Federal Railroad Administration
Office of Safety
Headquarters Assigned
Accident Investigation Report
HQ-2005-01

CSX Transportation (CSX)
Glenco, Kentucky
January 5, 2005

Note that 49 U.S.C. §20903 provides that no part of an accident or incident report made by the Secretary of Transportation/Federal Railroad Administration under 49 U.S.C. §20902 may be used in a civil action for damages resulting from a matter mentioned in the report.

DEPARTMENT OF TRANSPORTATION
FEDERAL RAILROAD ADMINISTRATION

FRA FACTUAL RAILROAD ACCIDENT REPORT

FRA File # HQ-2005-1

1.Name of Railroad Operating Train #1: CSX TRANSPORTATION	1a. Alphabetic Code: CSX	1b. Railroad Accident/Incident No.: 000009180
2.Name of Railroad Operating Train #2: N/A	2a. Alphabetic Code: N/A	2b. Railroad Accident/Incident: N/A
3.Name of Railroad Responsible for Track Maintenance: CSX Transportation [CSX]	3a. Alphabetic Code: CSX	3b. Railroad Accident/Incident No.: 000009180
4. U.S. DOT_AAR Grade Crossing Identification Number:	5. Date of Accident/Incident: Month 01 / Day 05 / Year 2005	6. Time of Accident/Incident: 03:04: ☑ AM ☐ PM

7. Type of Accident/Indicent (single entry in code box): 1. Derailment; 2. Head on collision; 3. Rear end collision; 4. Side collision; 5. Raking collision; 6. Broken Train collision; 7. Hwy-rail crossing; 8. RR grade crossing; 9. Obstruction; 10. Explosion-detonation; 11. Fire/violent rupture; 12. Other impacts; 13. Other (describe in narrative): 01

8. Cars Carrying HAZMAT	9. HAZMAT Cars Damaged/Derailed	10. Cars Releasing HAZMAT	11. People Evacuated	12. Division
0	0	0	0	LOUISVILLE

13. Nearest City/Town	14. Milepost (to nearest tenth)	15. State Abbr	15. State Code	16. County
GLENCOE	73.6	N/A	KY	GRANT

17. Temperature (F) (specify if minus)	18. Visibility (single entry) 1. Dawn 2. Day 3.Dusk 4.Dark	Code	19. Weather (single entry) 1. Clear 2. Cloudy 3. Rain 4. Fog 5.Sleet 6.Snow	Code	20. Type of Track 1. Main 2. Yard 3. Siding 4. Industry	Code
45 F		4		4		1

21. Track Name/Number	22. FRA Track Class (1-9, X)	Code	23. Annual Track Density (gross tons in millions)	24. Time Table Direction 1. North 3. East	Code
LCL Main Line		2	34.8		2

OPERATING TRAIN #1

25. Type of Equipment Consist (single entry): 1. Freight train; 2. Passenger train; 3. Commuter train; 4. Work train; 5. Single car; 6. Cut of cars; 7. Yard/switching; 8. Light loco(s).; 9. Maint./inspect.car; A. Spec. MoW Equip. — Code: 1

26. Was Equipment Attended? 1. Yes 2. No — Code: 1

27. Train Number/Symbol: Q23103

28. Speed (recorded speed, if available) R - Recorded E - Estimated: 7 MPH — Code: R

29. Trailing Tons (gross tonnage, excluding power units): 3170

30. Method(s) of Operation (enter code(s) that apply): a. ATCS; b. Auto train control; c. Auto train stop; d. Cab; e. Traffic; f. Interlocking; g. Automatic block; h. Current of traffic; i. Time table/train orders; j.Track warrant control; k. Direct traffic control; l.Yard limits; m.Special instructions; n. Other than main track; o. Positive train control; p. Other (Specify in narrative) Code(s): g, k, N/A, N/A, N/A

30a. Remotely Controlled Locomotive? 0 = Not a remotely controlled; 1 = Remote control portable; 2 = Remote control tower; 3 = Remote control transmitter - more than one remote control transmitter: 0

31. Principal Car/Unit	a. Initial and Number	b. Position in Train	c. Loaded (yes/no)
(1) First involved (derailed, struck, etc)	N/A	1	yes
(2) Causing (if mechanical cause reported)	0	0	N/A

32. If railroad employee(s) tested for drug/alcohol use, enter the number that were positive in the appropriate box.

Alcohol	Drugs
0	0

33. Was this consist transporting passengers? (Y/N): N

34. Locomotive Units	a. Head End	Mid Train b. Manual	Mid Train c. Remote	Rear End d. Manual	Rear End c. Remote
(1) Total in Train	2	0	0	0	0
(2) Total Derailed	1	0	0	0	0

35. Cars	Loade a. Freight	Loade b. Pass.	Empty c. Freight	Empty d. Pass.	e. Caboose
(1) Total in Equipment Consist	41	0	0	0	0
(2) Total Derailed	6	0	0	0	0

36. Equipment Damage This Consist	37. Track, Signal, Way, & Structure Damage	38. Primary Cause Code	39. Contributing Cause Code
179657	20000	T499	N/A

Number of Crew Members

40. Engineer/ Operators	41. Firemen	42. Conductors	43. Brakemen
N/A	0	1	0

Length of Time on Duty

44. Engineer/Operator: Hrs 8 Mi 10

45. Conductor: Hrs 8 Mi 10

Casualties to:	46. Railroad Employees	47. Train Passengers	48. Other
Fatal	0	0	0
Nonfatal	N/A	0	0

49. EOT Device? 1. Yes 2. No — 1

50. Was EOT Device Properly Armed? 1. Yes 2. No — 1

51. Caboose Occupied by Crew? 1. Yes 2. No — 2

OPERATING TRAIN #2

52. Type of Equipment Consist (single entry): 1. Freight train; 2. Passenger train; 3. Commuter train; 4. Work train; 5. Single car; 6. Cut of cars; 7. Yard/switching; 8. Light loco(s).; 9. Maint./inspect.car; A. Spec. MoW Equip. — Code: N/A

53. Was Equipment Attended? 1. Yes 2. No — Code: N/A

54. Train Number/Symbol: N/A

55. Speed (recorded speed, if available) R - Recorded E - Estimated: 0 MPH — Code: N/A

57. Method(s) of Operation (enter code(s) that apply): a. ATCS; b. Auto train control; g. Automatic block; h. Current of traffic; m.Special instructions; n. Other than main track

57a. Remotely Controlled Locomotive? 0 = Not a remotely controlled; 1 = Remote control portable

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56. Trailing Tons (gross tonnage, excluding power units)	c. Auto train stop d. Cab e. Traffic f. Interlocking	i. Time table/train orders j.Track warrant control k. Direct traffic control l.Yard limits	o. Positive train control p. Other (Specify in narrative) Code(s)	2 = Remote control tower 3 = Remote control transmitter - more than one remote control transmitter
0			N/A N/A N/A N/A N/A	N/A

58. Principal Car/Unit	a. Initial and Number	b. Position in Train	c. Loaded (yes/no)	59. If railroad employee(s) tested for drug/alcohol use, enter the number that were positive in the appropriate box.	Alcohol	Drugs
(1) First involved (derailed, struck, etc)	0	0	N/A		0	0
(2) Causing (if mechanical cause reported)	0	0	N/A	60. Was this consist transporting passengers? (Y/N)	N/A	

61. Locomotive Units	a. Head End	Mid Train b. Manual	Mid Train c. Remote	Rear End d. Manual	Rear End c. Remote
(1) Total in Train	0	0	0	0	0
(2) Total Derailed	0	0	0	0	0

62. Cars	Loade a. Freight	Loade b. Pass.	Empty c. Freight	Empty d. Pass.	e. Caboose
(1) Total in Equipment Consist	0	0	0	0	0
(2) Total Derailed	0	0	0	0	0

63. Equipment Damage This Consist	64. Track, Signal, Way, & Structure Damage	65. Primary Cause Code	66. Contributing Cause Code
0	0	N/A	N/A

Number of Crew Members				Length of Time on Duty	
67. Engineer/ Operators	68. Firemen	69. Conductors	70. Brakemen	71. Engineer/Operator	72. Conductor
0	0	0	0	Hrs 0 Mi 0	Hrs 0 Mi 0

Casualties to:	73. Railroad Employees	74. Train Passengers	75. Other
Fatal	0	0	0
Nonfatal	0	0	0

76. EOT Device? (1. Yes 2. No)	77. Was EOT Device Properly Armed? (1. Yes 2. No)	78. Caboose Occupied by Crew? (1. Yes 2. No)
N/A	N/A	N/A

Highway User Involved

79. Type	Code
A. Auto B. Truck C. Truck-Trailer. D. Pick-Up Truck E. Van F. Bus G. School Bus H. Motorcycle J. Other Motor Vehicle K. Pedestrian M. Other (spec. in narrative)	N/A

80. Vehicle Speed (est. MPH at impact)	81. Direction geographical) 1.North 2.South 3.East 4.West	Code
0		N/A

82. Position	Code
1.Stalled on Crossing 2.Stopped on Crossing 3.Moving Over Crossing 4. Trapped	N/A

86a. Was the highway user and/or rail equipment involved in the impact transporting hazardous materials? (1. Highway User 2. Rail Equipment 3. Both 4. Neither)	Code
	N/A

Rail Equipment Involved

83. Equipment	Code
1.Train(units pulling) 2.Train(units pushing) 3.Train (standing) 4.Car(s) (moving) 5.Car(s) (standing) 6.Light Loco(s) (moving) 7.Light(s) (standing) 8.Other (specify in narrative)	N/A

84. Position of Car Unit in Train
0

85. Circumstance	Code
1. Rail Equipment Struck Highway User 2. Rail Equipment Struck by Highway User	N/A

86b. Was there a hazardous materials release by (1. Highway User 2. Rail Equipment 3. Both 4. Neither)	Code
	N/A

86c. State here the name and quantity of the hazardous materials released, if any.
N/A

87. Type of Crossing Warning (1.Gates 2.Cantilever FLS 3.Standard FLS 4.Wig Wags 5.Hwy. traffic signals 6.Audible 7.Crossbucks 8.Stop signs 9.Watchman 10.Flagged by crew 11.Other (spec. in narr.) 12.None)	88. Signaled Crossing Warning (See instructions for codes) Code	89. Whistle Ban (1. Yes 2. No 3. Unknown) Code
Code(s) N/A N/A N/A N/A N/A N/A N/A		N/A

90. Location of Warning (1. Both Sides 2. Side of Vehicle Approach 3. Opposite Side of Vehicle Approach)	Code	91. Crossing Warning Interconnected with Highway Signals (1. Yes 2. No 3. Unknown)	Code	92. Crossing Illuminated by Street Lights or Special Lights (1. Yes 2. No 3. Unknown)	Code
	N/A		N/A		N/A

93. Driver's Age	94. Driver's Gender (1. Male 2. Female)	Code	95. Driver Drove Behind or in Front of Train and Struck or was Struck by Second Train (1. Yes 2. No 3. Unknown)	Code	96. Driver (1. Drove around or thru the Gate 2. Stopped and then Proceeded 3. Did not Stop 4. Stopped on Crossing 5. Other (specify in narrative))	Code
N/A		N/A		N/A		N/A

97. Driver Passed Standing Highway Vehicle (1. Yes 2. No 3. Unknown)	Code	98. View of Track Obscured by (primary obstruction) (1. Permanent Structure 2. Standing Railroad Equipment 3. Passing Train 4. Topography 5. Vegetation 6. Highway Vehicle 7. Other (specify in narrative) 8. Not obstructed)	Code
	N/A		N/A

101. Casulties to Highway-Rail Crossing Users	Killed	Injured
	N/A	N/A

99. Driver Was (1. Killed 2.Injured 3. Uninjured)	Code
	N/A

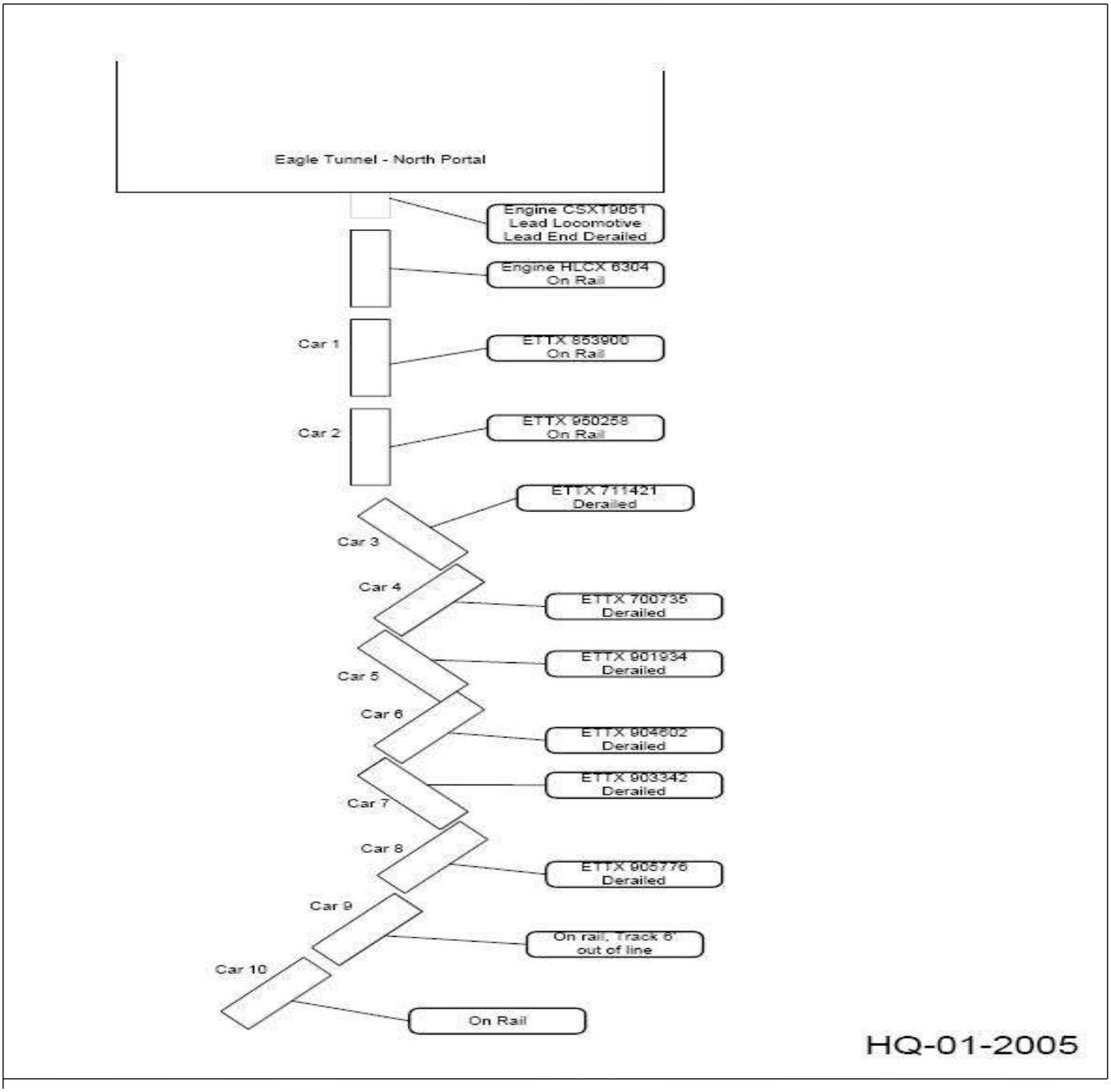
100. Was Driver in the Vehicle? (1. Yes 2. No)	Code
	N/A

102. Highway Vehicle Property Damage (est. dollar damage)	103. Total Number of Highway-Rail Crossing Users (include driver)
0	N/A

104. Locomotive Auxiliary Lights? (1. Yes 2. No)	Code	105. Locomotive Auxiliary Lights Operational? (1. Yes 2. No)	Code
	N/A		N/A

106. Locomotive Headlight Illuminated? (1. Yes 2. No)	Code	107. Locomotive Audible Warning Sounded? (1. Yes 2. No)	Code
	N/A		N/A

108. DRAW A SKETCH OF ACCIDENT AREA INCLUDING ALL TRACKS, SIGNALS, SWITCHES, STRUCTURES, OBJECTS, ETC., INVOLVED.
HQ-1-2005
sketch.jpg



109. SYNOPSIS OF THE ACCIDENT

On January 5, 2005, at 3:04 a.m. Eastern Standard Time (EST), a southbound CSX Transportation (CSX) train Q23103 derailed after impacting a collapsed tunnel. The crew consisted of an engineer and conductor. They reported for duty on January 4, 2005 at 7 p.m. in Cincinnati, Ohio (OH). Train Q23103 consisted of two locomotives, CSX 9051 in the lead, and HLCX 6304 trailing with 41 loaded automobile carriers. Train Q23103 was 3,904 feet in length with 3,170 trailing tons. It originated at Roguemere Yard in Detroit, Michigan (MI), destined for Louisville, KY.

The southbound train was traveling about 17 miles per hour (mph) before the derailment. The event recorder showed that an emergency brake application was initiated about six seconds before impact, slowing the train to a recorded speed of seven mph. The derailment occurred about 40 feet inside the north portal of Eagle Tunnel.

The lead truck of CSX 9051 derailed upon impact, while the second locomotive remained on the rail. The first and second cars remained on the rail, and the third through the eighth car derailed accordion style. Both crew members sustained non-life threatening injuries requiring medical attention and were examined at Saint Mary Elizabeth Hospital in Williamstown, KY.

The derailment occurred on CSX Louisville Division, LCL Subdivision on single main track at milepost (MP) T73.6, near the city of Glencoe, KY. The maximum allowable timetable speed is 35 miles per hour (MPH) north of the tunnel, and 25 mph through the tunnel as shown in the CSX Louisville division timetable No. 3. The method of operation on the LCL subdivision is Direct Traffic Control System (DTC), with Automatic Block Signal (ABS) Rules.

Damages include $20,000 to track and $179,657 to equipment. This does not include lading damage of automobiles, excavation, detour, or tunnel repairs.

At the time of the accident it was dark, rainy, with patches of fog. The temperature was 45 F.

The probable cause of the accident is the Eagle Tunnel collapsed, causing a substantial debris pile that obstructed the track.

110. NARRATIVE

Circumstances prior to the Accident

The crew of train Q23103 included a locomotive engineer and a conductor. They first reported for duty at 7 p.m., January 4, in Louisville, KY, their home terminal. They were transported to Cincinnati, OH to pick up their assigned train Q23103. Both employees received proper rest under the Federal Hours of Service Law before reporting for duty.

Train Q23103 consisted of two locomotives, CSX 9051 in the lead, HLCX 6304 trailing, and 41 loaded automobile carriers. It was 3,904 feet in length with 3,170 trailing tons. The crew completed a Class 1 air brake test and departed Cincinnati MP T101.4 on January 5, at 12:34 a.m. At 12:52 a.m., train Q23103 went into an undesired emergency at MP T81.05 due to an air hose separation at the 22nd car. The crew repaired the air hose, completed a brake test, and continued south at 1:46 a.m. At 2:10 a.m. train Q23103 made another unscheduled stop at MP T75.31, due to low air pressure on the rear-end train device. They completed the repairs, performed another brake test and continued south at 2:58 a.m. They were operating the train at a recorded speed of 17 mph.

As the southbound train approached the accident area, the locomotive engineer was seated at the controls on the west side of the leading locomotive and the conductor was seated on the east side. The engineer and conductor both observed an obstruction in the track while approaching Eagle Tunnel. Approaching the north end of Eagle Tunnel the track is tangent with a 1.07 percent descending grade.

The CSX timetable direction of train Q23103 was south. Timetable direction is used for this report.

The Accident

Both the engineer and conductor said as they approached the Eagle Tunnel they saw what looked like fog inside the north portal of the tunnel. As the lead locomotive entered into the tunnel, the engineer realized a large pile of debris was blocking the track. At 3:04 a.m., the engineer put the train into emergency and six seconds later struck the pile of debris in the tunnel at a recorded speed of seven mph.

The first set of trucks on lead locomotive (CSX 9051) derailed upon impact. The second locomotive (HLCX 6304) remained upright on the rail. The first and second cars remained on the rail. The third through eighth car derailed accordion style, and the remaining cars remained on the rail. Upon impact, the engineer and conductor fell out of their seats onto the floor of the locomotive, immediately got up and exited out the rear door.

Once outside the locomotive, the conductor rested on the ground due to a injured knee. The engineer attempted to contact the CSX train dispatcher with his hand held radio, but was unsuccessful. He also attempted to contact CSX train 508 for help, but was unsuccessful. The engineer climbed up the embankment to see if he could locate anyone to help. At that time he met a Kentucky State Trooper and the Dry Ridge Fire Department and Rescue team, who had been notified of the accident. The rescue team lowered a rope down to retrieve the conductor up the embankment. The engineer and conductor were transported to Saint Mary Elizabeth Hospital in Williamstown, KY where they received medical attention. The train crew sustained non-life threatening injuries and were both released the same day.

Analysis and Conclusions:

Analysis

The tunnel is 636 feet long, and believed to be originally built around the late 1870's. Tunnel construction is a rock bore through shale, right circular arch constructed arch liner of brick / steel combination, brick abutment walls set upon large quarry cut stone foundation bearings founded on shale bed rock. The tunnel liner to the best available information was constructed of four brick courses thick in the arch barrel spring line to spring line. The abutment walls are six brick courses thick from the bearing stones two thirds of the way up the wall, then five courses thick to the spring line. The tunnel has Masonry portals. Eagle Tunnel has undergone six tunnel clearance projects, three of the projects were under CSX ownership as follows:

1997 – Clearance project, lower, cut down bed rock invert to lower track.
2000 – Clearing ditch line of debris.
2004 – Repairs to the north end of the tunnel, bench wall and underpin foundation.

Various modifications have been made to the tunnel liner, and cutting down into the bedrock for higher car clearances. The east wall about 40 to 60 feet south of the collapse area showed several locations with more undercutting than other areas within the entire length of both sides of the tunnel. Undercutting under the east wall appeared to be the most severe. The width of the abutment wall, measured through a weep hole, was about 36-inches wide. The depth of bedrock undercut varied from 21 inches deep under the bearing stones, about 30 foot in length longitudinally under the wall, this leaving less than half of the foundation supported. This along with signs of unstable shale bedrock shelling into the ditch line creates concern for foundation integrity in this area.

Directly above this excessively undercut area there was a longitudinal crack in the gunite coating, and the brick liner east of the arch crown running about 20 feet to a point south. It appeared to run down to the spring line on a 45 degree angle. In this area there was a slight rotation in towards the bottom of the east wall. There was no excessive water flow, or infiltration through the tunnel liner observed outside what would be considered normal spot wetness. Normal water volume flowed in both ditch lines through the tunnel.

A portion of the west side wall of the tunnel, about 60-feet from the north end portal, collapsed. This collapsed portion was about 75 feet long. A crack was observed 40 to 60-feet in from the north end emanating from the collapsed arch, it extended about 20 feet into the crown. An area of about 10-feet from the collapse showed a flattening in the crown.

A large volume of overburden, fell into the tunnel, including some layered fragmented shale rock and loose earth. A portion of the West Side wall of the tunnel was found on the bottom of the debris pile excavation with the interior facing down laying on the track. It was intact, and it hinged upward at an angle when it struck the far sidewall. A large section of the crown from the top center and west side were found about four feet above the west wall debris, this implies the wall fell first. Fill material from the upper west quadrant fell next, and then the crown fell. The tops of the footings were briefly observed between debris collapses, and were observed after further excavation.

No extreme water flows were observed, although there was some wetness from the current rain and prior snow melt. The collapse allowed the packing material of layered stone to be observed. It was well placed, and would have filled the void area. It allowed for drainage behind the tunnel wall, distributes uniform loads on the arch structure, and prevents impact loading from falling material. During excavation no large amounts of flowing water or mud conditions, nor unexpected materials were found. The soil that fell out of the overburden was basically dry, as well as soil exposed as the overburden was being removed from on top of the tunnel. From the pieces of tunnel structure observed, the tunnel appeared to be built as designed with four courses of bricks on the arch, five layers to the spring line, and six layers in the lower portion. There was no evidence of rotor boring in the arch barrel, or other clearance modifications other than the bedrock undercut.

Bench wall underpinning of both the east, and west walls had been constructed in 2004. The bench walls were from just inside the portal to short of the collapse. The tunnel barrel in the north, and south portion away from the collapse was of regular shape, even though the north barrel had a crack in it. In the damaged area, it appeared to be flat in the crack area towards the collapsed area. There was no signs of crushing of the brick sidewalls, or arch with no compression failure.

The foundation stones on the west side varied in width from 9 to 16-inches, 18, and 30 inches. Many of the stones had segments sheared off from the collapse, or from construction equipment that cleared the tunnel debris. This limited the opportunity to determine if the stones were level, but the general assessment was that they appeared fairly level. Some of the stone block's backsides appeared slightly rounded, and the blocks were narrower in the middle and wider on the ends. It was noted that the stone blocks were intended to hold in brick rubble and mortar sand that was used as additional bearing foundation behind the stones. From the face of the stone to the rock face the combination-bearing surface of quarried rock in the front and brick and sand behind was about four feet six inches wide.

It was noted after going into the south portion of the tunnel that some quarry stones protruded further into the tunnel than others and in some places two or three layers were used base on elevation changes, but the top layer was on the same alignment. Through examination of some wall and arch debris segments, observations of water, efflorescence between the brick courses and mortar joints indicating lost adhesion of the courses and signs of possible slippage as in would occur from a differential shift. Examination of data from a clearance truck run from 2001 gave indication of a shift in the arch barrel towards the east, and a run made January 2005 gave similar indications or were at best inconclusive to indicate no possibility of a shift in the arch barrel and walls

An area of undermine 18" to 24" back under the east wall and about three feet deep was measured under the east wall, north end. East wall bricks were tilted up and a crack was observed at a 30 degree angle. It leads vertically upward, and resembles a shear crack moving along the mortar joints of the brick. This section is about 15 feet long, and runs into another section of ditch coated with gunite. The gunited section of the east ditch is about 50 foot long. South along the east wall another 60 foot of undermine 12" into wall was observed. The remainder of the east wall, and all of west wall were measured to have about 6 inches of undermine.

No earthquakes in the immediate area were recorded according to the United States Geological Survey (USGS) web site as of January 6, 2005 at10 pm. There were no reported earthquakes in Kentucky during the week of the accident. There was an earthquake in Missouri, and two in Tennessee near the southeast corner of Kentucky. These were the only earthquakes in the United States east of Wyoming or Utah.

CSX operates about 20-22 trains daily over this portion of the LCL Subdivision with about 34.8 million gross tons annually.

FRA reviewed the previous two years of CSX tunnel inspection reports for the Eagle Tunnel. The most recent inspection conducted on March 30, 2004 noted:

Ditching needed on the north end
Shoring beneath the brick foundations at the north end
Scrape marks on the north end about two rail into the tunnel.

FRA reviewed the previous three months of CSX track inspection records on the LCL Subdivision. Twice weekly track inspections were conducted by qualified CSX employees. The LCL Subdivision main tracks were inspected on January 3 and 4, 2005 by a CSX qualified employee and no exceptions were recorded for the accident area.

Conclusion

The foundation integrity of the Eagle Tunnel was compromised by the undermining, and loss of support by shale foundation layers. This was a major factor affecting the uniform compressive loading within the arch, and walls of the tunnel liner. This would allow normal design forces to adversely affect the tunnel liner integrity.

Probable Cause