency but does not address it until the work zone is removed or altered for a new stage. NCDOT felt that a remedy of this situation could be to include provisions in the RFP stating that WZTC issues must be addressed in a specific time frame and damages are assessed

if it does not get addressed in that time. Documentation in writing (memorandum and/or email) is extremely valuable. The Contractor is more likely to give attention to comments and take corrective action when there is written documentation of the concerns.

The RFP for each of the projects required that four portable DMS be supplied for use on the corridor and for incident management purposes. The RFP specified that the DMS be supplied by the Contractor and that their function be controlled remotely by NCDOT TMCs. However, the RFP did not include requirements to ensure the signs were compatible with the existing NCDOT communications systems and infrastructure. This resulted in difficulties with communicating and controlling the DMS in the beginning of the project. NCDOT felt that this was one area where more detailed requirements would be beneficial.

The ITS devices (CCTV cameras and DMS) were initially controlled by two different TMCs. The Metrolina TMC in Charlotte (about 40 miles south of the project) controlled the ITS devices in the southern segment (AD project) and the Piedmont Triad TMC in Greensboro controlled the devices in the northern segment (AC project). Due to lack of CCTV cameras in the southern segment and the distance to the project area, the Metrolina TMC was not in the best position to clearly know the traffic and work zone conditions in the project area and post DMS messages in response to conditions. Eventually, the Piedmont Triad TMC was given full control with the exception of the Metrolina TMC controlling the DMS and cameras when special events (NFL, NASCAR, etc.) occurred in the Charlotte area.

#### **Key Aspect #6 – PS&E Shall Include TMP or Provisions for Contractors to Create a TMP**

*A TMP will be created and provided by the State or Agency, or the Contractor will develop it subject to the approval of the State prior to implementation.*

#### **Successes**

One of the major changes of the new NCDOT 2012 Standard Specifications is that it added the requirements of the Work Zone Safety and Mobility Rule. It defines the components of the TMP. The first paragraph of the Work Zone Traffic Control General Requirements section of the Standard Specification now reads:

*Maintain traffic through work zones in accordance with these Specifications, the MUTCD, Roadway Standard Drawings, 23 CFR 630 Subparts J and K and the Transportation Management Plan (TMP)*

Each of the RFPs outlined the design parameters and requirements of the TMP. NCDOT noted that it is important to be specific about requirements without being prescriptive. For example, one of the components of the design parameters referenced subpart 23 CFR Subpart K (FHWA's Temporary Traffic Control Devices Rule). NCDOT does not specify barrier, drums, or cones like it would in a design-bid-build project, but specifies that the Contractor must follow the AASHTO Roadside Design Guide, and requires the Contractor to perform an engineering study to assess the need for barrier as part of their

proposal. Other design parameters were lane and shoulder width, the minimum number of lanes to be kept open, minimum speed limits, etc.

The Contractors were able to work several value-added elements into their proposals, including:

- Self-imposed phases of completion with liquidated damages fixed to those dates.
  - In the RFP the AD project was to be completed no later than 10/31/13. The winning contractor team identified substantial completion for 4/30/13 and final acceptance for 5/30/13. Liquidated damages for missing these dates were \$2,000 per day.
- Longer and more significant warranties than required in the RFP, which added value – four additional years for the AD project.
- Minimization of the number of traffic shifts.
- Specific to the AD project (northern segment)
  - Maintain 12' lanes (RFP allowed reducing to 11' lanes).
  - Maintain 8' shoulders.
  - Provide two temporary portable closed-circuit television (CCTV) cameras.
  - Provide an extra loop ramp at the NC 150 interchange.
  - Building ramps from the closed Clark Road interchange to transport material across the roadway. This reduced the travel of project related vehicles on the Interstate by about 10,000 trips over the course of the project.

The RFPs for both projects included a section pertaining to cooperation between the Contractors of both projects. This section required coordination meetings between the two design-build teams and NCDOT, and stated that there was to be coordination to maintain safe traffic operation and pavement markings at all times during construction. Additionally, the RFPs stated that there would be no additional contract time or compensation for failure to coordinate schedules.

Personnel from both projects and NCDOT staff said that the cooperation between the two projects began shortly after the contract for the AD project was executed. Getting everybody together from the beginning was beneficial for both projects and for NCDOT, as the Contractors were able to share information and coordinate closures, lane shifts, and schedules for work that occurred in the area where the two segments bordered. An example of cooperation between the two projects was the innovative use of the Clark Road Bridge. The Clark Road Bridge was a part of the Clark Road Interchange, and the Interchange was to be removed in the AC project once all the ramps and the Clark Road Bridge were closed. The AC Contractor used the inactive bridge for moving materials and equipment from one side of the Interstate to the other. Due to early coordination between the two Contractors, the AC Contractor was aware that the AD Contractor would also benefit from using the bridge for moving materials and equipment. The AC Contractor left the Clark Bridge in place after they no longer needed it so that the AD Contractor could use it for movement of materials and equipment as well. The result of this cooperation was a significant reduction in the number of construction vehicles traveling through traffic lanes in the work zone. The effect of this cooperative and innovative agreement was a less

congested, safer work zone. This solution also led to a significant reduction in construction time and cost.

### **Issues and Challenges**

NCDOT felt that an important mechanism for ensuring that safety and mobility receive the necessary attention during scoping, RFP development, and proposal evaluation of design-build projects is to include WZTC personnel in each stage of the project development. WZTC personnel can help ensure that the work zone safety and traffic control elements of the technical requirements are updated and improved based on lessons learned from past projects and the appropriate level of scoring is attached to safety and mobility in the proposal evaluation criteria. It is also valuable to have WZTC staff on the evaluation and selection committee to ensure that safety and mobility factors are adequately considered and weighed in the proposal evaluation process.

While this was not an issue for the I-85 Corridor Improvement Project, NCDOT stressed the importance of having a qualified designer/traffic engineering firm on the design-build team and establishing good quality management policies and processes to produce quality work zone and traffic control plans. This is particularly important for a design-build project such as the I-85 project, as NCDOT had a very limited window (10 days) for reviewing the plans. It is possible that the winning design-build team has a well-qualified general contractor who teams up with a design firm or a traffic engineering firm who may not have the same level of qualifications and experience in developing work zone and traffic control plans. It is a challenge to the Agency to establish scoring criteria and a selection process for design-build projects to ensure the winning team has appropriate qualifications in all areas.

### **Key Aspect #7 – Pay Item Provisions – Method or Performance Based**

*For method-based specifications, individual pay items, lump sum payment, or a combination thereof may be used. For performance-based specifications, applicable performance criteria and standards may be used.*

### **Successes**

The RFPs for each of the two projects list several different intermediate contract times (ICT), which identify time restrictions for when specific lanes and ramps can be narrowed or closed during given time periods; weekdays, weekends, special events, etc. For each ICT there are liquidated damages identified for lane narrowing or closures during the restricted time periods.

The AC project has three different ICTs with liquidated damages including:

- \$10,000 per hour for lane narrowing, closure, and special event and holiday restrictions for I-85 and all ramps.
- \$5,000 per 15-minutes for road closure time restrictions for I-85 and all ramps.
- \$4,000 per day for ramp closures at the NC150 interchange during restricted times.

The AD project has five different ICTs with liquidated damages:

- \$5,000 per 30-minutes for lane narrowing, closure and special event and holiday restrictions for I-85, I-85 Business and all ramps.
- \$500 per 30-minutes for lane narrowing, closure, and special event and holiday restrictions for Belmont Road.
- \$2,500 per 15-minutes for road closure time restrictions for I-85 and all ramps.
- \$500 per 15-minutes for road closure time restrictions on all other minor roads.
- \$2,500 per 15-minutes for continuous weekend road closure restrictions for I-85 Business ramps.

The different levels of liquidated damages provide some flexibility to the Contractor. The Contractor was able to weigh the benefits of keeping a closure for a given time over the limit against the costs they would incur. Often the benefit/cost of having a little more time to finish a task now was greater than stopping and completing the task later with a new traffic control installation. The AD Contractor noted that it was beneficial to have the liquidated damages broken down to 15 and 30-minute periods instead of by hour increments. While it does create a short-term inconvenience to motorists, extending a lane closure to complete work can be a safer and less disruptive alternative than having to remove the closure prior to finishing work and then having to install the same closure again later. This often helped shorten the overall lane closure duration and reduce impacts to work zone safety and mobility.

### **Issues and Challenges**

One of the Contractors expressed some frustration with the manner in which the payment for the project was made. NCDOT handled design-build project payments in the same manner as they did design-bid-build projects, which was by tracking amount of materials used, moved, built, etc. The monthly payment for MOT was based on the total amount estimated for traffic control, divided by the total months the project would take. The Contractor was initially anticipating being paid based on schedule and progress, not by materials used.

### **Key Aspect #8 – Designated Trained Person**

*The State and the Contractor shall each designate a trained person at the project level who has the primary responsibility and sufficient authority for implementing the TMP and other safety and mobility aspects of the project.*

### **Successes**

The RFP for both projects require a Traffic Control Supervisor (TCS) who is knowledgeable of TCP design and application and has full authority of the maintenance of traffic. That person was required to have a minimum of 24 months of on the job training, and be certified by either the Contractor or NCDOT that they were qualified to perform all duties.

NCDOT felt that traffic control for one of the projects segments was very successful because the TCS had extensive knowledge and experience and fully understood NCDOT's expectations. The TCS for that segment had a great deal of experience with work zones in the state of North Carolina, and his

knowledge and familiarity of local processes proved to be an important success for the project. This is not necessarily unique to design-build projects; however, since the Contractor has more responsibility for preparing and implementing the traffic control on design-build projects, a solid TCS can be particularly helpful when this project delivery method is used.

### **Issues and Challenges**

Because of the nature of these two projects being adjacent to each other, NCDOT and both Contractors acknowledged that there could be difficulties with traffic control activities in the area where the projects border. There was an instance where each Contractor had plans to close different lanes of the roadway in the common area at the same time. This issue was resolved by getting the designated TCS from each project working together with NCDOT. This experience actually improved coordination between the two projects for future traffic control activities.

## 6. Other NCDOT Design-Build Projects

NCDOT has been using the design-build delivery method since 2001. Initially, the State was limited to letting 25 design-build projects per year, but that restriction was later lifted. NCDOT personnel from several different disciplines indicated that NCDOT has become more comfortable with the process as they have completed more design-build projects. One result is NCDOT's transition from more restrictive specifications for design-build projects to ones that allow for more innovation. Initially NCDOT used fairly prescriptive RFPs for their design-build projects. More recently, NCDOT has used more performance based specifications, allowed flexibility in alternative technical concepts (ATCs), and shifted to more focus on the final product and less on the process.

As part of its experience with design-build, NCDOT highlighted two design-build projects in the Raleigh area, one that had recently been completed project and one that was upcoming. The I-40 Widening Design-Build Project was a \$49 million project that included the following improvements:

- Expanding from four lanes to six lanes, including the widening of two structures to accommodate future expansion to eight lanes.
- Providing 12' shoulders.
- Adding a permanent dynamic message sign (DMS).
- Adding new signs on the nearby I-440 to reflect modified route designations.

The future I-40/I-440 design-build project south of Raleigh was planned to include:

- Reconstruction of 11 miles of roadway.
- Bridge rehabilitation.
- Addition of some auxiliary lanes between interchanges.
- Traffic management related elements:
  - Accelerating \$700,000 of ITS (35-40 devices, including CCTV cameras and DMS) so that it could be used to manage traffic and provide traveler information during construction.
  - Adding two dedicated positions at the Traffic Management Center (TMC).
  - Liquidated damages if the Contractor does not have the DMS in place, operating and communicating prior to construction or at any time during the project.

### Application of the Rule to other NCDOT Design-Build Projects

During the site visit for this case study, the NCDOT WZTC Team also discussed NCDOT's experience on applying the Rule to these other design-build projects. Much of the discussion focused on the recently completed I-40 Widening Project. This section summarizes the discussion on some of the key aspects of the Rule.

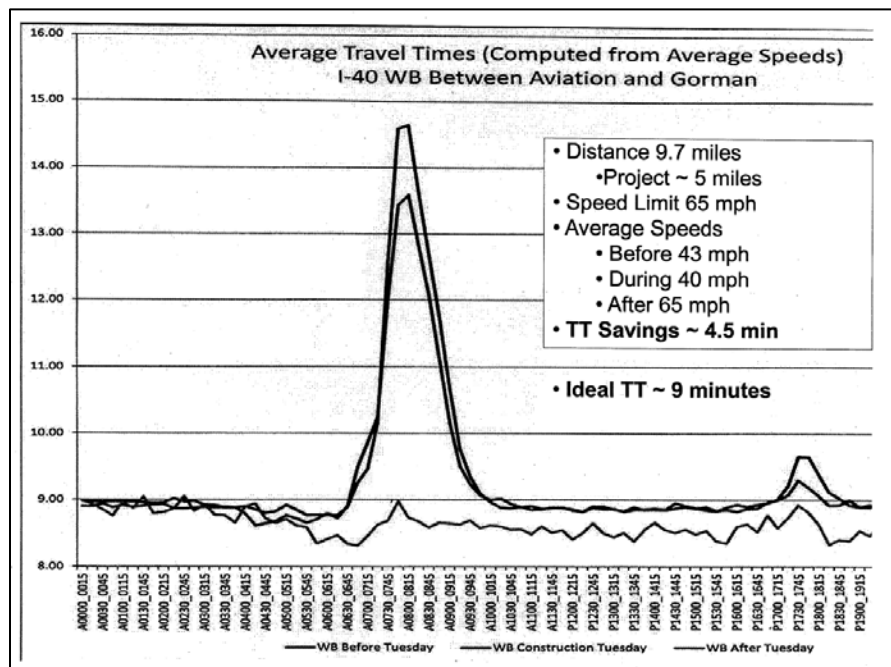
#### Key Aspect #2 – Work Zone Data Collection and Analysis

There was a valuable example of collecting data in a work zone in the I-40 project. Collection and analysis of work zone data benefitted NCDOT, as it uses the information to train and educate their staff and Contractors. NCDOT took advantage of a gradual triple lane closure the Contractor was installing on the mainline. Per the RFP, the Contractor was allowed to close one lane at 8:00 pm, a second lane at

9:00 pm, and the third lane of a four lane highway at 10:00 pm. NCDOT placed cameras on an overpass above the area where the lane closures were occurring, and were also gathering volume data using the Traffic.com sensors.

During the first hour with one lane closed, there was no major effect to traffic. As the second lane was closed queues began to develop, and by the time the third lane was closed there were major queues occurring back from the closure area. NCDOT then compared the video to the volume data and found that queuing started when traffic volume rose to about 1,500 vehicles per hour per lane (vphpl). NCDOT now uses the information they gathered to educate their personnel about how queues propagate and to give them a feel about what the 1,500 vphpl threshold looks like. The information is also used to assist in training their staff and Contractors about traffic management. NCDOT indicated that the effort cost them about \$1,000 and the benefits they have gotten out of the exercise have far exceeded the cost.

NCDOT collected travel time data before, during, and after the I-40 construction project. The travel time through the corridor was based on average speed data collected at nearly 40 locations. These data for the before, during, and after construction conditions were overlaid in order to show the travel time savings from building the construction project. Figure 6-1 presents an example of this travel time comparison.



Source: NCDOT

**Figure 6-1. I-40 Travel Time Comparison**



### Key Aspect #5 – Transportation Management Plan

Discussions with NCDOT and the design-build teams about the differences between design-build and design-bid-build identified several key differences that affect TMP development, which are highlighted in Table 6-1.

**Table 6-1. Differences in Plan Aspects Between Project Delivery Methods**

Aspect	Design-Bid-Build	Design-Build
<b>Plan Development</b>	<p>The Agency does not know the specific strengths or equipment of the Contractor that will win the job, so plans need to be more general and conservative.</p> <p>A full set of plans is ready before contract award and work can begin as soon as the notice to proceed is given.</p> <p>If the Agency thinks some additional measures are needed in the plans, the Agency has the ability to require the change and pay for it.</p>	<p>The Contractor knows the strengths and capabilities of its team and equipment, and can develop plans that fit these strengths. TMP developers can create more specific plans for MOT because they better know the needs (e.g., where the Contractor will get its materials from or how wide their paver is).</p> <p>Early in the project, the Contractor may want to work ahead of the plans while they are still under development or review and are not yet released for construction. Some DOTs have allowed elements of the work that do not affect traffic and safety to proceed.</p> <p>More responsibility and liability lie with the Contractor and their team developing the plans, which can be beneficial when the Contractor is thorough about their plans and conscientious about safety. If the Agency thinks additional elements are needed in the plans, the Agency has to convince the Contractor to do it.</p>
<b>Plan Review</b>	<p>Detailed reviews of plans by the Agency are needed before bid because if something is missed it could result in an additional cost later.</p>	<p>Details about the plans are developed by the Contractor as the project progresses, so reviews are needed at many points along the way and often in short timeframes. If something was missed by the Contractor in developing the plans, it can usually be added without cost.</p>
<b>Plan Changes</b>	<p>One small change to the plans can result in the need to rework other plans and make more changes.</p>	<p>Plans are developed as the project progresses, and there is an effort to look at how everything fits together and an ability to have discussions and make adjustments along the way.</p> <p>Plans may change much more often because the Contractor is suggesting changes to its own plans, which may result in increased need for Agency plan reviews.</p>

One of the major elements as well as challenges of the I-40 Widening project was the movement of material to and from the widening area (the center of the roadway). NCDOT felt that consistent hauling in and out of the work zone would act almost as a lane closure due to the slow deceleration and acceleration of the haul vehicles. The NCDOT 2006 Standard Specifications Book (the current version at the time of the I-40 project) did not have language on hauling restrictions.

To make sure that the Contractor could not constantly interrupt traffic due to hauling operations, NCDOT included specific hauling restrictions into the RFP. The restrictions dealt with both single vehicle hauling and multiple vehicle hauling operations. Single vehicle hauling is defined as handling of equipment or materials to or from the project with delivery intervals of more than five minutes and resulting in no more than one vehicle in the work site at any given time. Multiple vehicle hauling is stated to be delivery intervals of less than five minutes and/or more than one vehicle in the work zone at a given time. The RFP restricted multiple vehicle hauling during a 15-hour period on weekdays and a 12-hour period on weekends. Single vehicle hauling was restricted during weekday peak periods. An additional clause stated that the hauling vehicles must enter and exit the work area at no less than 10 mph less than the speed limit of the highway they were exiting and entering.

The Contractor felt that they would be far too impacted by the hauling restrictions, and came up with an innovative solution. They used conveyor systems from both sides of the Interstate, over the roadway to move materials to and from the inside where the widening was occurring (see Figure 6-2). The Contractor estimated the use of the conveyors eliminated 237 lane closures and nearly 12,000 truckload trips that otherwise would have been needed to haul materials from the I-40 travel lanes. This is a good example of the benefit of innovation in a design-build project. NCDOT felt that had the project used the design-bid-build delivery method, they would not have been able to specify the conveyor requirement under the standard practices and guidelines used in NCDOT. As a result of the success on this design-build project, the new 2012 version of the NCDOT Standard Specifications now includes a section about single vehicle and multiple vehicle hauling restrictions.

One other element of the contract was that the Contractor was prohibited from installing barriers more than two weeks in advance of work commencing in a particular area of the work zone. NCDOT was very pleased with the inclusion of this provision and was considering making it part of all projects. Though this requirement would not really differ from design-bid-build to design-build projects, it can improve work zone mobility and the Agency's credibility without compromising safety. Restricting inactive work zones helps with public perception and satisfaction as they do not have to drive through work zones where work is not being performed. Furthermore, when the public has complaints, it is the Agency who is called regardless of who is responsible for traffic control, or what type of project delivery method is being used.



*Source: S.T. Wooten Corporation*

**Figure 6-2. I-40 Widening Project Material Conveyor**

The Contractor also wanted to expand hauling hours on NC 54, a road which passes under I-40. NCDOT required the Contractor to first conduct a traffic study to see if the additional hours would cause unacceptable delays. The Contractor used VISSIM to analyze work zone impacts using Traffic.com sensor data. The study showed that hauling hours could be extended for two hours on weekdays and four hours on Saturday. Based on the study results, NCDOT modified the hours Monday through Thursday, but not on Friday and Saturday. The Contractor used a two-week trial period to determine the impact of the two additional hours in which they could haul, and after the trial period received a \$50,000 credit from NCDOT for their effort.

#### **Key Aspect #7 – Pay Item Provisions – Method or Performance Based**

The I-40 project experienced some problems with striping and pavement markings. The I-40 RFP included requirements such as a defined level of retro-reflectivity, but it lacked provisions about the quality or durability of the material and installation. The Contractor installed the markings, but during the winter season the striping faded and wore off. At that time of year it was too difficult to restripe due to cold temperatures and the lanes were now all under traffic.

NCDOT did not place any consequences in the RFP for failing to meet the minimum requirements regarding striping and pavement markings. With a design-build contract, because there are not individual pay items the Agency cannot withhold payment for or pay for more units of a given item. NCDOT thought that a solution to this problem would be to use performance-based specifications and attach liquidated damages in the RFP. When monetary consequences are applied to a specific element of the project, there is a greater likelihood that the minimum requirements will be met.

## 7. Lessons Learned and Opportunities

This case study documents how the Work Zone Safety and Mobility Rule was applied to design-build projects in Colorado and North Carolina. The following describes lessons learned about how eight key aspects of the Rule were applied to these projects.

### Overall

- **Recognize that the Agency has other types of risk in a design-build project and a key part to managing them is to write a good RFP.** Although the primary risk (responsibility, schedule, quality of facility) for a design-build project is on the Contractor, the owner assumes a different type of risk – the loss of some of the control that exists in a traditional design-bid-build project. As valuable as innovation is for a design-build project, the owner must be clear and firm with their non-negotiables in the RFP to avoid bearing unnecessary risks. In writing the RFP, it can be helpful to give more emphasis and attention to process than to pay items, and to “DO THIS” than to “DON’T DO THIS”.
- **Make project safety a priority right from the start.** Maximizing safety of workers and the traveling public during construction should be a top priority for construction projects. It is important to emphasize safety and establish goals right from the beginning of a project. Both the project owner and the Contractor should recognize such an emphasis and work cooperatively to establish a strong safety ethic that continues throughout the project.
- **Value-added elements are a great benefit of design-build projects.** An emphasis on value added elements encourages innovation. Value-added elements can improve work zone safety and mobility through the use of strategies such as reducing periods of lane or ramp closures, deploying positive protection (pre-cast portable barrier in lieu of barrels and cones), and shortening the schedule to reduce the overall project duration. With the conventional design-bid-build method, opportunities or incentives for these methods are likely minimal.
- **Encouraging contractor innovation can be a major benefit to design-build projects.** One of the major benefits of the design-build delivery method is that it allows the Contractor flexibility to generate and implement innovative ideas to shorten the project schedule, increase safety and mobility, and reduce project costs. It is important for the Agency to recognize the value of innovation in improving work zone safety and mobility. To encourage innovation, the Agency should avoid including very prescriptive requirements in the RFP that specify how to do something to allow the Contractor the opportunity to be innovative. While it is true that the Agency can be innovative in designing projects, in some cases ideas that originated from the Agency have been considered risky or not practical due to established Agency guidelines or because such ideas have not been used previously by the Agency. The design-build delivery method can be an effective way for the Contractor to deliver innovations that the Agency would not consider due to institutional or political concerns.

### RFP Development and Proposal Evaluation

- **Agency work zone traffic control staff should be involved in RFP development and proposal evaluation and selection.** The responsibility for the development and implementation of work zone traffic control in a design-build project lies largely with the Contractor. The traffic

engineering firm on the design-build team is critical to the success of the TMP and work zone traffic control plans. To include an appropriate level of scoring for safety and mobility elements in the proposal evaluation criteria, it is valuable to have work zone traffic control staff on the RFP development team and the evaluation and selection committee to ensure safety and mobility factors are adequately considered and weighed in the proposal process.

- **Proposal evaluation criteria and scoring are very important and should reflect the level of traffic management on the project.** The evaluation criteria and scoring, and the relative weight for each criterion, need to be carefully considered. Because the Contractor bears much of the responsibility for work zone traffic management in a design-build project, safety and traffic management related elements may need to be assigned more evaluation points to communicate to potential bidders that these elements are important and to ensure safety and mobility are given appropriate consideration during proposal evaluation and Contractor selection.
- **Value-based selection is important to successful work zone safety and mobility for a project.** It is critical that the owner to have safety, mobility and quality as part of the value-based criteria to communicate to bidders that these factors are important to the project owner and will be considered in proposal scoring. The owner should identify its goals and put together good specifications, and then review the proposals for indications of how the design-build team intends to provide for work zone safety and mobility during the project through design, MOT, public outreach, etc.
- **Use project specific guidance in the RFP.** There are cases where the owner's guidelines and/or procedural requirements are conflicting or vague. When this is the case, it is important that the RFP includes project specific guidance that supersedes policy material to ensure that clearly defined and unambiguous guidelines and requirements are specified.
- **Provisions should be included in the RFP to require that work zone traffic control issues are addressed in a timely manner.** Due to the fast moving nature of design-build projects, issues implementing the TMP and/or traffic control may not be addressed before the work associated with the issues has been completed and the work zone has been removed or altered to a new stage. Also, some of the usual means to address issues, such as withholding payment, are not available due to the lack of individual pay items. These issues can be addressed by including provisions in the RFP stating that work zone traffic control issues must be addressed within a specific time frame or monetary damages will be assessed.
- **Performance-based specifications in the RFP require measureable data for verification.** Performance-based specifications are difficult to use if appropriate data cannot be collected. It is important to identify data needs for performance-based specifications and define data collection responsibilities early in project development. Explicitly defining data needs and data collection responsibilities in the RFP is critical to ensure data required for performance-based specifications are captured.

## TMP Development and Implementation

- **Direct involvement by the Agency in reviewing TMPs may be more effective in reflecting Agency needs and expectations.** An Agency can benefit from using qualified staff within its organization to perform TMP review to ensure all standards, requirements, and Agency goals and expectations are met. An Agency may opt to hire a consultant, on behalf of the Agency, to review the TMP developed by the Contractor for a design-build project. The Agency should be aware that a potential conflict of interest may exist when a consultant reviews the work done by another consultant with whom it may have a business relationship with on other projects. The conflict of interest may hinder the consultant's ability to perform an unbiased review.
- **Make sure all parties are informed.** Subcontractors may not be on the job site every day and may not be as versed on the entire project. Effective communication mechanisms to deliver and pass on up-to-the-minute information on work progress between work shifts and locations is critical to maintain not only work progress but also safety and mobility within the work zone. For example, if a traffic control supervisor leading a night time ramp closure is unaware that an emergency lane closure occurred upstream during the previous shift, the planned ramp closure may be in conflict with the unplanned emergency lane closure. This type of situation can be avoided by establishing a well thought out communication method and making sure all parties are supplied with the necessary tools and/or up-to-minute information.
- **In monitoring TMP performance, recognize potential data sources and collaborate closely with them throughout the project.** Data are needed to assess the effectiveness of TMP implementation and whether adjustments to the TMP are needed, as well as to assess if performance-based specifications are being met. Parties other than the owner and the Contractor may be potential data collectors and sources. For instance, law enforcement agencies and towing companies may have crash data for after hours that are not collected by the owner or the Contractor.

## Quality Management

- **Successful implementation of a Quality Management Plan can save money.** Implementation of a comprehensive QMP leads to mutual understanding in roles and responsibilities; positive collaboration between the Owner, Designer, and Contractor; and increased commitment and subject knowledge by the developers of the QMP. This leads to efficient and effective utilization of resources, quality products, and cost savings for both the Owner and the Contractor.

## Team Capabilities

- **Agency staff needs to have knowledge and recognize the value of the Rule.** Buy in from all levels of Agency staff is important for Rule implementation. Applying the Rule to construction projects can be a major challenge if the Agency staff is not familiar with the Rule. Lack of familiarity with the Rule hinders the effective application of the Rule to work zones. For design-build projects, it hampers the Agency's ability to convey the key messages of the Rule to the Contractor provide guidance and oversight to the Contractor regarding implementation of the Rule, and adequately weight work zone safety and mobility factors in the proposal evaluation process.

- **Contractors need to be familiar with the Rule.** Contractor knowledge and buy-in is critical to effectively apply the Rule to projects. The Contractor's familiarity with the Rule is more important in design-build projects because the Contractor bears more responsibilities in work zone management. The Agency may need to educate the Contractor, and it may take time for the Contractor to realize the benefits of applying the Rule. Once the Contractor is familiar with the Rule, they tend to realize the benefits - more work gets done and the project does not suffer setbacks when the work zone is safer and less congested.
- **A trained Traffic Control Supervisor with knowledge on local guidelines and processes is beneficial.** A common characteristic of design-build projects is that many of the Contractor's workers come from out-of-State and often from a different design-build project that has been recently completed. These individuals may not be as versed on the guidelines, protocols, and policies that are unique to the Agency, the project, and other local stakeholder agencies (e.g. DNR, watershed district, EPA). Having a designated trained person with previous experience and expertise working in the particular State can be very beneficial.

## Coordination and Partnership

- **Project collaboration and good partnership are important to project efficiency and success.** It is important to have the project owner and the Contractor working together, forming a strong partnership, and identifying their common goals to lead to a more cooperative and efficient project. Establishing different task forces early on in the project to guide the development and review of quality and safety plans will lead to solid results and will be very beneficial throughout the project.
- **Key stakeholders should be brought in early on.** Improving work zone safety and mobility is a collective effort by all parties involved in the project. These include not only the Agency and the Contractor, but also other stakeholders. For a design-build project, early engagement and participation from stakeholders helps with building goals and expectations into the RFP to ensure the Contractor can develop a TMP that meets the Agency's needs and the project requirements. For example, involving incident management stakeholders early in the incident management planning during project development enhances work zone safety and mobility. While early engagement of incident management stakeholders in the design, RFP, and TMP development for design-bid-build projects is essential, it is even more critical for design-build projects as plan development is handed off to the Contractor.
- **The design-build delivery method promotes coordination and collaboration and builds a strong sense of ownership for all parties involved.** Due to the nature of the design-build process, all parties involved in the project (including the Agency and all members on the Contractor team) have to work collaboratively to ensure project success. The designer, traffic engineer, construction contractor, and the Agency all have to work closely throughout the project to successfully develop and implement the design, the TMP, and other aspects. This close working relationship helps build a strong sense of project ownership for all parties involved in a design-build project.



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