RTI
Semi-Annual Progress Report

Date of Report: August 29, 2008 **Project Number:** 9-4973 **RMC:** 5

Period Covered: [ ] September 1 – February 28/29 [X] March 1 – August 31

Project Title: Guidelines for Designing Bridge Piers and Abutments for Vehicle Collisions

Research Supervisor (name & agency): Gene Buth, TTI

Please see note about contract modification at the end of this report.

1. Progress to Date, by Task

Task # 1a.	**Task Name / Description** Literature Review
% Complete 100	**If task is complete, state when Technical Memorandum was submitted to RTI** *Tech memo pending. Will be submitted by Aug, 29, 2008*
Work Accomplished this Period (Brief description of work done and any major problems encountered.)	
Work Planned for next Reporting Period (Brief description of work planned.) Researchers will continue to monitor literature.	

Task # 1b.	**Task Name / Description** Computer simulations of vehicle/bridge column and abutment collisions
% Complete 75%	**If task is complete, state when Technical Memorandum was submitted to RTI**

Work Accomplished this Period (Brief description of work done and any major problems encountered.)

Simulation Matrix (Completed as of 1-8-08)					Force (Kips)	
	Pier Diameter (in)	**Vehicle/Mass**	**Container**	**Impact Speed (mph)**	**Engine Block**	**Ballast**
Matrix I	24	Dump Truck (65 klb)	Rigid	50	560	2490
	36	Dump Truck (65 klb)	Rigid	50	570	2430
	48	Dump Truck (65 klb)	Rigid	50	560	2160
Ballast Test Matrix	36	Dump Truck (65 klb)	Rigid	40	500	1470
	36	Dump Truck (65 klb)	Rigid	50	570	2430
	36	Dump Truck (19 klb)	Rigid	50	550	*No Ballast
Matrix II	36	Dump Truck (65 klb)	Rigid	40	500	1470
	36	Dump Truck (65 klb)	Rigid	50	570	2430
	36	Dump Truck (65 klb)	Deformable	60	590	-
	36	Tractor-Trailer (80 klb)	Rigid	60	-	-
	36	Tractor-Trailer (28 klb)	Rigid	60	460	-
	36	Tractor-Trailer (28 klb)	Rigid	50	510	-

Work Planned for next Reporting Period (Brief description of work planned.)

Simulations for the following collision conditions will be performed:

Proposed Ballast Test Matrix

- Rigid Ballast (spread across trailer floor area), 50 mph, 36” Rigid Pier, 80 K-lbs.
- Rigid Ballast (concentrated over axles), 50 mph, 36” Rigid Pier, 80 K-lbs.
- Deformable Ballast (spread across trailer floor area), 50 mph, 36” Rigid Pier, 80 K-lbs.
- Deformable Ballast (concentrated over axles), 50 mph, 36” Rigid Pier, 80 K-lbs.

Proposed Matrix I

- 40 mph, Rigid Ballast, 36” Rigid Pier
- 50 mph, Rigid Ballast, 36” Rigid Pier
- 60 mph, Rigid Ballast, 36” Rigid Pier

Proposed Matrix II

- 40 mph, Deformable Ballast, 36” Rigid Pier
- 50 mph, Deformable Ballast, 36” Rigid Pier
- 60 mph, Deformable Ballast, 36” Rigid Pier

Task #	Task Name / Description
1c.	Accident survey and analysis study
% Complete	**If task is complete, state when Technical Memorandum was submitted to RTI**
80%	

Work Accomplished this Period (Brief description of work done and any major problems encountered.)

Data have been obtained for seven highway collisions involving trucks and bridge piers as listed below:

#1 Accident location is County Road 2110 Over Pass #98 over IH-30 and it occurred on August 8, 1994. Bridge location is @ Mile Post 207 over IH-30 in Texarkana, Texas in Bowie County. The trooper interveiwed was Trooper Kevin Lorance and we have an accident report. Lance Simmons, P.E.is the Texas Department of Transportation contact and we have structural details. Truck weight at impact was 70-80K lbs. gross wt; Speed was 50-60 mph approx. and type of material or load was Industrial Steel Rolls.

#2 Accident location is Bridge @ IH-45 SB, (Chatfield Road over IH-45) and it occurred on May 30, 2007. Bridge location is @ IH-45 SB Mile Post 232 Corsicana, Texas in Navarro County. The trooper interviewd was Casey J. Crocker and we have an accident report. Tony Okafor, P.E. is the Texas Department of Transportation contact and we have structural details. Truck weight at impact was 80K lbs. gross wt.; Speed was 65-75 (approx. 70mph) and type of material or load was Home Products.

#3 Accident location is Bridge @ IH-37 North & US 181 South (Belden St.?)and it occurred on May 14, 2004. Bridge location is 109 ft. east of Tancahua St., Corpus Christi, Texas in Nueces County. The officers interviewed were M. Staff and C. Lynch and we have an accident report. Anthony Villarreal, P.E. is the Texas Department of Transpotation contact and we have structural details. Truck weight at impact was 72K lbs. gross wt.: Speed was 50-55 (approx. 52mph) and type of material or load was Chemical Butane (hazmat type).

#4 Accident location is Bridge @ IH35 & US 77, Red Oak, Texas and it occurred on July 7, 2005. Bridge location is @ Mile Post 409 SB IH 35E in Dallas County. The officer interviewed was Josh Newman and we have an accident report. Tony Okafor, P.E. is the Texas Department of Transportation contact and we have structural details. Truck weight at impact was 75-80K lbs. gross wt.; Speed was 60-70 (approx. 65mph) and type of material or load was TBA.

#5 Accident location is Bridge Pyka Road over IH-10 and occurred on January 28, 2004. Bridge location is @ Mile Post 717 on IH-10 in Austin County. The officer interviewed was Lt. Reese and we have an accident report. Kenny Ozuna, P.E. is the Texas Department of Transporation contact but we have no structural details. Truck weight at impact was 80K approx. gross wt.; Speed at impact was 60-70 (approx. 65mph) and type of material or load was a Load of Sheet Pilings.

#6 Accident location is Bridge @ IH45 & SH 14, Dallas, Texas and it occurred on September 8, 2002. Bridge location is @ Mile Post 219 on IH45, 7.4 Miles South Corsicana, Texas in Navarro County. The officer that was interviewed was Patrick Brice. Tony Okafor, P.E. is the Texas Department of Transportation contact, but we have no structural details. Truck weight at impact was 80K gross wt.; Speed at impact was 60-70 (approx. 65mph) and type of material or load was 3-4 Lg. Paper Reims.

#7 Accident location bridge over I-20 at Mile Post 519, Canton, TX. The accident occurred on August 18, 2008. A truck-tractor trailer (unloaded) impacted a 30-inch diameter pier and caused severe damage. The approximate speed of the truck was approximately 70 mph. A site visit was made on August 19, 2008 and officer Obie Phillips was interviewed. Photos were taken of the damaged pier and detailed drawings of the pier and bridge were obtained.

Work Planned for next Reporting Period (Brief description of work planned.)

Two additional accident sites have been identified and will be visited. Information for these collisions will be collected and analyzed.

Further analyses will be performed in attempts to quantify loads imposed on the piers involved in the collisions.

Task #	**Task Name / Description**
1d.	Development of a risk analysis methodology for vehicle/bridge column and abutment collusions (analogous to AASHTO LRFD vessel impact requirements)
% Complete	**If task is complete, state when Technical Memorandum was submitted to RTI**
50%	

Work Accomplished this Period (Brief description of work done and any major problems encountered.)

The purpose of this task is to develop a methodology for estimating the risk of a collision between a heavy vehicle and bridge columns. Over the last nine months, the research team collected crash data involving heavy vehicles (three axles or more) running-off-the-road and heavy vehicles hitting a bridge pier located on principle arterial highways in Texas, both controlled and non-controlled access facilities. The data collection also included information about the location of bridges on these highway segments that was provided by the Transportation Planning and Programming Division. Four years of data were collected (1998-2001). The sources of data were provided by DPS (Accident, Roadway Inventory, and Vehicle files) and TxDOT (TRM). The sample size consisted of 4,999 undivided segments and 4,214 divided segments.

Using these data two series of analyses were conducted. The first one consisted in developing a risk analysis methodology based on conditional probabilities, which involves the risk for a heavy vehicle to leave the traveled-way, and once it leaves the traveled-way, the probability for the vehicle to hit a bridge pier. The second methodology aimed at developing predictive models to estimate the risk for a heavy vehicle to hit a bridge pier as a function of the number of bridges crossing on top of the segments under study as well as other roadway characteristics.

Work Planned for next Reporting Period (Brief description of work planned.)

Given recent meetings among the TTI researchers, the methodologies need to be revised or updated to capture additional risk factors, if possible, that can influence the risk of a bridge pier collision involving a heavy vehicle. This may include the location of bridges on curves and the offset of the bridge piers with respect to the traveled-way. To support and validate the analysis carried out with the Texas data, the research team plans on using data from the State of Minnesota, a state that is part of the pooled fund study. The crash and roadway data are available via the FHWA's Highway Safety Information System (HSIS) managed by Highway Safety Research Center at the University of North Carolina. Additional information, such as the location of bridges on the segments, may be needed from the MnDOT. The research team may need the help of TxDOT for the initial contact with the MnDOT.

Task #	**Task Name / Description**
1e.	Detailed justification and work plan for research (if any) to be conducted under Phase 2 of the project

% Complete 0%	If task is complete, state when Technical Memorandum was submitted to RTI
Work Accomplished this Period (Brief description of work done and any major problems encountered.) Task scheduled to begin August 2008.	
Work Planned for next Reporting Period Work plan and supporting justification for research for phase 2 will be prepared and submitted to TxDOT	

Task # 1f.	Task Name / Description Provide facilities and host a meeting to present Phase 1 results to project sponsors, including pooled fund project contributors from other state DOT's
% Complete 0%	If task is complete, state when Technical Memorandum was submitted to RTI
Work Accomplished this Period (Brief description of work done and any major problems encountered.) Task scheduled to begin September 2008	
Work Planned for next Reporting Period The meeting will be scheduled and held.	

Task # 2a.	Task Name / Description Crash testing with a single unit truck to verify loading from Phase 1 literature survey and computer simulations.
% Complete 0%	If task is complete, state when Technical Memorandum was submitted to RTI
Work Accomplished this Period (Brief description of work done and any major problems encountered.) Task scheduled to begin October 2008	
Work Planned for next Reporting Period (Brief description of work planned.) None	

Task # 2b.	Task Name / Description Crash testing of a 5-axle tractor trailer rig to verify loading from phase 1 literature survey and computer simulations
% Complete 0%	If task is complete, state when Technical Memorandum was submitted to RTI
Work Accomplished this Period (Brief description of work done and any major problems encountered.) Task scheduled to begin October 2008	
Work Planned for next Reporting Period (Brief description of work planned.) None	

2. Progress to Date, by Deliverable

Deliverable #	Deliverable Description	Progress to Date &/or Date Submitted to RTI

P1	Guidelines supplementing current AASHTO LRFD Specifications for collision loads on piers and abutments, including example utilizing proposed methodology	Due 3-31-09 None
P2	Presentation materials in suitable format for use in introducing concepts and new methodology to bridge design engineers.	Due 3-31-09 None
R1	Research report comprehensively documenting all phase 1 work performed, including recommendations for Phase 2 work (if any).	Due 10-31-08 None
R2	Research report comprehensively documenting all Phase 2 work performed (if Phase 2 is conducted).	Due 05-31-09 None
PSR	Summary of work performed, findings, and conclusions.	Due 05-31-09 None

3. Equipment Purchases

Description of Equipment	Date Purchased	Task and / or Deliverable Directly Related to Equipment Purchase
No Equipment Requested		

The schedule and budget for this project are being revised to move some work and funds from FY'08 to FY'09. Delays were experienced during FY'08 that were beyond the researcher's control. CRIS accident data for performance of task 1d were not available until late in FY'08. The finite element model of a tractor/trailer for use in performing task 1b was not available as expected and is still not available. The researchers plan to work with an alternate finite element model of a trailer that they will adopt from a model of a single-unit truck box.

A request to move $200,000 of funds and a corresponding amount of work from FY'08 to FY'09 is being processed. Total funds will remain unchanged. The project completion date will need to be changed to August 31, 2009.