Guidelines for Designing Bridge Piers and Abutments for Vehicle Collisions

State Pooled fund Study: TPF-5(106)
Panel Meeting
April 14, 2009
Texas Transportation Institute

Phase 1a Literature Review & 1c Accident Survey

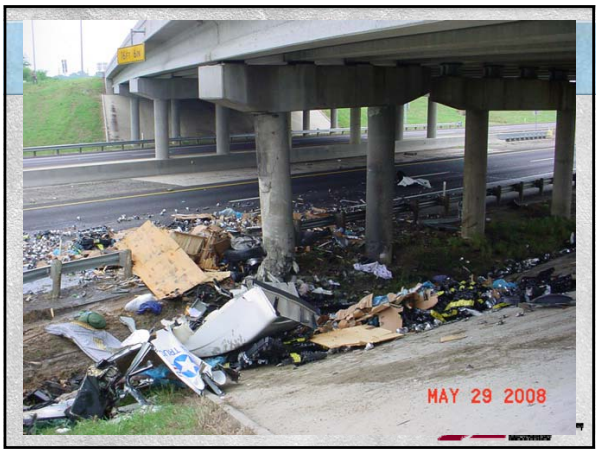
- A thorough Literature review of available information on large truck collisions with bridge piers has been completed.
- Data from several highway accidents (19) involving large trucks colliding with bridge piers has been collected. A brief review of data from three of the accidents is presented as follows.

Accident #1: Semi Tractor-Trailer Crash
FM 2110 Bridge Over I-30,
Texarkana, TX, August 8, 1994
80,000 lbs. @ 65 mph w/
30-inch Pier

Accident #2: Semi Tractor-Trailer Crash
FM 3041 Bridge Over I-45, Corsicana, TX, May 30, 2007
<80,000 lbs., est. 65 mph w/ 30-inch Pier

Accident #7: Semi Tractor-Trailer Crash
Pyke Road Bridge Over I-10, Sealy, TX, January 28, 2004
Approx. 80,000 lbs., est. 50 mph w/
30-inch Pier

Accident #18: Semi Tractor-Trailer Crash
FM-1401 Bridge Over IH-30,
Mount Pleasant, TX,
May 29, 2008
Approx. 80,000 lbs., est. 65 mph w/
30-inch Pier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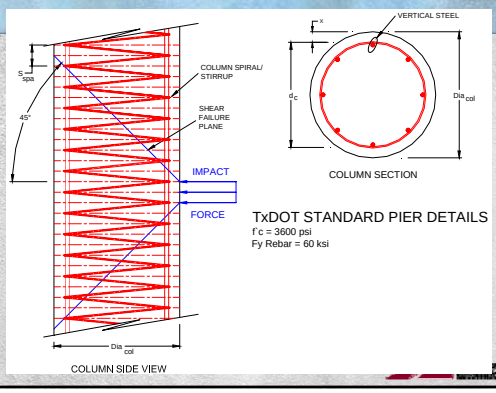
Phase 1c – Calculations to Quantify Pier Shear Capacities

- From accident investigations, TxDOT pier details (and others) 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”.

Observed Failure Mechanism

Circular Pier Shear Failure Mechanism & Details



Summary of Calculated Circular Concrete Pier Shear Capacities

Table 1 - Shear Capacities of Circular Piers From Accident Investigations

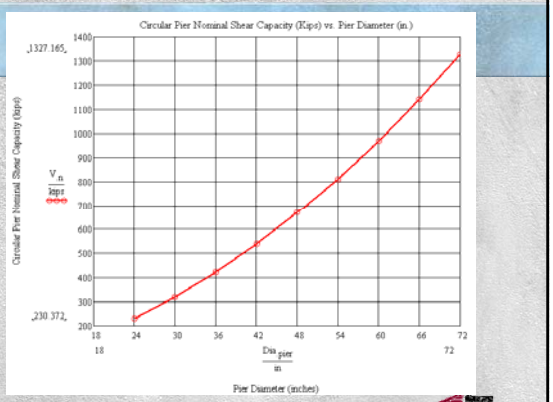
Accident No.	Pier Dia. (in.)	Design (Estimated) Con. Comp. Str. (psi)	Shear Reinfor. Size	Vertical Reinforc.	Calc.Shear Cap. (kips)*
1	30	3050 (4000)	#2 - 6" Pitch	8 - #9's Eq. Spa.	230.6 (255.6)
2	30	3050 (4000)	#2 - 6" Pitch	8 - #9's Eq. Spa.	230.6 (255.6)
3	30	3050 (4000)	#2 - 6" Pitch	8 - #9's Eq. Spa.	230.6 (255.6)
4	30	3050 (4000)	#2 - 6" Pitch	8 - #9's Eq. Spa.	230.6 (255.6)
5	30	3050 (4000)	#2 - 6" Pitch	8 - #9's Eq. Spa.	230.6 (255.6)
7	30	3050 (4000)	#2 - 6" Pitch	8 - #9's Eq. Spa.	230.6 (255.6)
8	30	3050 (4000)	#3 - 6" Pitch	8 - #9's Eq. Spa.	304.3 (329.2)
10	24	3050 (4000)	#2 - 6" Pitch	8 - #7's Eq. Spa.	161.6 (178.2)
17	32	4300 (5500)	#4 - 6" Pitch	9 - #9's Eq. Spa.	481.2 (511.3)
18	30	4300 (5500)	#3 - 6" Pitch	8 - #9's Eq. Spa.	304.3 (329.2)
19	30	4300 (5500)	#2 - 6" Pitch	8 - #9's Eq. Spa.	230.6 (255.6)

* - Design (Estimated) Concrete Compressive Strength

Summary of Calculated Shear Capacities For Variable Pier Diameters

Table 2 - Calculated Shear Capacities For Different Pier Diameters

Pier Dia. (in.)	Design Con. Comp. Str. (psi)	Shear Reinfor. Size	Calc.Shear Cap. (kips)
24	3600	#3 - 6 " Pitch	230
30	3600	#3 - 6 " Pitch	319
36	3600	#3 - 6 " Pitch	422
42	3600	#3 - 6 " Pitch	538
48	3600	#3 - 6 " Pitch	668
54	3600	#3 - 6 " Pitch	812
60	3600	#3 - 6 " Pitch	970
66	3600	#3 - 6 " Pitch	1142
72	3600	#3 - 6 " Pitch	1327



Phase 1 – Summary of Literature & Calculations to Quantify Pier Shear Capacities ….Questions?