Ohio Department of Transportation

Bob Taft
Governor

Cable Barrier Systems

OTEC Presentation
October 26, 2004

Dean Focke, ODOT
Standards Engineer

Gordon Proctor
Director

Question:

Why are we considering cable products anyway?

Courier News

2 killed on I-78 when SUVs collide head-on

Clinton Twp. wreck closes highway for hours on Sunday

By KYLE S. THOMAS
Staff Writer

CLINTON TOWNSHIP — Two people were killed and seven others were injured Sunday morning during a four-vehicle collision on a rain-swept stretch of Interstate 78.

The accident — involving two sport utility vehicles, an 18-wheel tractor-trailer and a car — closed both sides of I-78 for about three hours while road crews cleared the scene, leaving holiday-weekend traffic backed up for miles. A similar accident Friday on I-78 in Warren County also left two dead.

Sunday's accident killed a New York City couple and seriously injured three New York men. Four others also were injured, police said.

State police on Sunday did not identify the couple that was killed, pending notification of their next of kin.

State police investigators said the collision occurred about 8:56 a.m. between exits 20 and 20A when one of the SUVs, traveling east on I-78, crossed over the grassy center median into the westbound lanes and caused a chain reaction of crashes along the wet roadway near the Clinton Township/Lebanon border.

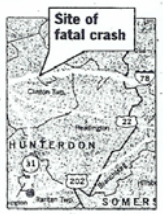
The SUV, a large-framed Chevy Tahoe occupied by Jessie Wray, 28, of New York City and Remigio Newton and Kevin Mitchell, both 31 from the Bronx, collided head-on with a GMC Yukon that was traveling west, instantly killing the couple inside the Yukon, according to state police spokesman Sgt. Kevin Rehmann.

The couple was pronounced dead at the scene, police said.

See WRECK, Page A-6

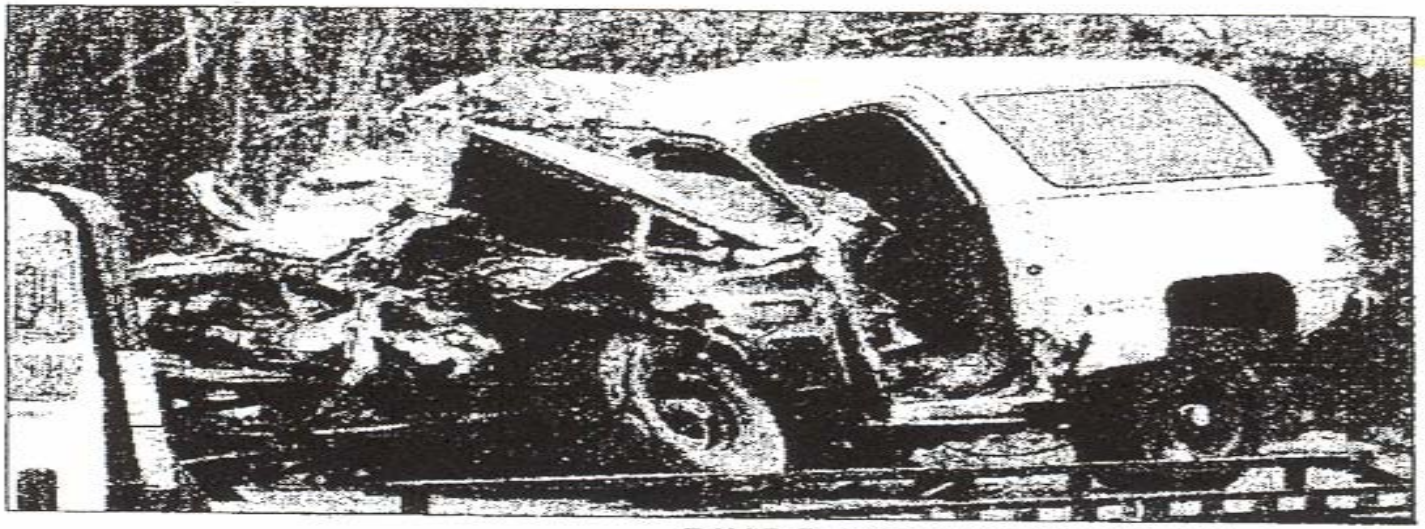
STAFF PHOTOS BY ED PAGLIARINI

Police and rescue personnel look over the shell of an SUV that crashed head-on into another sport utility vehicle Sunday morning on Interstate 78.



Police said a tractor-trailer heading west crossed the grass median on I-78 after striking an eastbound Chevy Tahoe that had veered across the median into opposing traffic.

Philadelphia Inquirer



DAVID SWANSON / Inquirer Staff Photographer

A GMC Jimmy, one of the first two vehicles in the accident, sits on a flatbed in Westville. The Jimmy's driver, William Ruddell, 45, died.

Hatboro driver killed on I-295

The fiery multi-vehicle crash in Gloucester County closed the highway's northbound lanes for five hours.

STAR LEDGER

Two die in Lebanon crash on Route 78

2nd fatal accident in 3 days spurs DOT meeting

BY JERRY BARCA
STAR-LEDGER STAFF

A sport utility vehicle veered across the median on Route 78 in Hunterdon County yesterday, setting off a series of crashes that killed a New York couple and halted traffic on both sides of the highway for three hours.

It was the second fatal accident in three days on Route 78, prompting state Transportation Commissioner Jack Lettiere to call an emergency meeting for tomorrow to examine highway safety.

"With two incidents in less than three days, it's disturbing," said Anna Farneski, spokeswoman for the Department of Transportation.

Kevin Mitchell and Remigio Newton, both 31 and of the Bronx, and Jessie Wray, 28, of New York City were in a Chevrolet Tahoe heading east at 8:56 a.m. when the SUV crossed the grass median and slammed head-on into a GMC Yukon, killing the couple inside, police said.

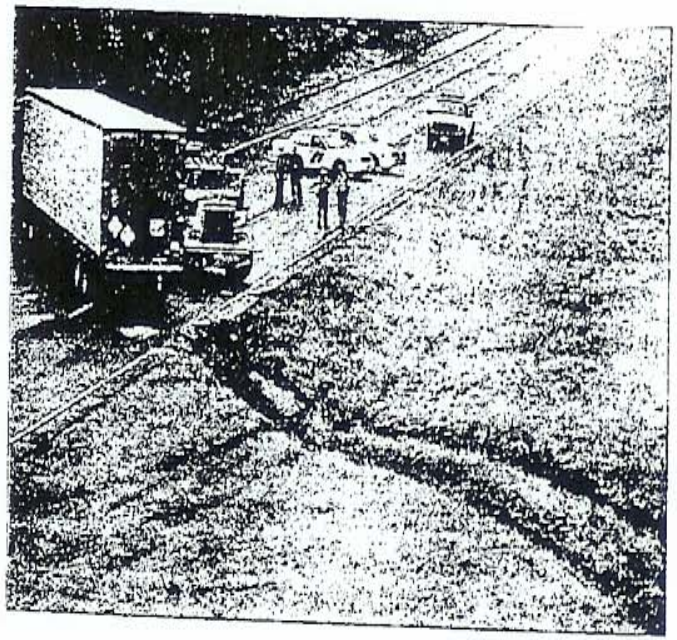
Authorities withheld the names of the couple pending notification of their families.

It was foggy and raining at the time of the crash, which occurred near mile marker 20 in Lebanon, police said.

After striking the Yukon, the Tahoe was hit by a tractor-trailer driven by Stephen Kidd, 40, of Fort Worth, Texas. The tractor-trailer then sideswiped a Nissan Maxima, which was carrying five people from Roanoke, Va., whom police did not identify. The truck slid across the median and eastbound lanes, coming to a stop in a tree line 100 yards from the initial impact, police said.

The accident remains under investigation and police said they do not know why the Tahoe

(See **FATAL,** Page 20)



JENNIFER BROWN/THE STAR-LEDGER

The scene of a double fatal accident on Route 78 in Clinton Township yesterday. The truck came to rest in the eastbound lane.

The Record

Death and gridlock

Turnpike, Rte. 80 grind to halt after 2 accidents

All cars north of the accident scene were diverted to the turnpike's western spur, creating traffic jams almost a mile long, Orlando said.

Northbound lanes of the eastern spur remained open, but rubbernecking caused slowdowns

See **WRECKS** Page **A-14**

By YUNG KIM
and JUSTO BAUTISTA
STAFF WRITERS

Two people died Wednesday as a pair of accidents created enormous traffic jams on some of North Jersey's busiest highways during the peak afternoon commute.

Both deaths were the result of a 12-vehicle pileup in the southbound lanes of the New Jersey Turnpike's eastern spur in Secaucus, said Joseph Orlando, spokesman for the New Jersey Turnpike Authority.

A second accident on eastbound Route 80 in Fairfield tied up that highway from Wayne to Parsippany.

On the turnpike, two buses, a tractor-trailer, and nine cars were involved in a 4 p.m. accident about two miles south of Exit 16E.

Officials closed all three southbound lanes until 8 p.m. to conduct an investigation and clear debris, Orlando said.

"The accident stretched about 200 feet from the first car to the last car, and does not take up all three lanes," Orlando said. "We had to close them all for safety reasons, though."

A chain of minor accidents caused a sudden slowdown on the roadway, but the driver of a bus loaded with about 50 passengers was unable to brake in time, state Trooper Stephen Jones said.

The bus rear-ended a Mercedes-Benz, which then struck a utility truck. Both occupants of the Mercedes were pronounced dead at the scene, Jones said. Their identities were withheld pending notification of relatives.

Two people suffered minor injuries.

"The majority of cars involved were able to drive away under their own power," Orlando said.

A single lane through the scene was opened more than two hours after the accident to clear out trapped vehicles in the congestion immediately behind the accident, Orlando said.

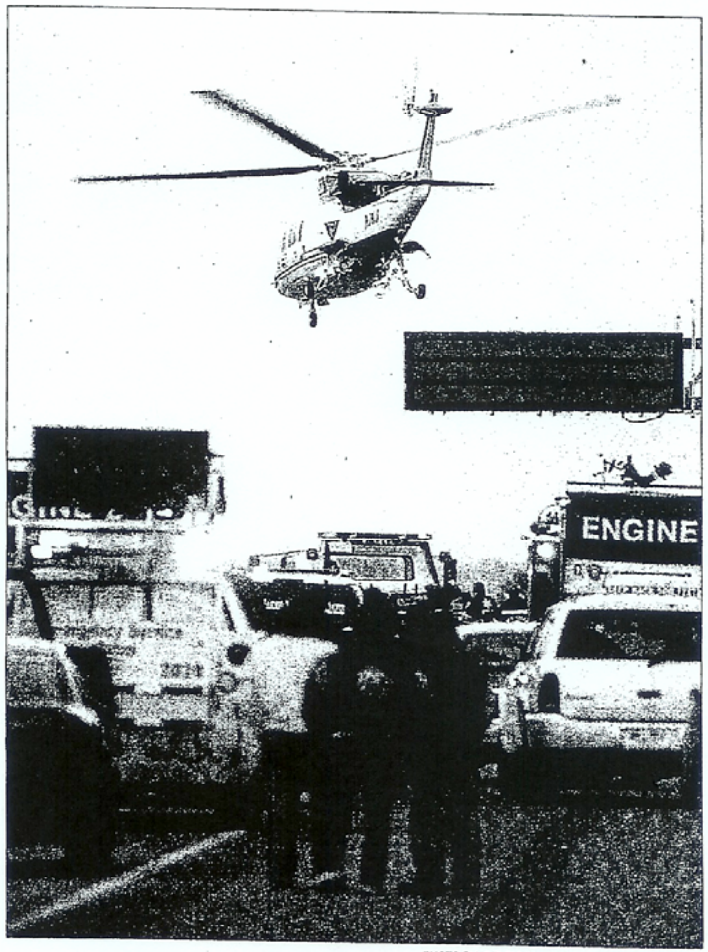


PHOTO BY KYE-RYUNG LEE/SPECIAL TO THE RECORD

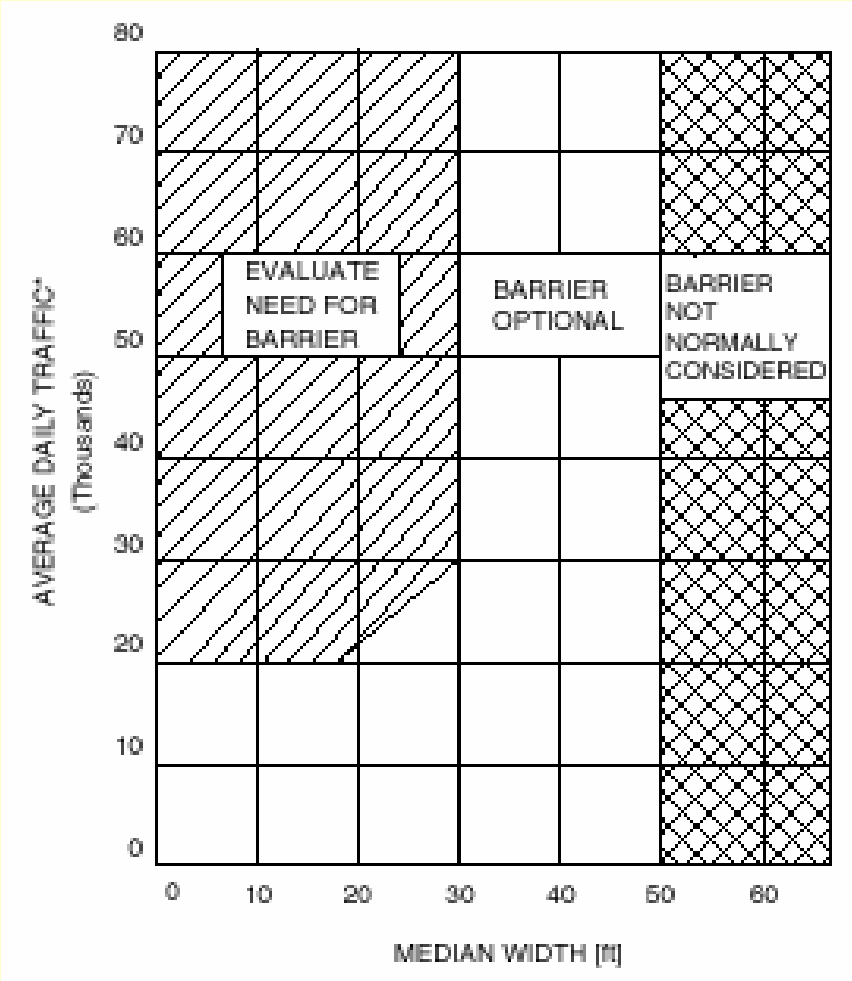

690-CXT

Time Required to Cross a 46 Foot Wide Median, with an Assumed 6:1 Side Slope, and a 30° approach angle.

Speed	Seconds to Cross Median
55 MPH	1.14 seconds
60 MPH	1.05 seconds
65 MPH	.97 seconds
70 MPH	.90 seconds

Are the current AASHTO Median Barrier warrants out-dated?

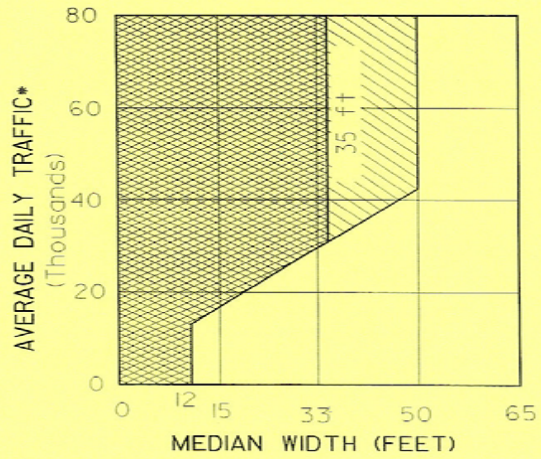
AASHTO Roadside Design Guide Median Barrier Warrants



Source: Roadside Design Guide (AASHTO, 2002)

ODOT Location And Design
Median Barrier Warrants

MEDIAN BARRIER WARRANTS	601-2
	REFERENCE SECTIONS 601.2



April 1999

AASHTO Warrants

- Based on two older studies
  - Graf, V. D. and N. C. Winegerd, 1968
  - Ross, H. E., Jr., 1974
- Warrants based on
  - Before/After Accident Data Analysis
  - Low-Moderate Traffic Volumes
  - Attempt to Minimize Serious Injury/Fatal Crashes

National Transportation Safety Board, AASHTO, FHWA, and many State Transportation Agencies agree the warrants need revisited.

Individual State Research

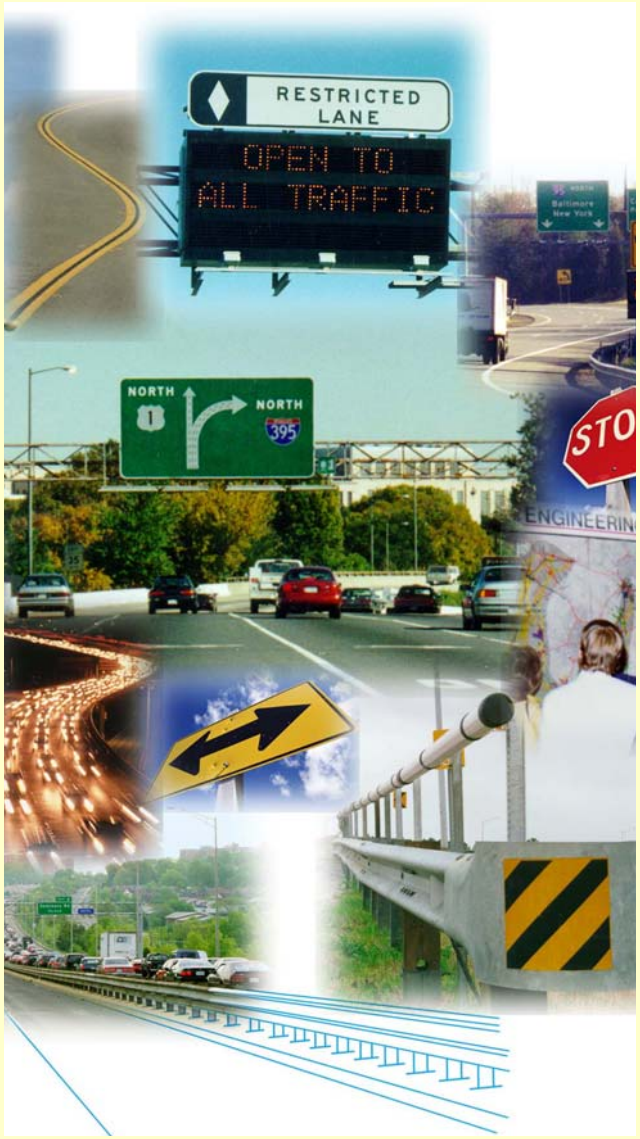
- Several studies have been undertaken by individual states to address median barrier warrants
  - California - 1997
  - North Carolina – 1998
  - Georgia - 2000
  - Pennsylvania - 2001
  - Washington – 2002
  - Maryland – 2003
  - Florida – 2003

Characteristics of Median Cross-Overs

- 19% involved or was suspected to involve alcohol
- 2% involved a truck as the crossing vehicle
- 78% occurred when the vehicle's speed was within 5 miles per hour of posted speed limit
- Weather conditions were good in 75% of crashes
- 83% were result of driver error and avoidance maneuvers
- Half of the crashes during bad weather involved hydroplaning
  - the other half were driver error.
- 82% of all crashes occurred within one mile of interchange ramps

Summary of State Research

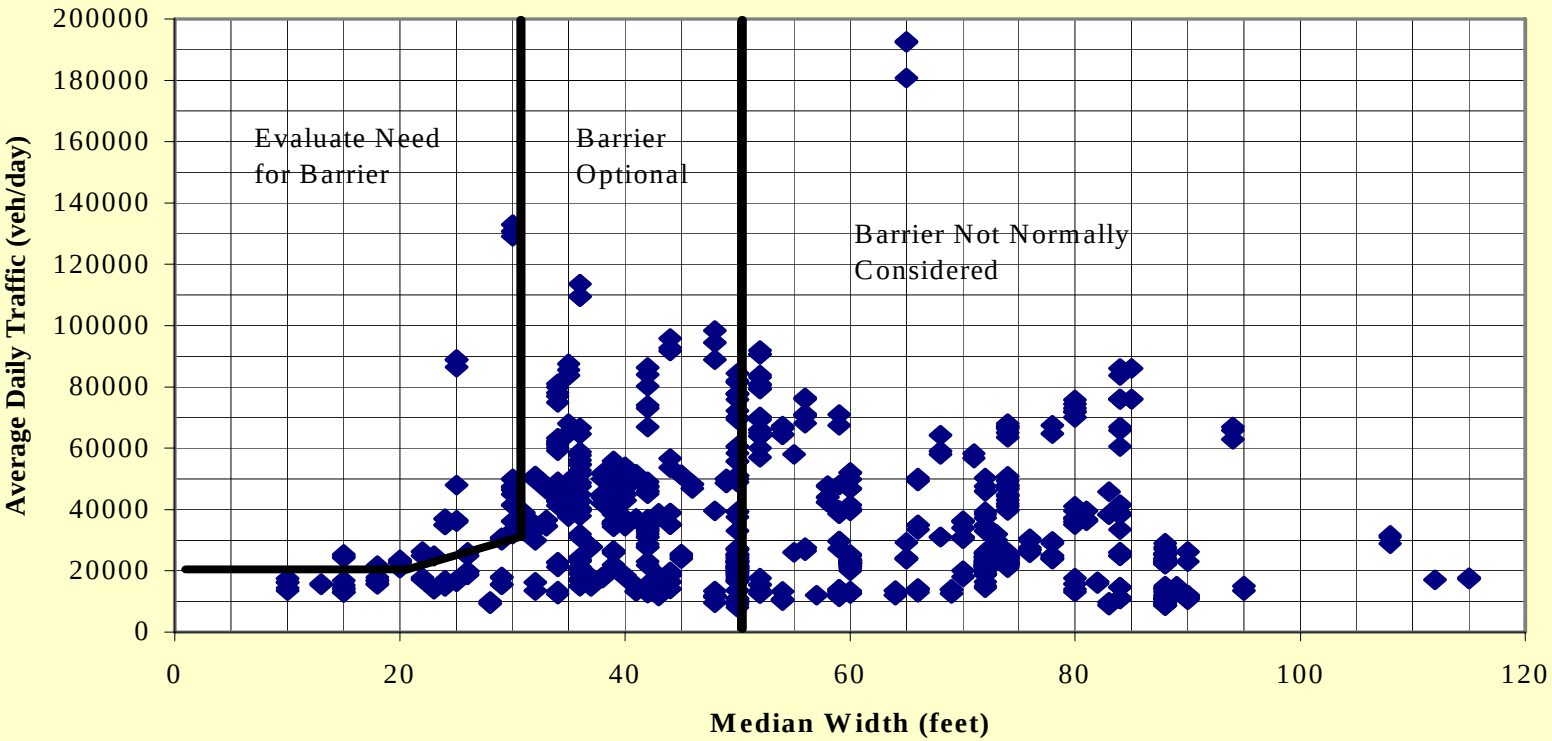
- Every state discussed has recognized the need for improved cross median crash safety
  - High severe injury and fatality rate = high costs
- Use of median barriers has been shown to reduce the incidence of fatal crashes
- Conversely, the frequency of injury and property damage crashes increase with the use of median barrier
- Existing guidelines based upon engineering judgment or questionable B/C analyses



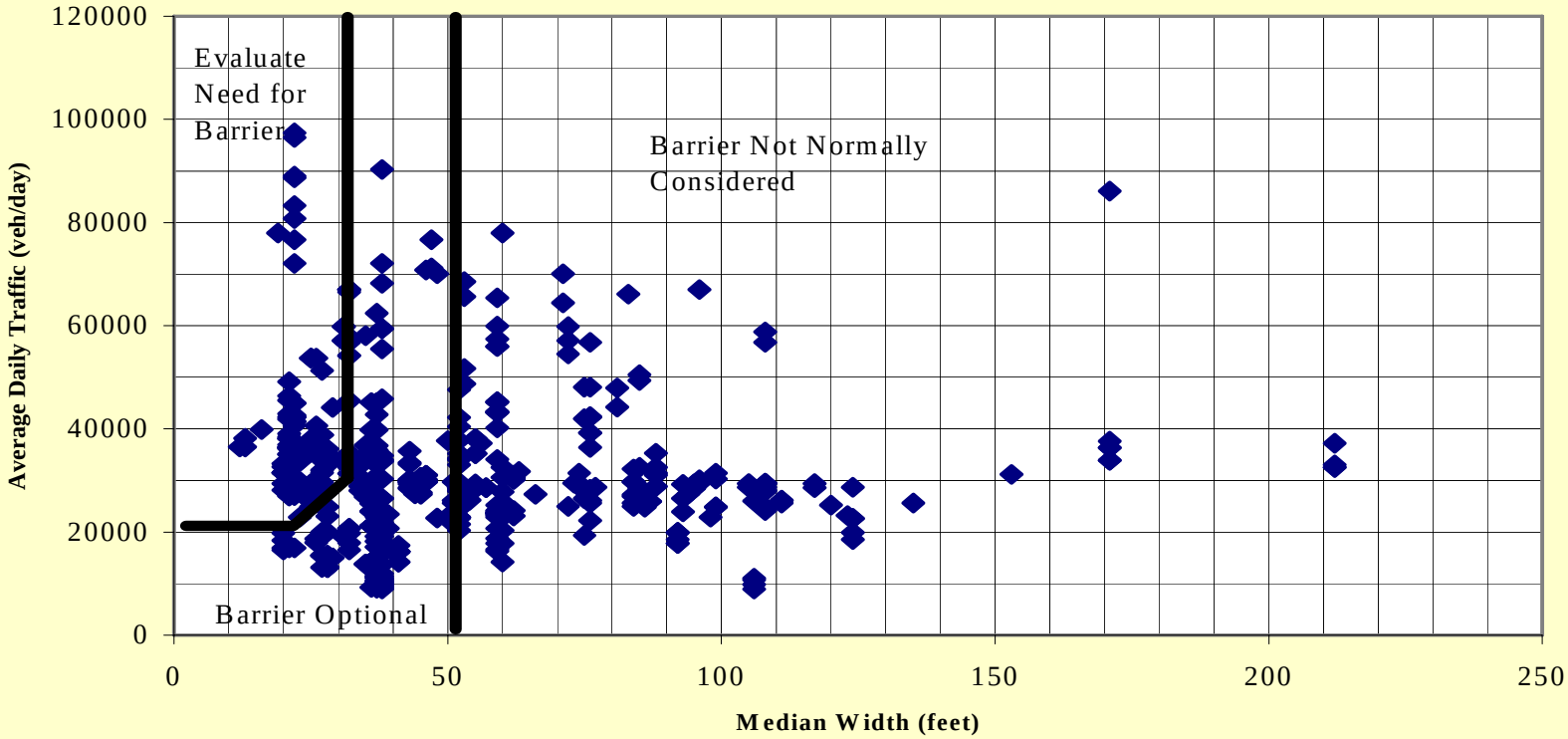
Improved Guidelines For Median Safety NCHRP Project 17-14

BMI·SG

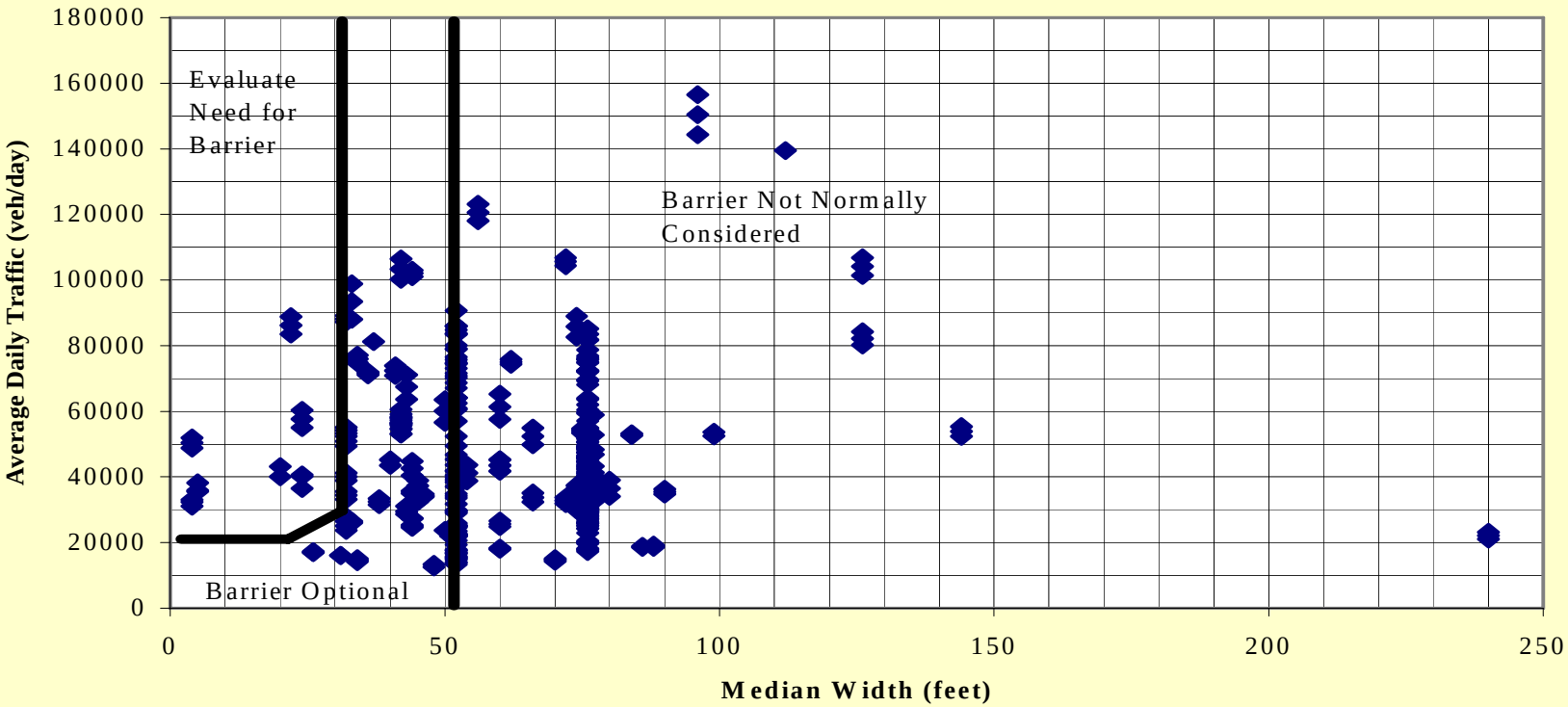
CA Median-involved Crashes



NC Median-involved Crashes



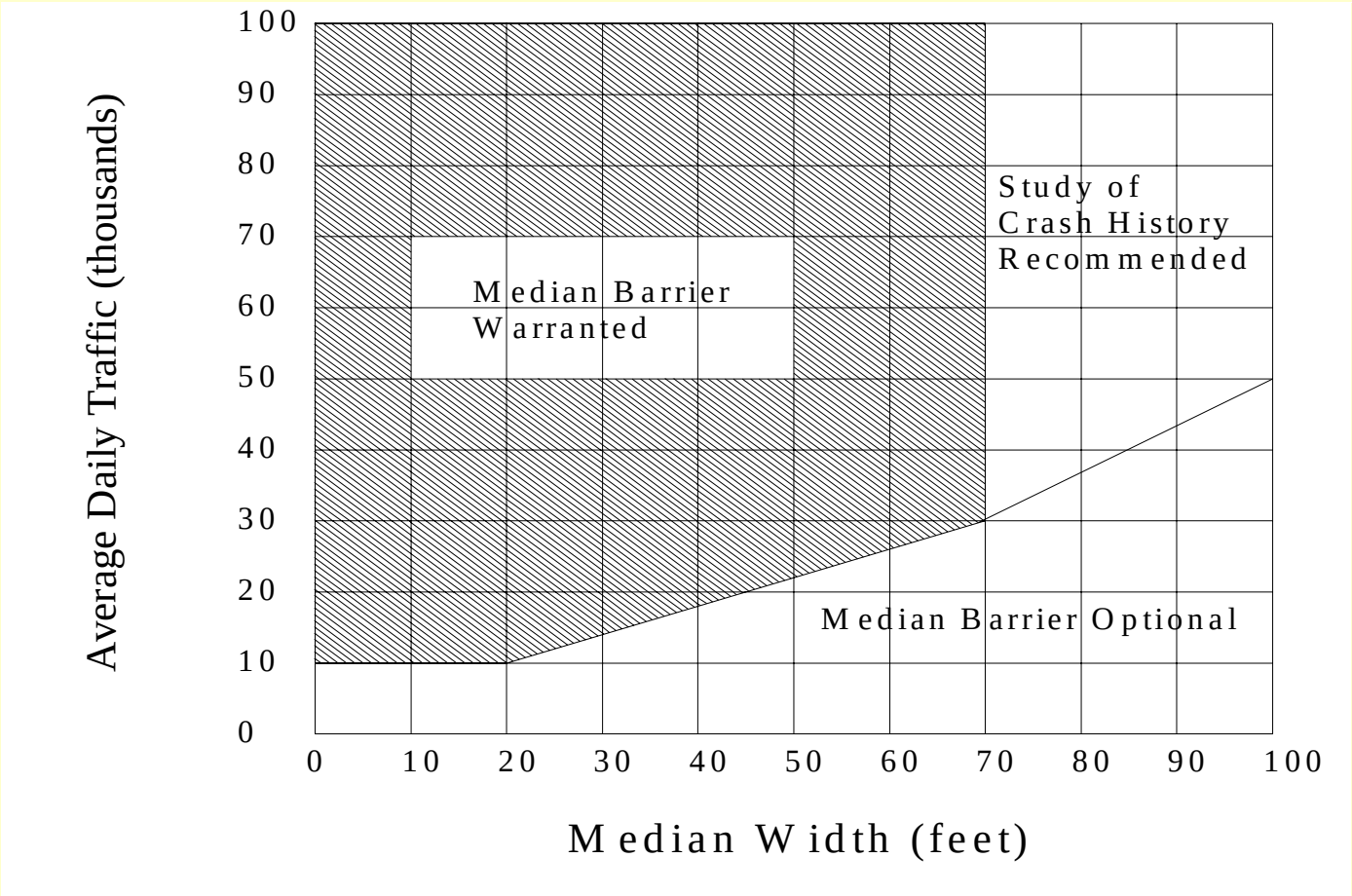
OH Median-involved Crashes



NCHRP Project 17-14 Conclusions

- Median-involved crash frequency decreases as median width increases.
- Average daily traffic volume has greatest influence on median-involved crashes.
- Median side slopes influence median-involved crash frequency.
- NC CMC crash severity is greatest when median width is less than 70-ft.

NCHRP Project 17-14 Recommended Median Barrier Warrants



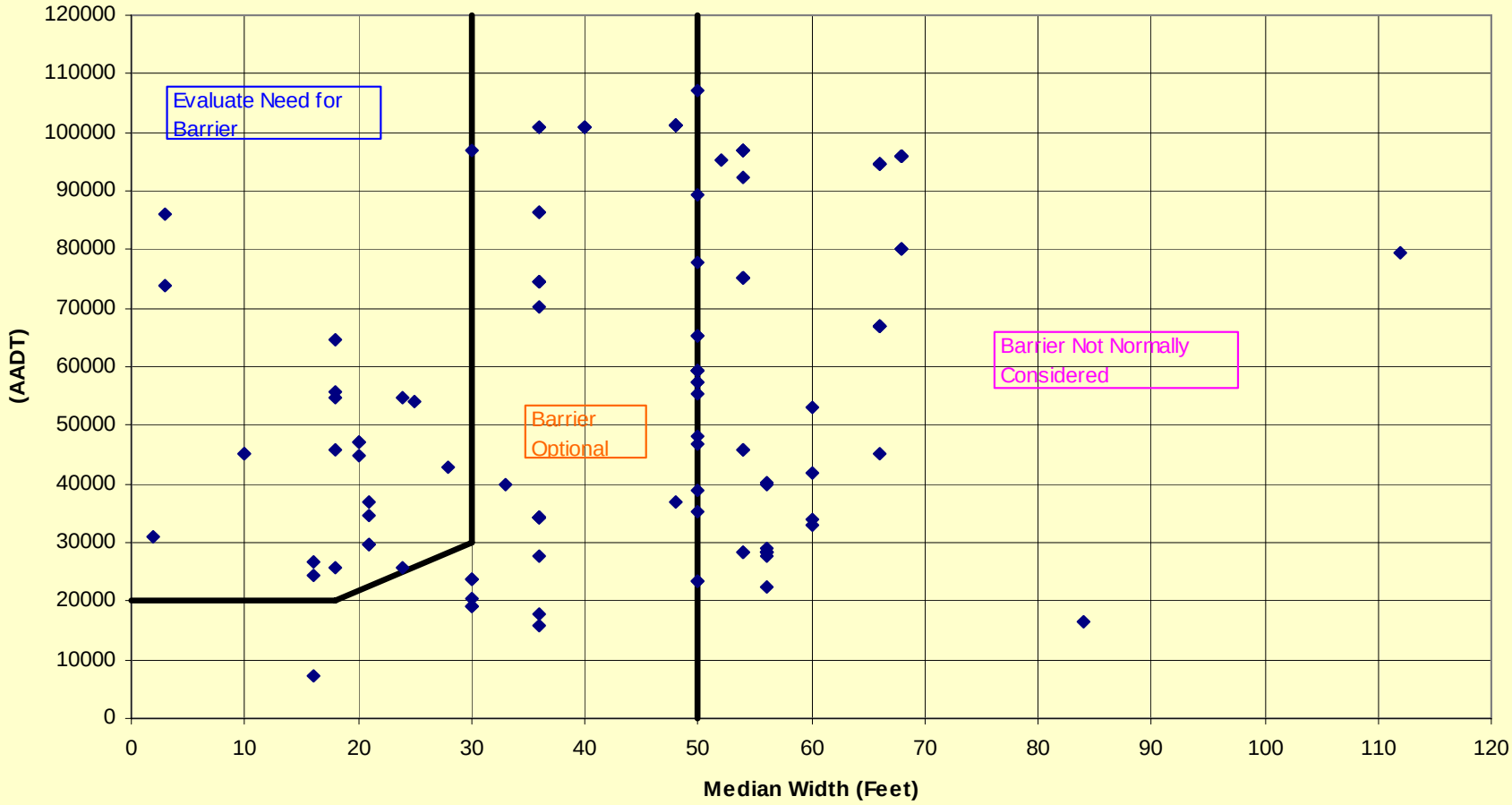
FHWA Analysis of Cross Median Crashes

- Conducted in 2004
- Information gathered from 30 States

Initial Survey Findings…

- Many state DOTs unable to correlate crash locations with median width/characteristics
- Revising warrants upwards likely to reduce cross median crashes in several states

MEDIAN BARRIER WARRANT
(AASHTO 2002 Figure 6.1)
1999-2002 NJ Median Cross Over Crashes



What FHWA knows….

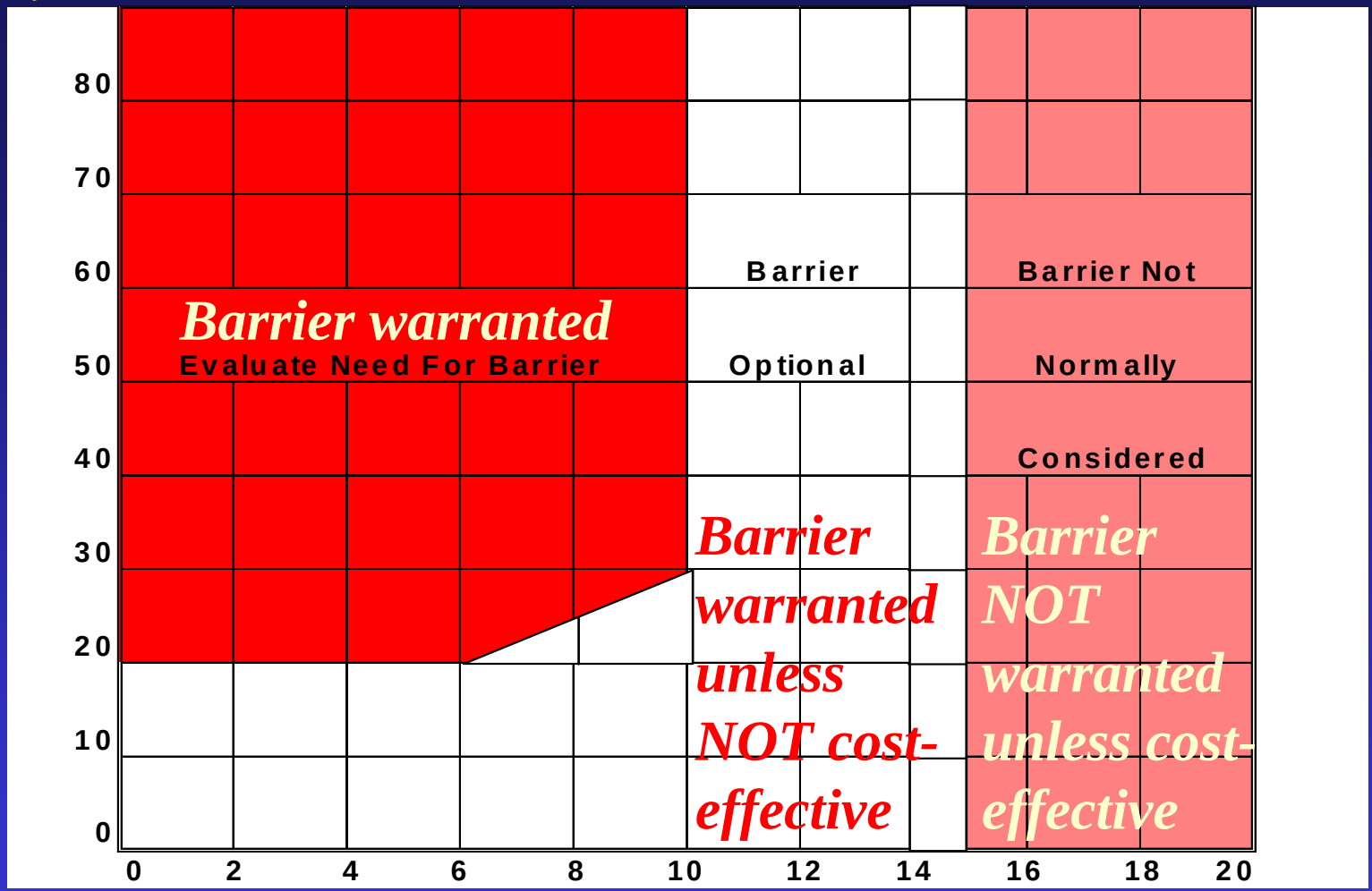
- A 30-foot wide median is inadequate on freeways
- Median encroachments are likely to increase with higher traffic volumes
- Cross-over crashes are severe
- Median barriers can significantly reduce cross over crashes
- Barrier selection and placement are critical for optimal performance

What FHWA still doesn't know…

- What median width/ADT combinations result in cost-effective warrants?
- How should crash history be considered?
- How will offset metal-beam or concrete barriers perform when struck from the back?
- When will new warrants be adopted by AASHTO?

FHWA's proposal….

Figure 6.1

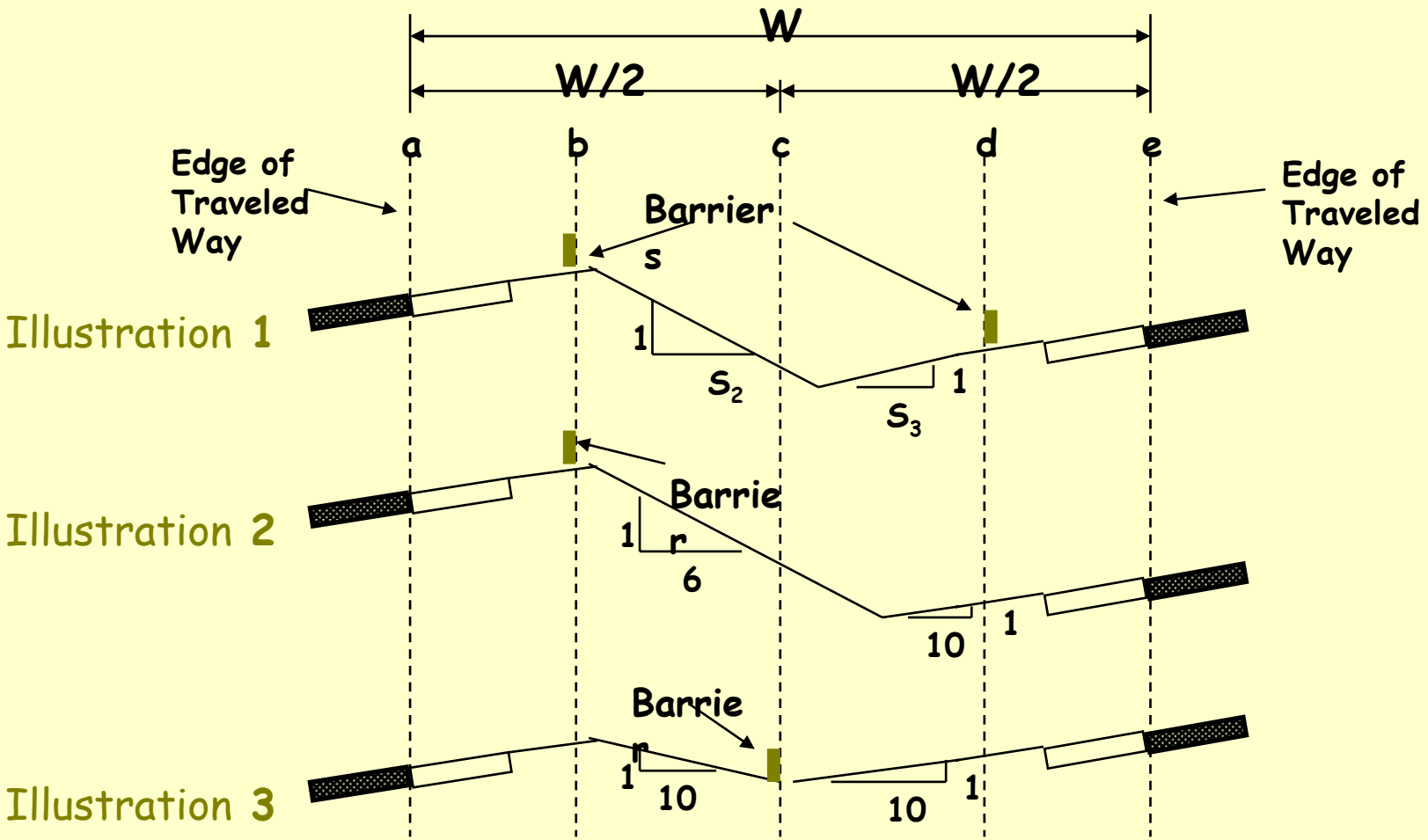


*Based on a 5-Year Projection

Median Barrier Placement

Has its own set of problems

Roadside Design Guide Figure 6.11




ROAD
WORK
1/2 MILE
214


Frame -00000041

Barrier Selection

Median Barrier Systems

- 3-Strand Cable
- W-Beam (weak post)
- Box-Beam
- W-Beam (strong post)
- Thrie Beam
- Modified Thrie Beam
- Concrete Safety Shape


CCX

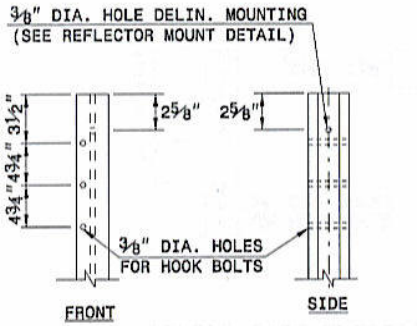
Cable Barrier Systems

- Generic
  - 3-Strand Cable
  - Untensioned
  - US Customary
- Tensioned Systems
  - Proprietary Systems

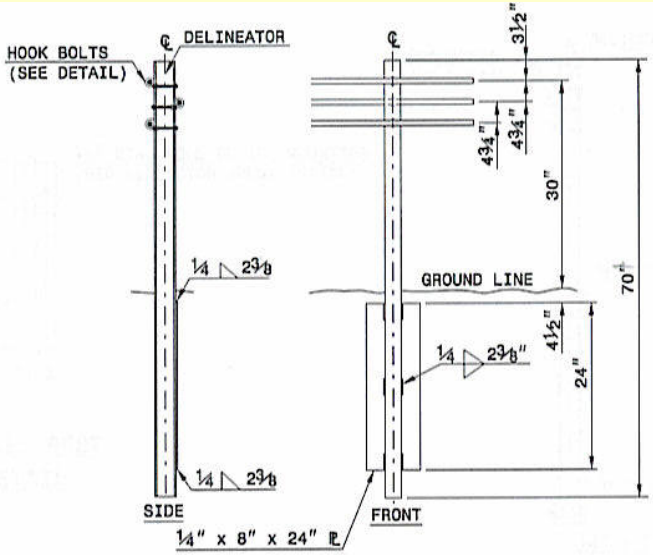
Generic Cable Barrier

US Customary System

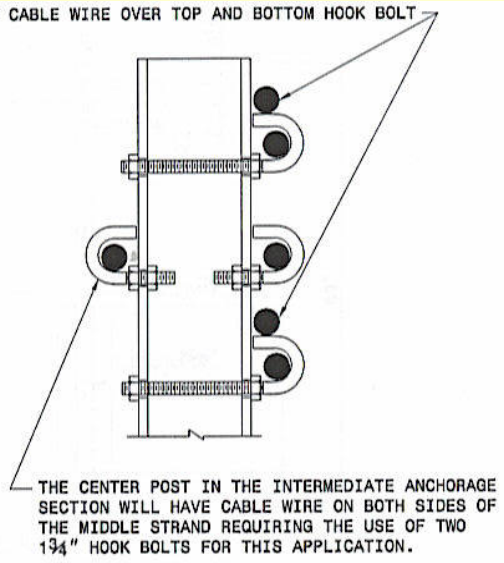
– In Ohio installed on LAK-2 in the early 1990’s



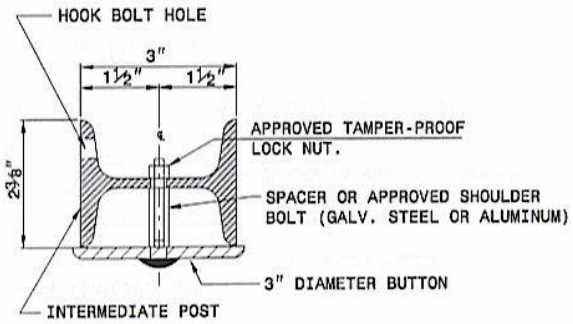
DOUBLE FACE GUIDERAIL POST
HOLE PLACEMENT DETAIL
INTERMEDIATE POST



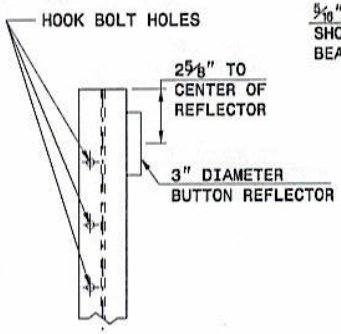
DOUBLE FACE GUIDERAIL
INTERMEDIATE POST



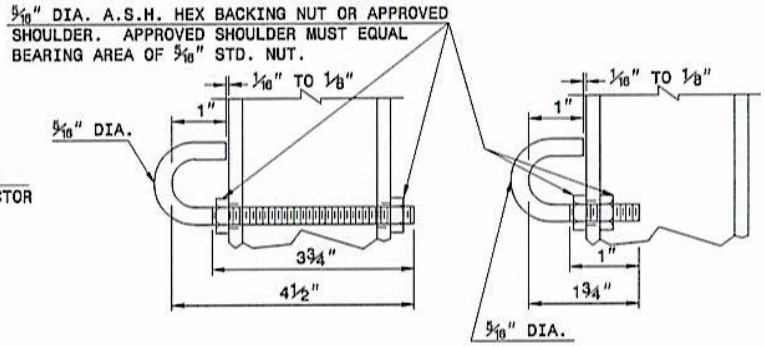
DETAIL "A" CENTER POST
INTERMEDIATE ANCHORAGE SECTION



REFLECTOR MOUNT DETAIL
PLAN VIEW



REFLECTOR MOUNT DETAIL
ELEVATION VIEW



HOOK BOLT (ALTERNATES)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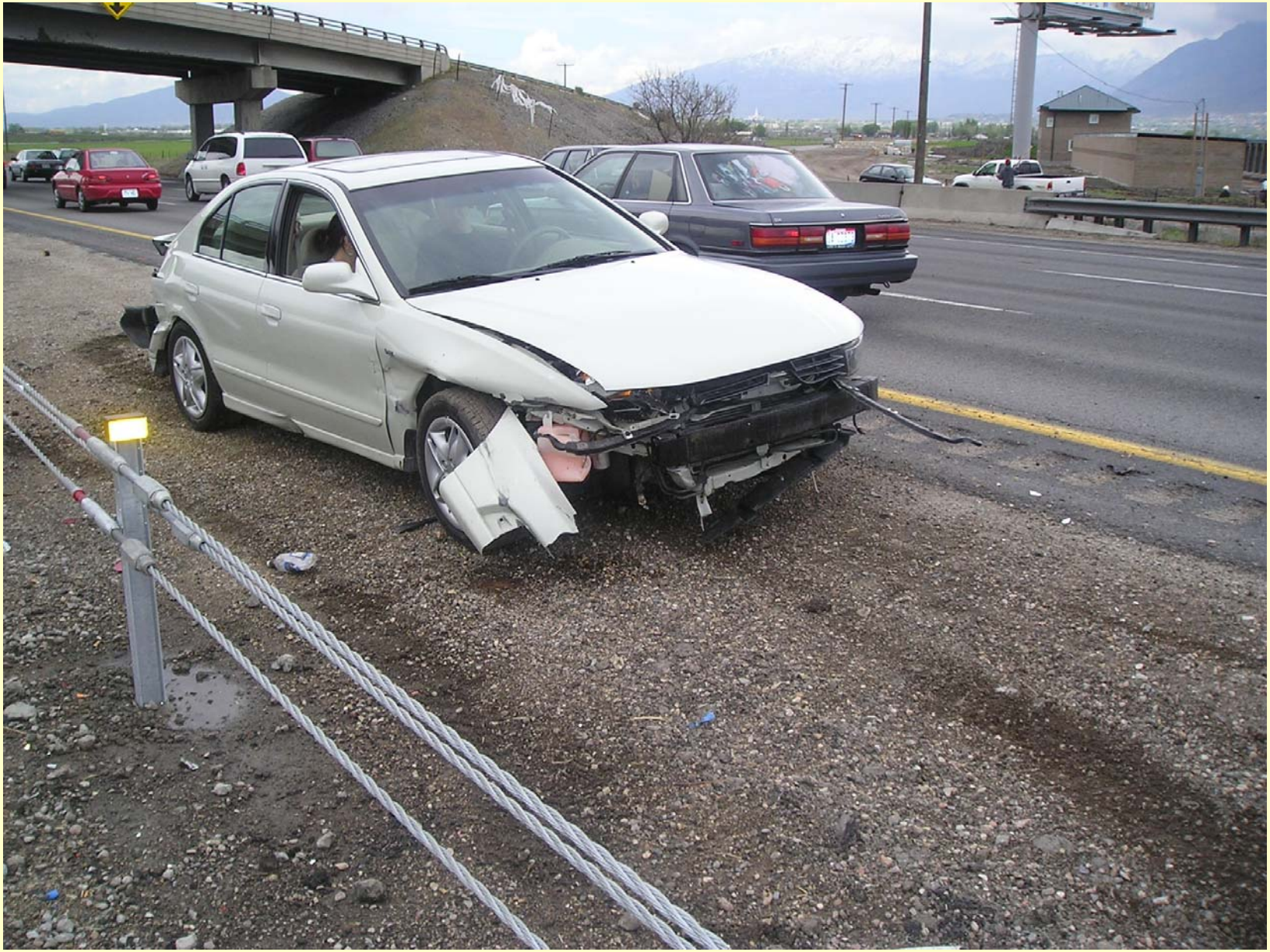
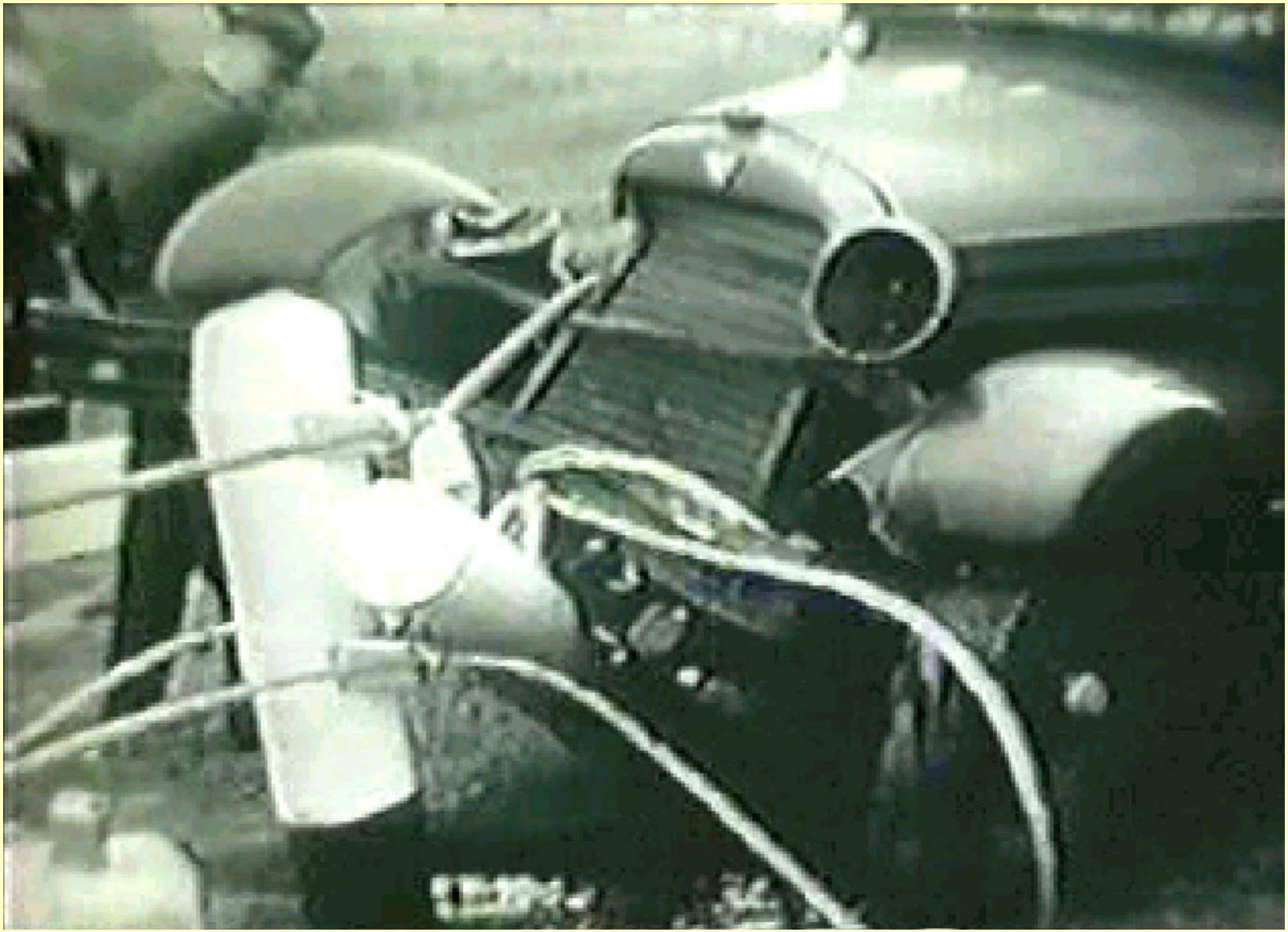
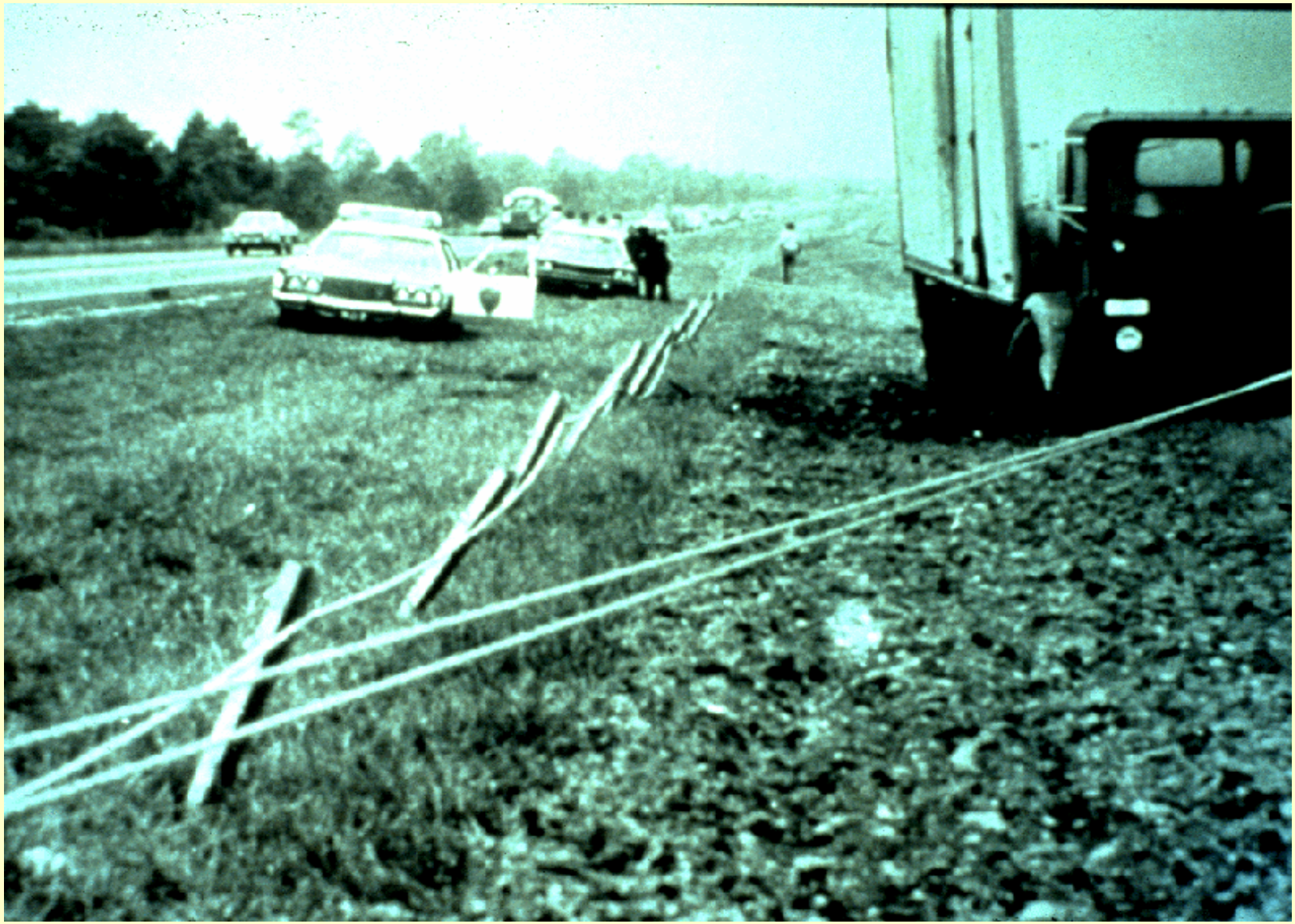
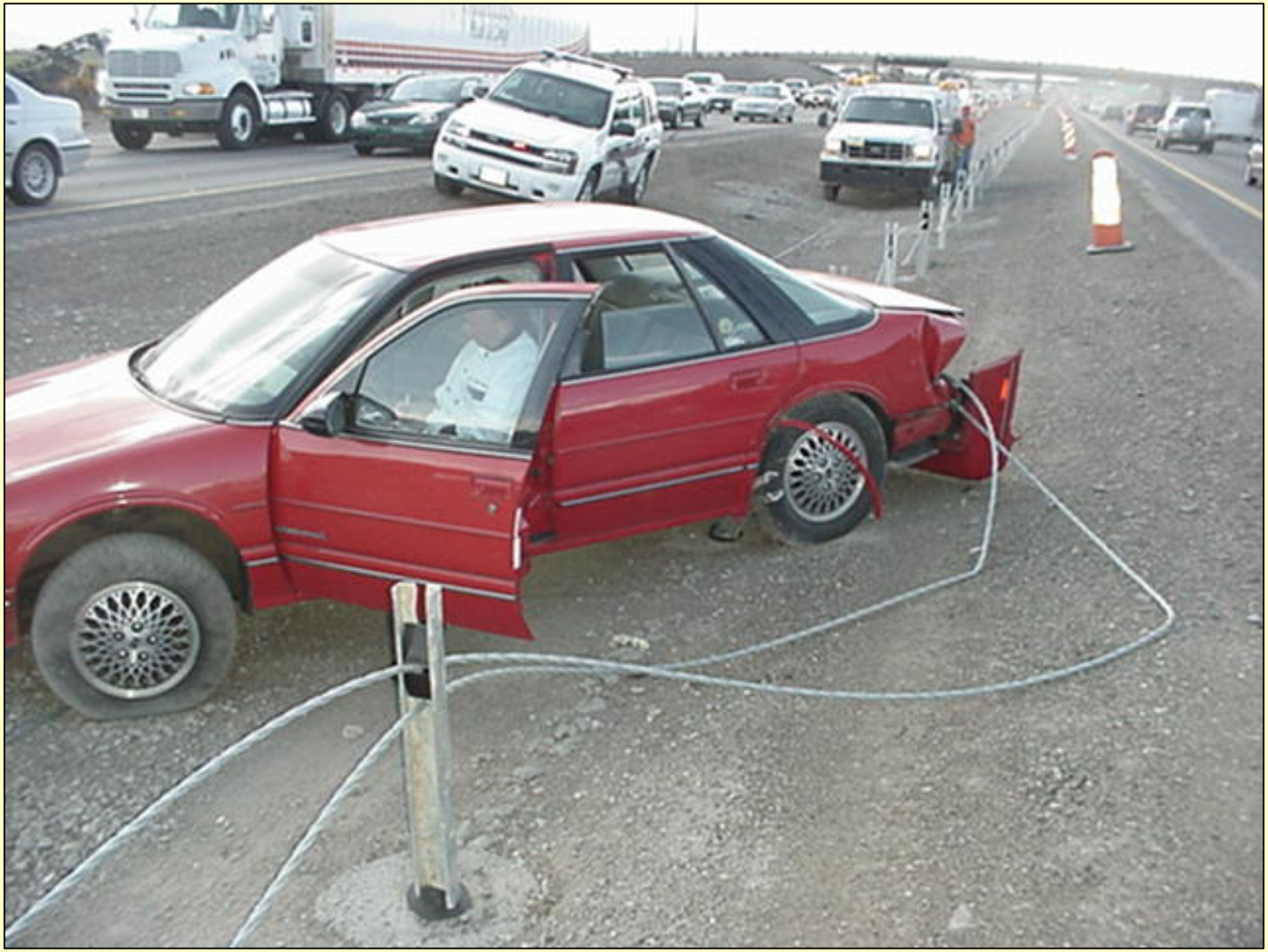








Proprietary Cable Barriers

- Wire Rope, Brifen USA
  - BUT/WAR-75
- SAFERoads, Marion Steel
  - FRA-270/315
- CASS, Trinity Industries
  - LOR-90

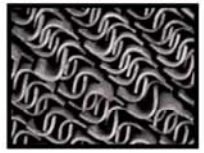
BRIFEN ★ USA INC.

WIRE ROPE SAFETY FENCE

Patented Interwoven Prestretched Ropes

Minimal Deflection

Aesthetically Appealing



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In Use in Over 30 Countries Since 1989

NCHRP350 - TL3 Approved

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Wire Rope Safety Fence

Background

- Developed by Brifen Ltd. in the United Kingdom in 1989
- In use in over 30 Countries around the world today
- First installed in the US in September 2000
- NCHRP350 - TL3 approved by FHWA
  - Length of Need
  - End Anchors

BRIFEN ★ USA INC.

Wire Rope Safety Fence

BRIFEN ★ USA INC.

Wire Rope Safety Fence

BRIFEN ★ USA INC.

Wire Rope Safety Fence

BRIFEN ★ USA INC.

Wire Rope Safety Fence

Proven Track Record

- Hundreds of miles of Brifen WRSF currently in use worldwide & in USA
- 14 years experience
- Extensive Research & Development
- Thousands of successful impacts
- Zero fatalities

BRIFEN ★ USA INC.

Wire Rope Safety Fence

BRIFEN ★ USA INC.

Wire Rope Safety Fence

Applications

- Medians
- Roadsides
- Basic Design Criteria
  - Recommend Smooth Slopes
    - 6:1 or flatter (approach side)
  - Predictability of vehicle impacting with suspension normal & all wheels on ground
  - Deflection less than 8 feet
  - Curve Radius 650 feet or more
    with standard post spacing; less with reduced post spacing

BRIFEN ★ USA INC.

Wire Rope Safety Fence

Benefits

- Economical to Install
  - Less than Concrete, W-Beam, or Box Beam
  - Socketed Line Post System – Typically $12.50 - $15.00 LF
  - Driven Line Post System – Typically $3.00 LF less

- Low Occupant Decelerations
  - NCHRP350 - TL3 Allows up to 20 G’s
  - Brifen Usually 4.0 G’s or less

BRIFEN ★ USA INC.

Wire Rope Safety Fence

Interwoven High Tensioned Ropes

- Reduced length of barrier damaged in crash
- Ropes typically stay up & can handle additional hits before repairs

BRIFEN ★ USA INC.

Wire Rope Safety Fence

Repair

- Typical repair time under 30 minutes
- Only one person required
- Inexpensive – normally just a few posts

BRIFEN ★ USA INC.
Wire Rope Safety Fence

Repair

- No lane closures required for heavy equipment
- No specialized tools (except tension meter on occasion)
- Ropes and rigging screws not damaged during impact

SAFERoads

NCHRP 350 Approved High Tension Cable Guide Barrier System

US High Tension Cable System™

SAFERoads

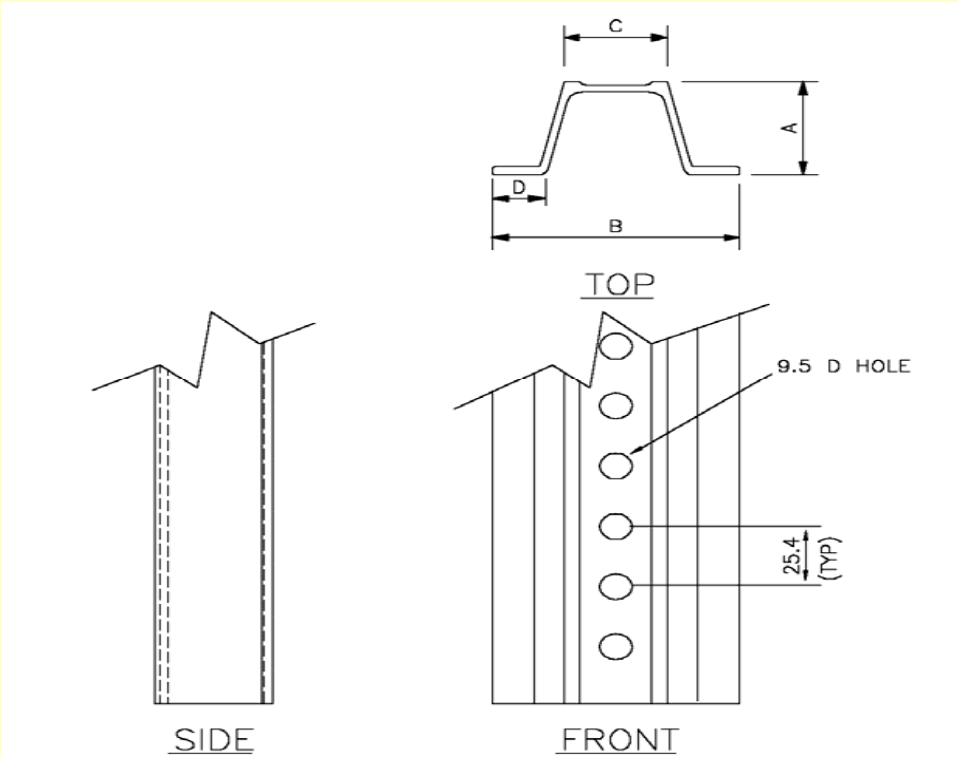
Key System Elements:

- Marion Steel Rib-Bak™ 6 kg/m (4lbs/ft) U-Channel posts.
- Hook bolts
- Turnbuckles
- Post spacing 2m (6.5ft)
- Cable tension 25kN. (5600#)
- Median Cable heights:
- Median 520 mm, 650 mm, and 775 mm.
- Max run 450m (1500 ft) to 900 m (3000 ft)
- Deflection 1.99m (6.5ft)

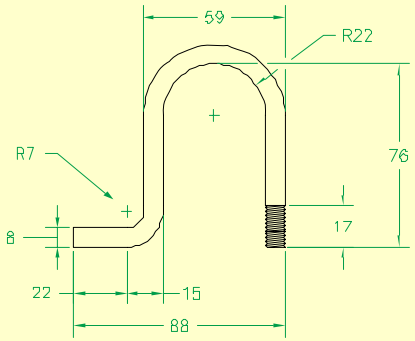
SAFE Roads

Rib-Bak™ Cable Line Post

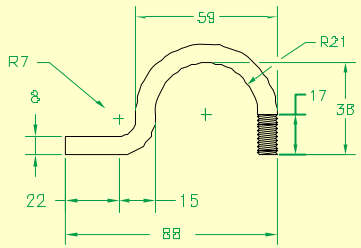
High strength Marion Steel Rib-Bak™ 6 kg/m (4lbs/ft) U-Channel posts.



SAFE Roads



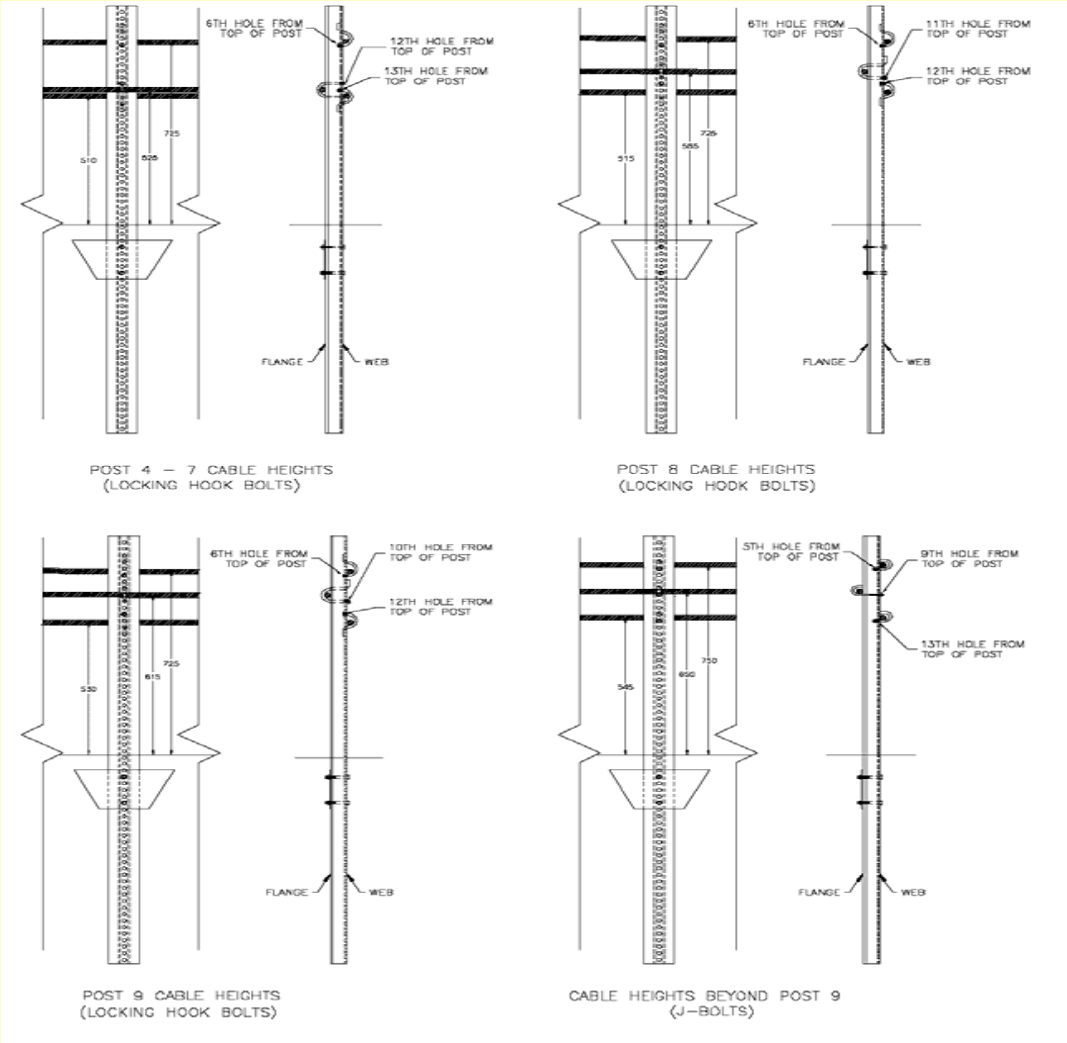
Special Locking Hook Bolts



LOCKING HOOK

SAFE Roads

Cable Positioning



SAFERoads

Advantages of US High Tension Cable System

- NCHRP 350 Approved End Treatment using Geo Metro small car with sloped front end
- Minimal damage to vehicle after impact
- Deflection 1.99m (6.5ft)
- Impacted areas of cables remain elevated after impact
- Line posts can be socketed for quick replacement
- Low initial instalation Cost
- Ease of Maintenance & Low Maintenance Costs

TRINITY INDUSTRIES INC.

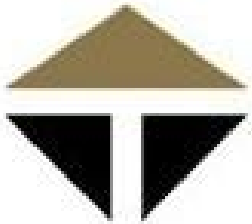
CASS

Cable Safety System

TRINITY INDUSTRIES INC.

TRINITY INDUSTRIES INC.

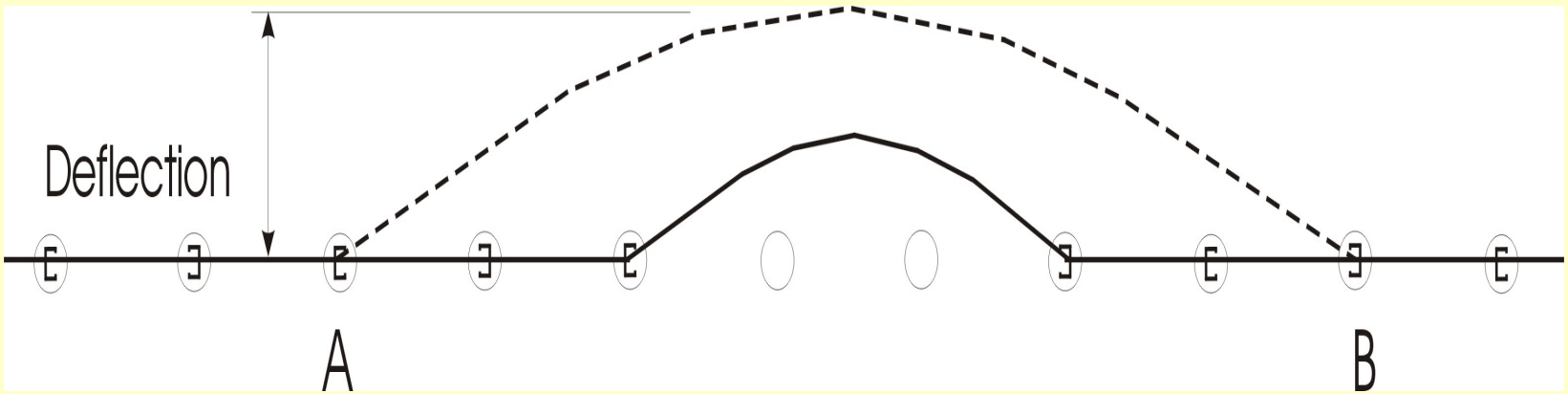
CASS



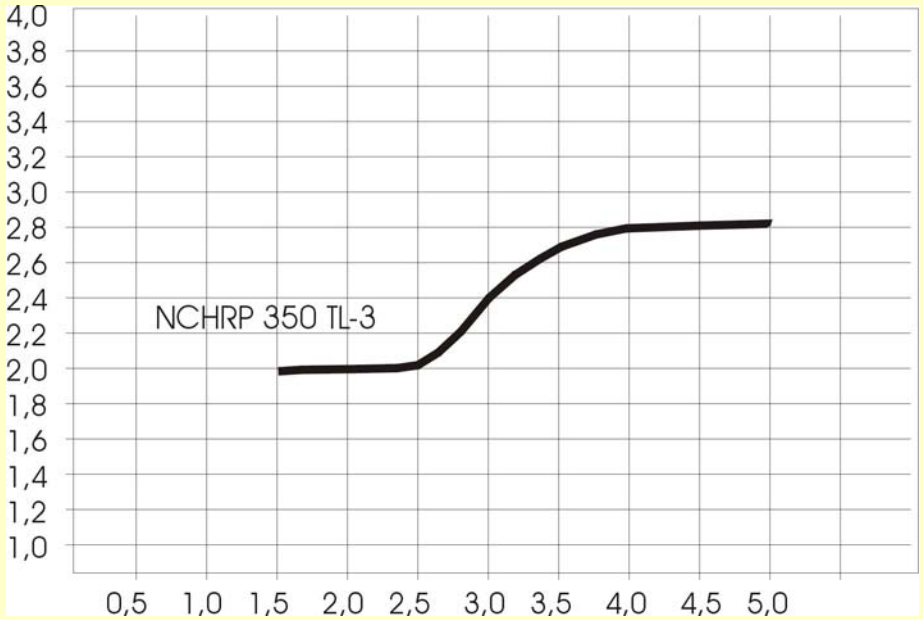
TRINITY INDUSTRIES INC.

- Weak posts
- Detachable cables
- Prestretched cables
- Tension

TRINITY INDUSTRIES INC.

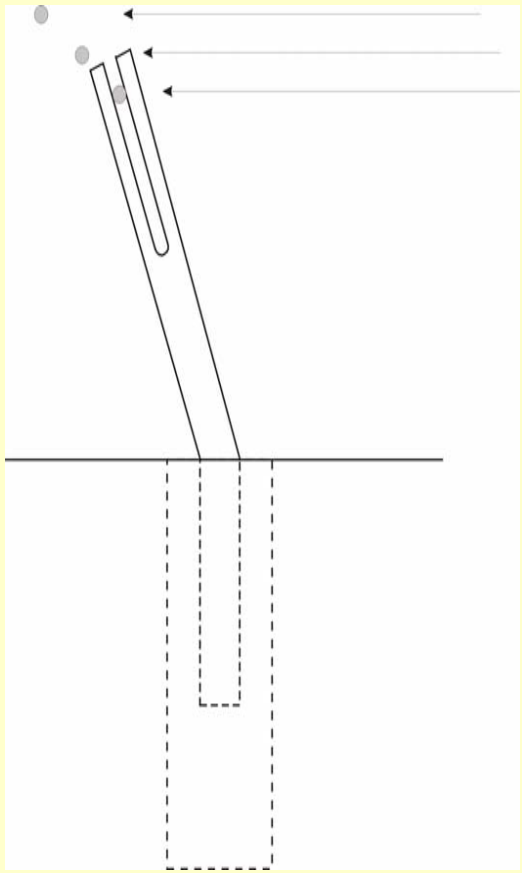


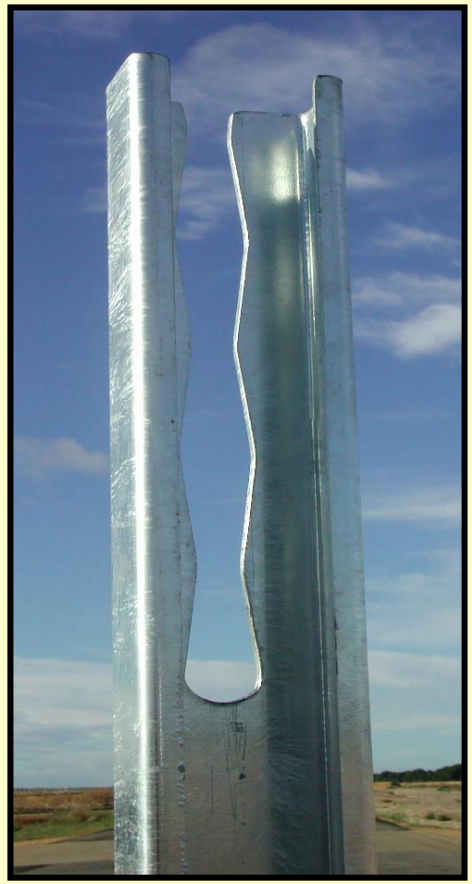
TRINITY INDUSTRIES INC.

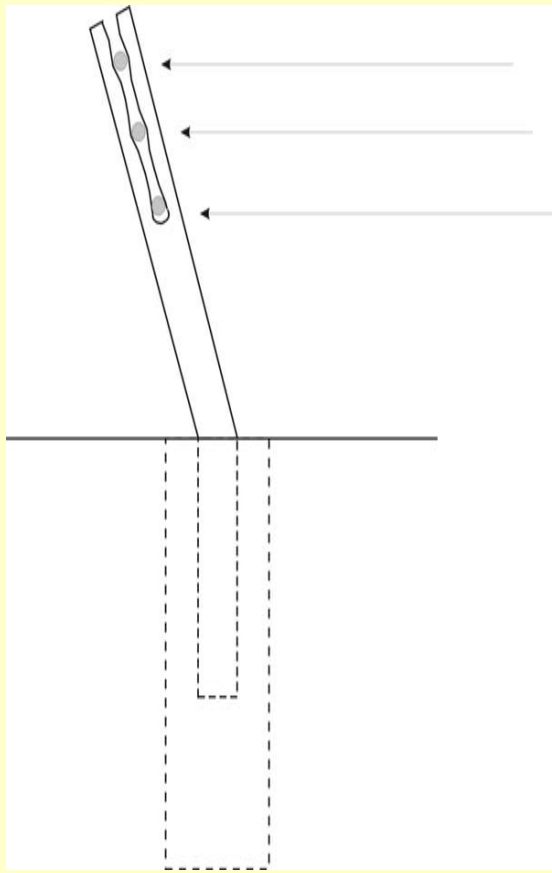


Designed by deflection (2.0 - 2.8 meters or 6’9” - 9’2”)

TRINITY INDUSTRIES INC.







TRINITY INDUSTRIES INC.

Cable Barrier Installation

Stacks of Cable in Staging Area

Cable Barrier Installation

Filling holes for concrete/sleeves…

Contractor able to get 75 to 100 holes per 10 yd truckload in most areas, using 4000lb/sq. in. strength concrete.

(Some areas, poor substrate created enlarged holes, only 50 per load possible there.)

Cable Barrier Installation

Inserting Sleeve

Contractor used vibrator to make this easier and to settle the concrete.

Cable Barrier Installation

Foreman later double-checks the alignment of each sleeve.

Cable Barrier Installation

In a day or so, posts can be inserted. Note good finish nearly level with ground.

(Sleeve cover not shown.)

Cable Barrier Installation

Cable Barrier Installation

Finished installation

Cable Barrier Repair

1) Removing Damaged Posts

Cable Barrier Repair

2) Setting
New Posts

Cable Barrier Repair

3) Cable Placement

Press coverage has been positive….

Cable splits I-15 — to save lives

By Laura Warner
Deseret Morning News

PROVO — Utah County drivers are watching cable as they drive down I-15.

No, they're not turning on their television sets, but what they are seeing is causing as many rumors as an episode of reality TV.

"I've heard that those wire dividers are supposed to kill drivers before they can kill someone else," said Lindon resident Lynn Stapley.

"It looks like they're supposed to ruin a car's engine before it can get any farther," Lehi driver Ben Lunford proffered.

According to Geoffrey Dupaix, Region 3 spokesman for the Utah Department of Transportation, the tension cable barrier that is being added to the center median along portions of I-15 in Utah County is doing exactly what it is supposed to do — save lives.

"The intent is to prevent or eliminate crossovers," Dupaix said. "It may not reduce the number of accidents in the same direction, but if we are able to eliminate that crossover, then it is definitely worth its being installed."

According to UDOT, crossover accidents on I-15 between American Fork and Provo took the lives of 16 people from 2000 to 2002.

While that number is a small fraction of total freeway accidents, it represents nearly all crossover accidents that took place during that time frame.

"Crossover accidents are bad accidents," said Lt. Ken Peay of the Utah Highway Patrol. "There are a lot serious injuries involved with these types of accidents and a lot of our fatal accidents have resulted from crossovers."

Before UDOT began adding the cable barriers, only a portion of the 44 miles of freeway in Utah County had a physical barrier — the 6-mile area between the Provo Center Street and North Springville exits.

Now, the department is nearing completion on a $1.3 million project that has installed cable barriers from Provo to Pleasant Grove. Another $1.1 million will be used shortly to continue the project to the 1200 West interchange in Lehi, where concrete barriers are already in place.

Dupaix said UDOT's decision to install the cable barriers in lieu of traditional concrete barriers was purely economical since concrete dividers are twice as expensive as their cable counterparts.

After studying the use of cable barriers in other states — including Ohio and Oklahoma — the department realized there were other benefits in using cables rather than concrete barriers. The cables cause less damage to vehicles and maintenance is much cheaper.

Dupaix said at least one vehicle has hit the cable barrier and simply driven off since the installation began. While there has been some minimal damage to vehicles in other accidents, there have been no fatalities thus far.

Fixing the barriers is equally economical, since the posts that secure the cable are removable. That allows crews to come in following an accident and restring the cable onto a new post without replacing the wire.

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Cable system prevents bus from crossing

No students were on vehicle when driver suffered attack

By Diana Baldwin and Michael Bratcher
Staff Writers

An Oklahoma City School District bus driver apparently suffered a heart attack Wednesday while driving his bus on Lake Hefner Parkway.

Woodrow Commander, 74, of Oklahoma City was admitted to a city hospital's intensive care unit in critical condition.

No children were aboard the bus about 6:20 a.m. when it left northbound Lake Hefner Parkway near the Britton Road exit.

Commander is in his 12th year of driving buses with the district, district spokeswoman Sherry Fair said.

He was on his way to pick up students headed for John Marshall High School, Fair said. About 50 high school students typically ride his route. A replacement bus picked up the students in time for classes, Fair said.

Commander also handled daily routes to Mark Twain Elementary School and Roosevelt Middle School, which also were driven by another district employee Wednesday.

The bus hit the cable barrier system in the median, stopping the vehicle from going into the southbound lanes, police Sgt. Charles Phillips said.

"It is impressive the way the cable barrier device worked and performed with an extremely large vehicle."

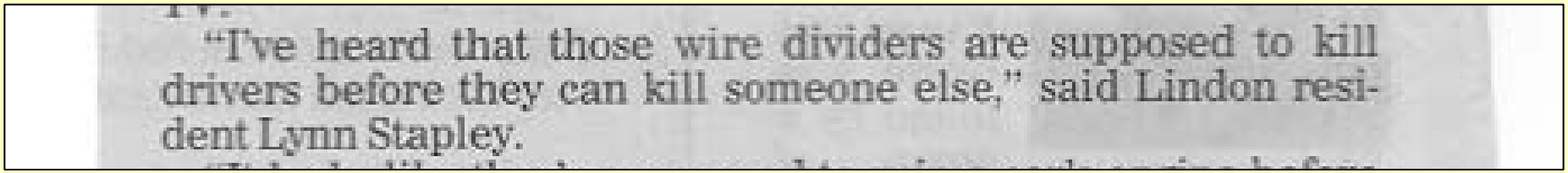
BY PAUL B. SOUTHERLAND, *THE OKLAHOMAN*

An Oklahoma City School District bus sits Wednesday morning in a drainage ditch on the east side of Lake Hefner Parkway. The driver, Woodrow Commander, apparently suffered a heart attack while driving, crashing the bus. No students were on board at the time.

The bus bounced off the cable barrier device and crossed over all the northbound lanes, running off the east side of the road, Phillips said.

The bus drove into the ditch and up an embankment. The bus finally stopped when it struck a chain link fence, Phillips said.

"It is impressive the way the cable barrier device worked and performed with an extremely large vehicle," Phillips said.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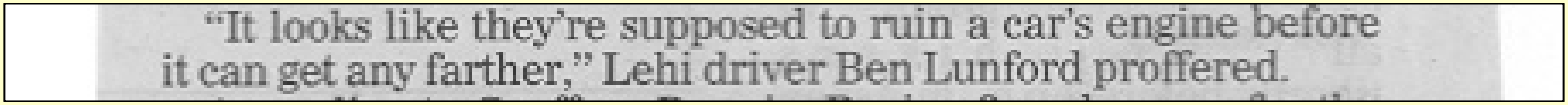
"It looks like they're supposed to ruin a car's engine before it can get any farther," Lehi driver Ben Lunford proffered.

…Although additional public education is needed

Ohio Department of Transportation

Bob Taft
Governor

Gordon Proctor
Director