Guidelines for Designing Bridge Piers and Abutments for Vehicle Collisions

Texas Department of Transportation (TxDOT) Project #: 9-4973

Project Status Meeting

August 13, 2008

TxDOT Riverside Office

Texas Transportation Institute

Project Tasks Phase 1

- **Task 1a** - Literature Review
- **Task 1b** – Computer Simulations of Vehicle/Bridge Column and Abutment Collisions
- **Task 1c** - Accident Survey & Analysis Study
- **Task 1d** – Development of a Risk Analysis Methodology for Vehicle/Bridge Column and Abutment Collisions
- **Task 1e** – Detailed Justification and Work Plan for Research to be Conducted under Phase 2.
- **Task 1f** – Provide Facilities and a Host Meeting to Present Phase 1 Results to Project Sponsors.

Texas Transportation Institute

Project Tasks Phase 2

- **Task 2a** – Crash Testing with a Single Unit Truck to Verify Loading From Phase 1 Literature Survey and Computer Simulations
- **Task 2b** – Full-Scale Crash Testing of a 5-Axle Tractor Trailer Rig to Verify Loading from Liter. Survey & Computer Simulations

Texas Transportation Institute

Task 1a - Literature Review

- A thorough Literature review of available information on large truck collisions with bridge piers has been completed.

Texas Transportation Institute

Task 1c - Accident Survey & Analysis Study

- Data from several highway accidents involving large trucks colliding with bridge piers has been collected. A brief review of data from two of the accidents is presented as follows.
- Task is 80% complete

Texas Transportation Institute

Semi Tractor-Trailer Crash
FM 2110 Bridge Over I-30,
Texarkana, TX, August 8, 1994
80,000 lbs. @ 65 mph w/
30-inch Pier

Texas Transportation Institute

Texas Transportation Institute

Texas Transportation Institute

Texas Transportation Institute

Semi Tractor-Trailer Crash
FM 3041 Bridge Over I-45, Corsicana, TX, May 30, 2007
80,000 lbs., est. 60 mph w/ 30-inch Pier

Texas Transportation Institute


05/30/2007

Transportation Institute

Texas Transportation Institute

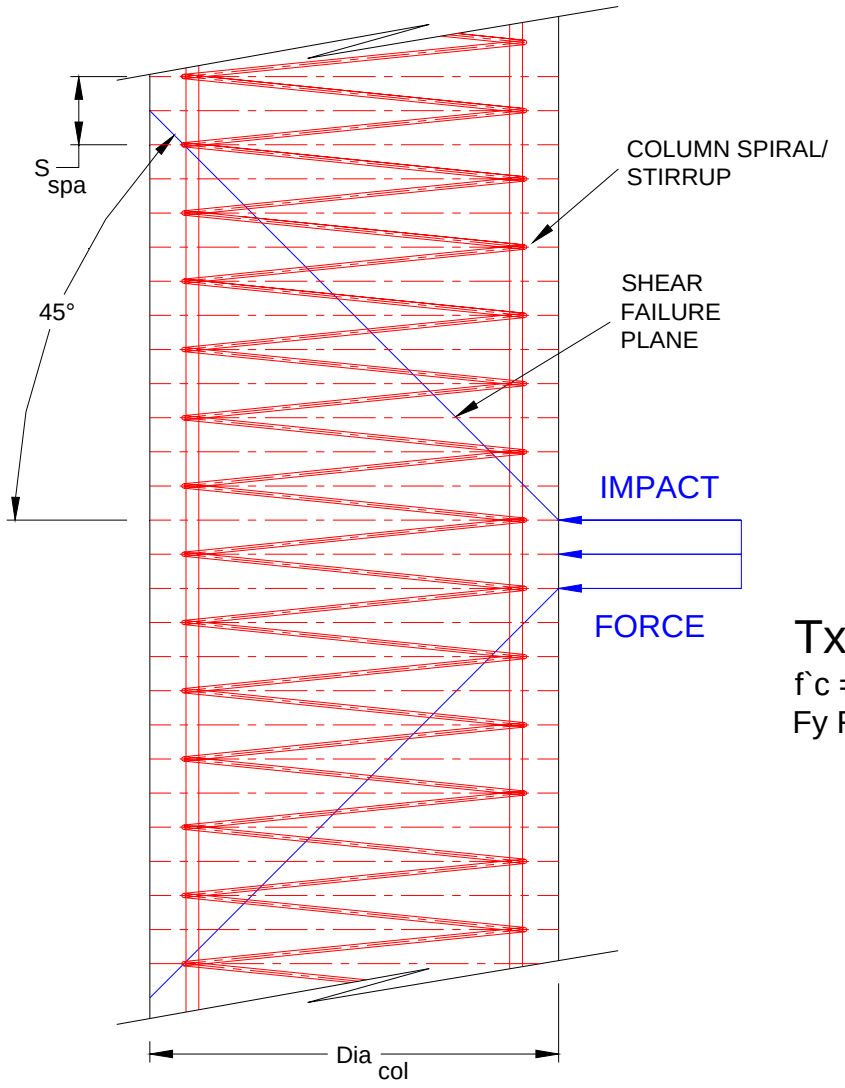

Transportation
Institute

Task 1c – Calculations to Quantify Pier Shear Capacities

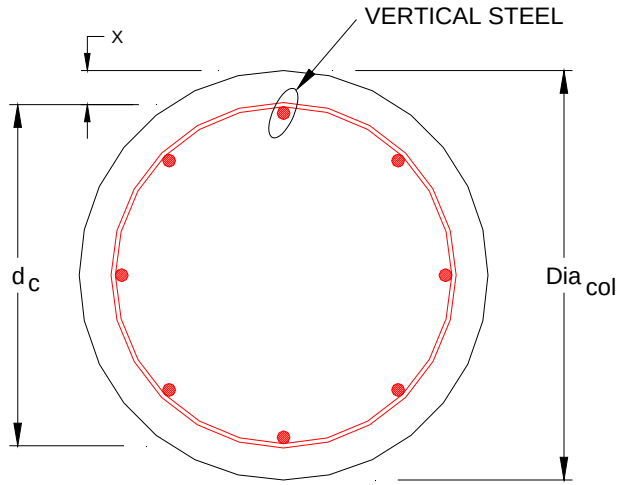
- Standard TxDOT Pier Details Where Obtained and Investigated
- Analytical Pier Shear Capacities were performed with Respect to American Concrete Institute (ACI) Specifications 318-R-05 Chapter 11 “Shear And Torsion”.

Texas Transportation Institute

Circular Pier Shear Failure Mechanism & Details



COLUMN SIDE VIEW



COLUMN SECTION

TxDOT STANDARD PIER DETAILS

f`c = 3600 psi

Fy Rebar = 60 ksi

Summary of Calculated Circular Concrete Pier Shear Capacities

Calculated Circular Concrete Pier Shear Capacities					
Diameter Pier (in.)	Stirrup Size	d_c Spiral Stirrup Diameter (in.)	V_c Concrete Shear Cap. (kips)	V_s Nom. Shear Stirrups (kips)	$V_n = V_c + V_s$ Nom. Shear Pier (kips)
24	#3	18	124.3	106	230.3
30	#3	24	186.6	132.5	319.1
36	#3	30	262.6	159	421.6
42	#5	36	352.4	515.4	867.8

Texas Transportation Institute

Task 1b – Computer Simulations of Vehicle/Bridge Column and Abutment Collisions

- Simulation Analysis Update & Approach
- Task is 75% complete

Texas Transportation Institute

Dump-Truck Matrix Study

- **Matrix I – Pier diameter study**
  - 50 mph
  - Rigid Ballast
  - 24”, 36” & 48” Rigid Pier
- **Ballast Test Matrix**
  - 36” Rigid Pier
  - 40 mph, 65 k-lbs., Rigid Ballast
  - 50 mph, 65 k-lbs., Rigid Ballast
  - 50 mph, 19 k-lbs., No Ballast
- **Matrix II**
  - Rigid Ballast
  - 36” Rigid Pier
  - 40 & 50 mph
- **Matrix III**
  - Deformable Ballast
  - 36” Rigid Pier
  - 40, 50 & 60 mph

Texas Transportation Institute

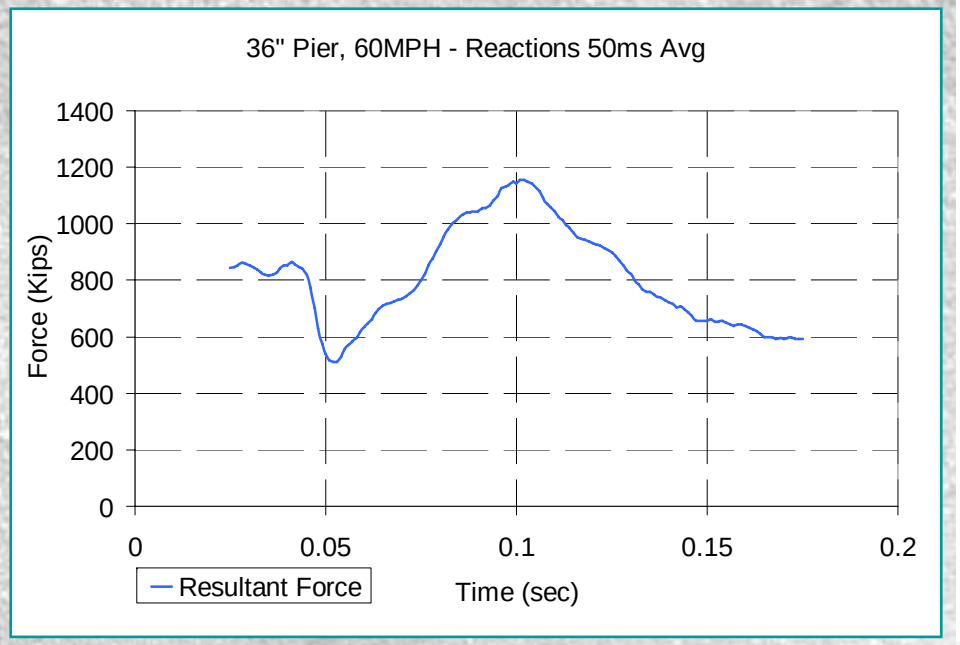
Tractor Trailer Matrix Study

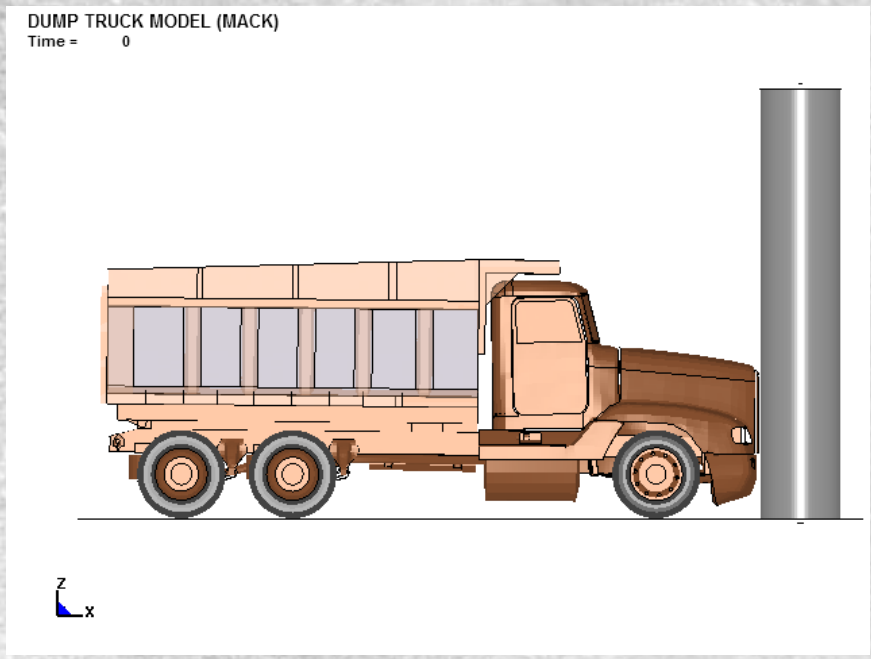
- **Planned Ballast Test Matrix**
  - 50 mph
  - 36” Rigid Pier
  - 80 K-Lbs.
  - Rigid Ballast (spread across trailer area)
  - Rigid Ballast (concentrated over axles)
  - Deformable Ballast (spread across trailer area)
  - Deformable Ballast (concentrated over axles)
- **Planned Matrix I**
  - Rigid ballast
  - 36” Rigid Pier
  - 40, 50 & 60 mph
- **Planned Matrix II**
  - Deformable Ballast
  - 36” Rigid Pier
  - 40, 50 & 60 mph

Texas Transportation Institute

Dump-Truck with Deformable Ballast

60 mph impact into 36” diameter rigid pier

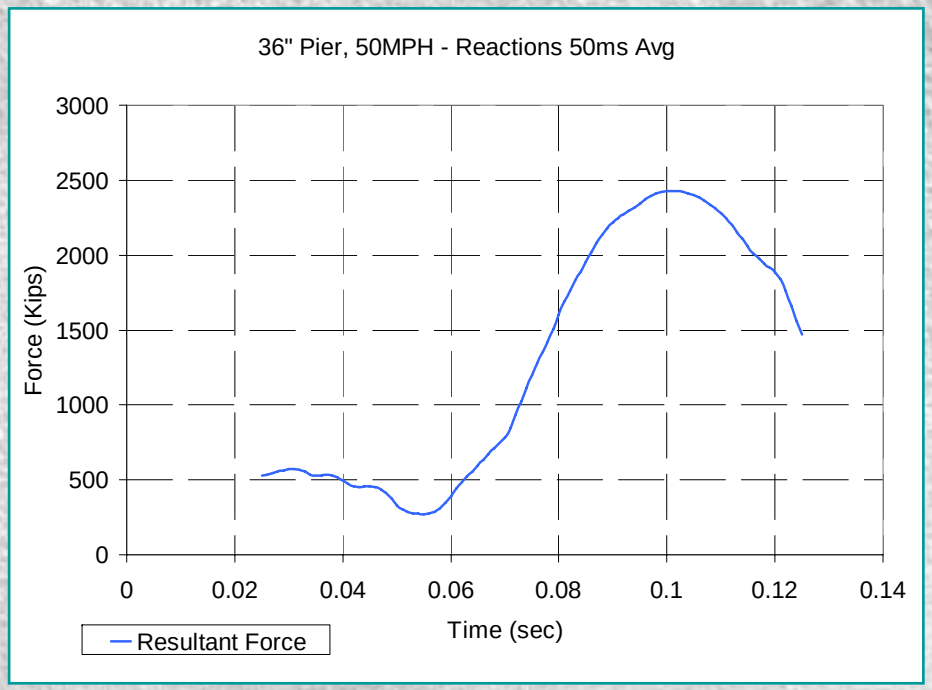


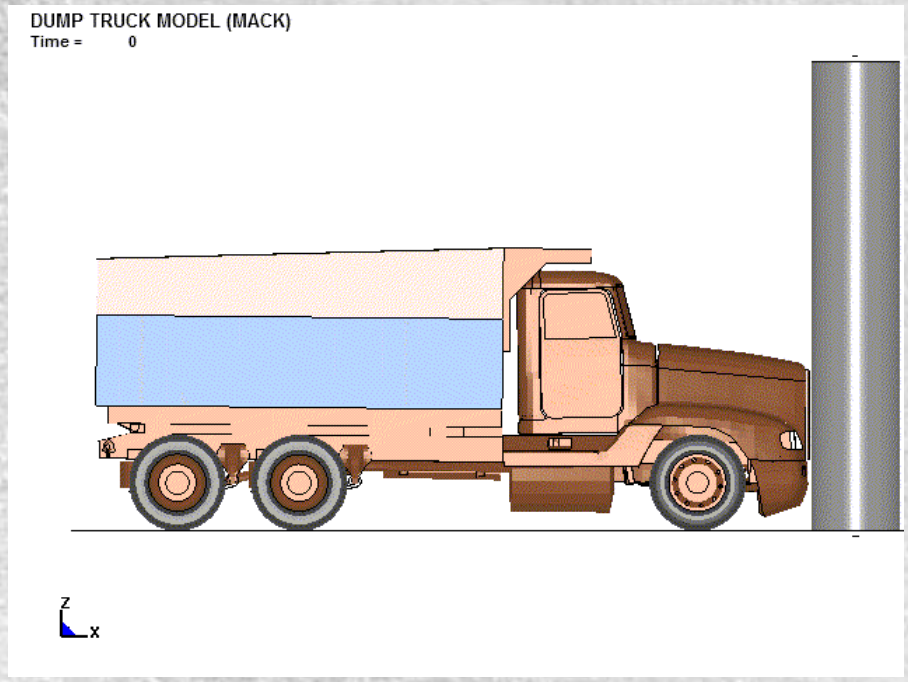


Texas Transportation Institute

Dump-Truck with Rigid Ballast

50 mph impact into 36” diameter rigid pier

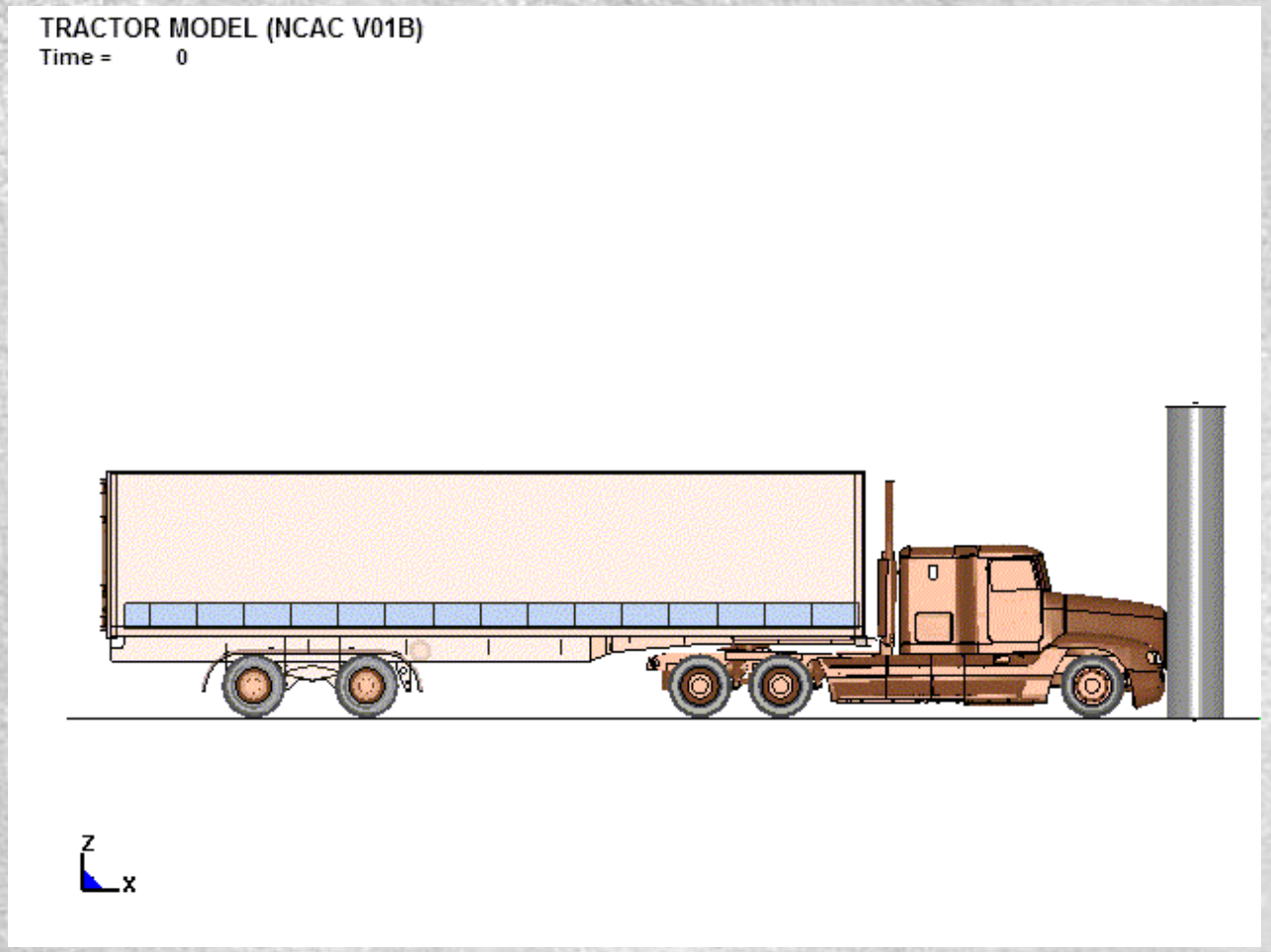




Texas Transportation Institute

Tractor Trailer with Rigid Ballast

60 mph impact into 36” diameter rigid pier



Texas Transportation Institute

Task 1d – Development of a Risk Analysis Methodology for Vehicle /Bridge Column and Abutment Collisions

- Texas accident data used
- Minnesota accident data to be used
- Task is about 50% complete

Texas Transportation Institute