Median Barriers in North Carolina

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Background

In 1998 North Carolina began a 3-phased approach to prevent and reduce the severity of Across Median Crashes on freeways


Add median protection to freeways with
historical crash problems (Phase I)

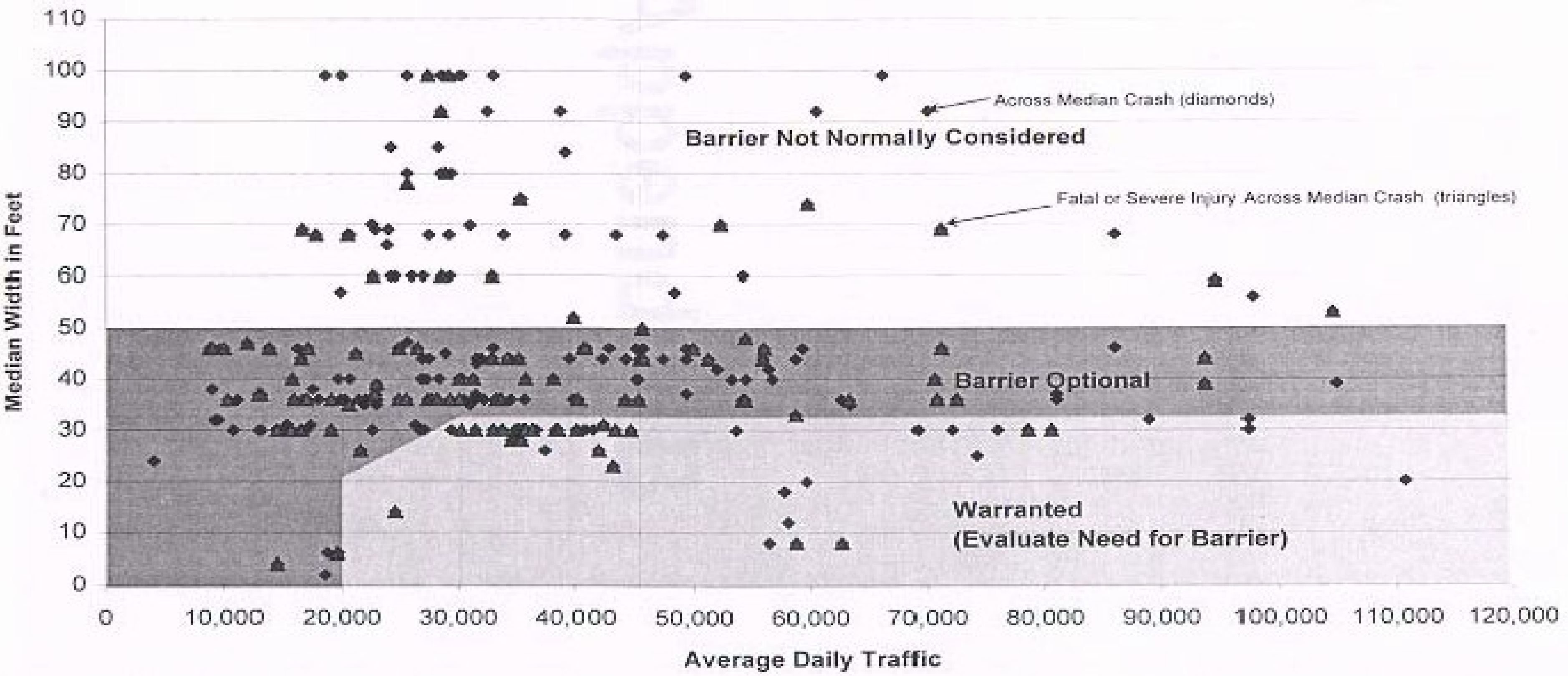
Systematically protect all freeways with medians of 70 feet or less (Phase II)

Revise Design Policy to protect all future freeways with median widths of 70 feet or less (Phase III)

Initial Crash Data Analyzed was between 1994 and 1997

- Over 1,375 miles of full control of access freeways were reviewed
- Over 10,000 total crashes were reviewed
- Over 1,000 across median crashes were identified
- For every one fatal across median crash there were 10 non-fatal across median crashes
- Across median crashes were 3 times more severe than other types of freeway crashes

In North Carolina median protection for a 70 foot median and less has the potential to eliminate approximately 95% of ALL MEDIAN CRASHES
There was no correlation to speed, median width, volume (AADT), time of day, or weather conditions for ACROSS MEDIAN CRASHES



2000-2006 Transportation Improvement Program included 58 Median Barrier Projects

- Approximately 1000 miles of freeway
- All projects have been let to contract or completed as of Spring 2004
- Initial projects were over $120,000,000 investment, not including reoccurring maintenance cost

Median Barrier Benefits

- Effect on Fatal Crashes and Fatalities

PHASE I AND PHASE II MEDIAN BARRIER PROJECT LOCATIONS							
	Fatal	X-Median Fatal	Percent		# of	# of X-Median	Percent
Year	Crashes	Crashes	of Total	Year	Fatalities	Fatalities	of Total
1990	145	33	22.8	1990	177	47	26.6
1991	144	26	18.1	1991	188	44	23.4
1992	128	22	17.2	1992	147	31	21.1
1993	158	20	12.7	1993	196	38	19.4
1994	146	23	15.8	1994	179	36	20.1
1995	150	18	12.0	1995	177	28	15.8
1996	159	26	16.4	1996	189	40	21.2
1997	147	33	22.4	1997	194	47	24.2
1998	198	33	16.7	1998	229	47	20.5
1999	178	24	13.5	1999	207	30	14.5
2000	191	23	12.0	2000	226	36	15.9
2001	160	7	4.4	2001	183	11	6.0
2002	152	13	8.6	2002	173	14	8.1
2003	129	12	9.3	2003	146	13	8.9

Effect on Fatal Crashes and Fatalities

Across Median Fatal Crashes (5 years before and after)

X-Median Fatal Crashes (1994-1998) 133

X-Median Fatal Crashes (1999-2003) 79

40.6% Fewer X-Median Fatal Crashes

X-Median Fatalities (1994-1998) 198

X-Median Fatalities (1999-2003) 104

47.5% Fewer Fatalities

Effect on Fatal Crashes and Fatalities

Estimated 59 Fatal Across Median Crashes have been avoided and 96 lives saved from January 1999 to December 2003

Results in crash cost savings of more than $205,000,000 in fatal crash cost alone

Long Term Median Barrier Evaluation

- Before and After Crash Analysis

  Projects locations being evaluated have at least 3 years of after crash data available

- Progress on Evaluation

  Analyzed 400 miles of median barrier projects

Long Term Median Barrier Evaluation

Median Barrier Types used on projects with 70 foot Medians and less

Cable Barrier (175 miles evaluated)

W-Beam Barrier (132 miles evaluated)

W-Beam and Cable Mixed (44 miles evaluated)

W-beam and Weak Post Barrier Mixed (18 miles evaluated)

Weak Post Barrier (31 miles evaluated)

Long Term Median Barrier Evaluation

Median Barrier Types used on projects with 70 foot Medians and less

Severity versus Frequency

Fatal and Severe Injury Across Median Crashes are Reduced

As AADT Increases Total Crashes, Minor Injury Crashes, and Property Damage Only Crashes increased

Long Term Median Barrier Evaluation

Average Crash Severity by Median Barrier Type

Barrier Type	# of Hits	Avg. Severity
Cable	1,592	1.31
Weak Post	567	1.44
W-Beam	1,266	1.63
Concrete Barrier	67	1.64
Total	**3,486**	**1.45**

The lower the Average Severity the safer the median barrier type

((Scale => 1 = Property Damage Only (PDO) …. 5 = Fatal))

Long Term Median Barrier Evaluation

Maintenance Concerns

Recovery of maintenance cost from drive-away vehicles

Frequency of repairs to cable guardrail

Moving

North Carolina Median Guardrail Placement Criteria

Median Width 30 - 36 feet

2 rows of W-Beam (assuming median slopes are steeper than 6:1)

North Carolina Median Guardrail Placement Criteria

- Median Width - 46 feet, 60 feet and 70 feet
- 1 line of cable guardrail if slopes are 6:1 or flatter (a minimum of 8 feet from the centerline of the ditch)

North Carolina Median Guardrail Placement Criteria

Why is the guardrail not placed in the centerline of the ditch?

Updated North Carolina Median Guardrail Placement Criteria

Why is the guardrail placement in relation to the ditch centerline critical?

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Cable Penetration Evaluation

Purpose of the Project

To identify common characteristics that may influence the probability of a vehicle traveling over, under or through cable guiderail

How?

Thorough investigation of each breaching crash

Factors Examined : Vehicle Type, Impact Angle, Initial Contact Between Vehicle and Barrier, and Site Characteristics

Cable Penetration Evaluation

Monitored 238 miles of freeway

Reviewed over 91 potential penetration crashes

Only 23 of these crashes qualified for this project

Needed crash report, site visit, and vehicle inspection to qualify

The study goal was to find 30 crashes meeting this criteria

23 usable crashes found - 8 (35%) Front Side Hits (before reaching ditch)

15 (65%) Back Side Hits (hit after traversing ditch slopes)

Cable Penetration Evaluation

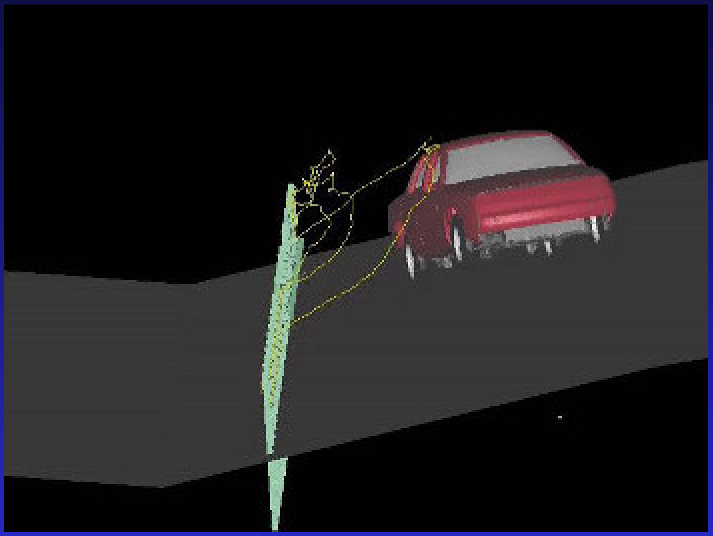
Vehicle Characteristics

Full size sedans

Sport Utility Vehicles

Full Size Vans

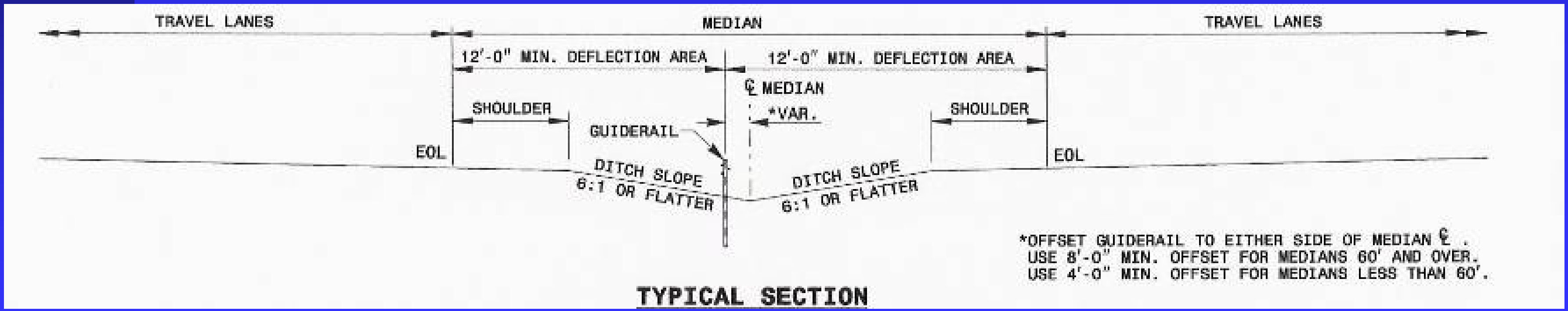
Tractor Trailers



Cable Penetration Evaluation

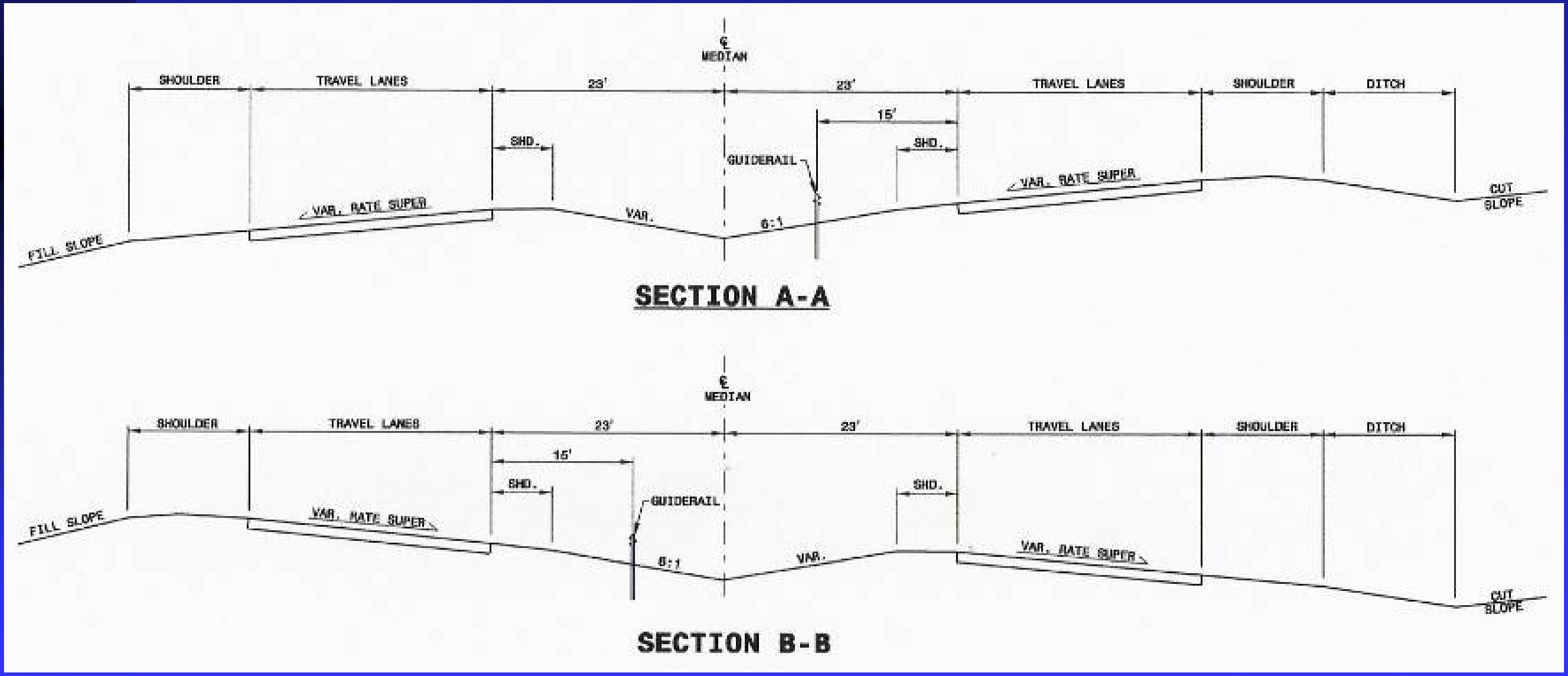
Site Characteristics

- Cable typically 4 feet offset from the ditch centerline
- Two strands of cable closest to the traffic and One strand on the ditch side
- Vast majority occur on tangent alignments
- Impact angle 11 to 90 degrees

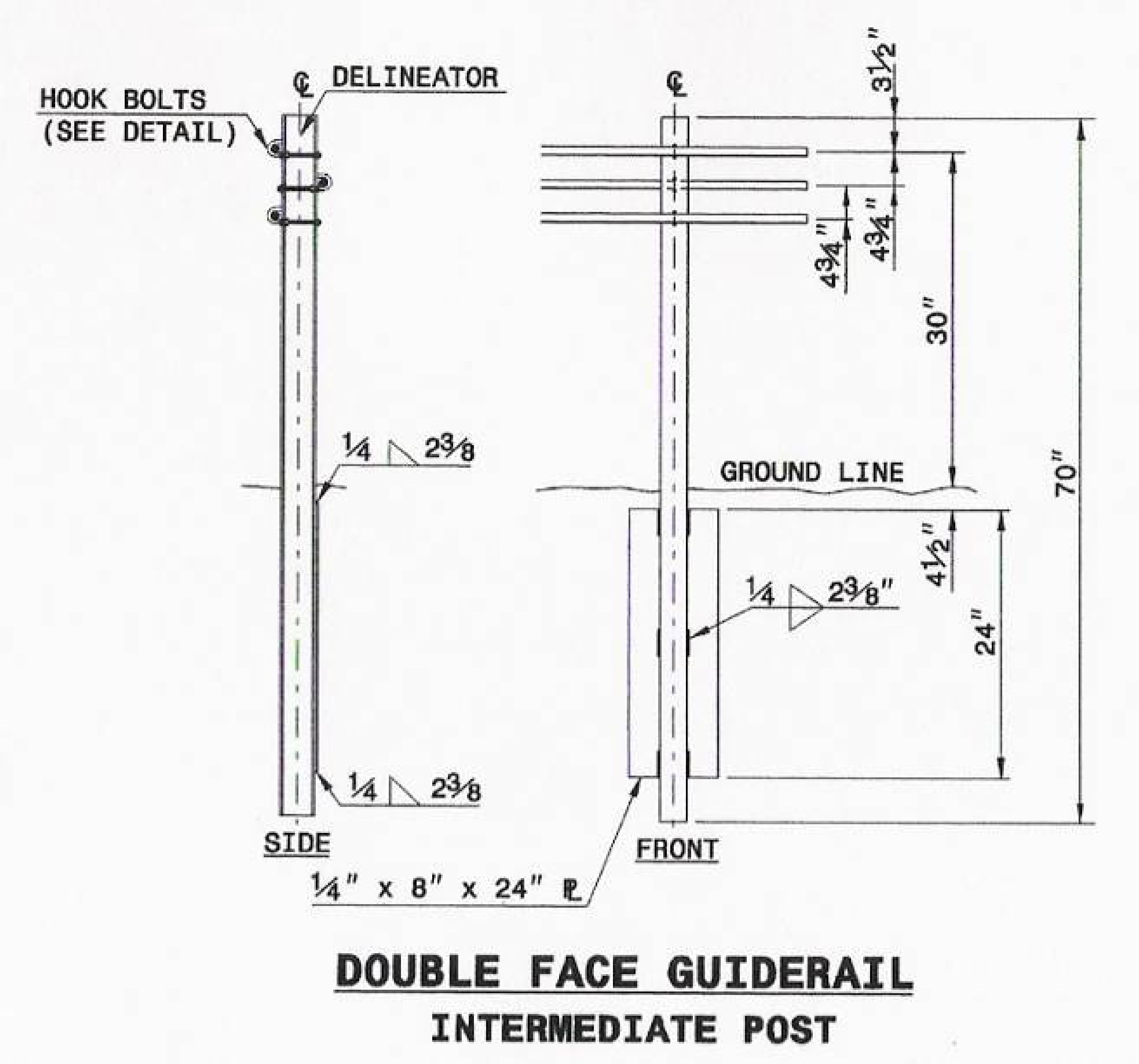


Cable Penetration Evaluation

On curved alignments the cable guardrail is placed 8 feet from the centerline of the ditch



Cable Penetration Evaluation



Cable Penetration Evaluation

Cable Penetration Evaluation

Common Themes

Under-rides account for a vast majority of the breaching crashes

Analysis Results

George Washington University has taken NCDOT data and performed a Finite Element Data Analysis to model our under-ride crashes

Vehicles under-rode cable in the computer simulation

Vehicle Suspension Dynamics are the key to under-ride crashes

Cable Penetration Evaluation

Common Themes

Turner Fairbank tested a Crown Victoria in a crash test with a 1 foot offset from the bottom of the ditch

The Crown Victoria did not under-ride the cable

Cable Penetration Evaluation

General Recommendations from analysis and testing

Add an additional cable - a forth cable at a lower height

Simulation shows that a maximum redirection can be achieved if the area from 1 foot - 8 foot from the bottom of the ditch is avoided

This language is present in the Chapter 6 draft re-write of the Roadside Design Guide

Tie the 3 strands of cable together to have the cables act as a netting system

Keep 3 strands and increase the gap from 4 3/4” to 8”- 9”. An example for 8” gapping, place the top strand at 33”, middle strand at 25”, and bottom strand at 17”.

AASHTO Technology Implementation Group - Cable Median Barrier

Purpose

- Development of Cable Median Barrier Best / Practices Guidelines

Emphasis Areas

- Background and Problem Identification
- Roadway Design Issues
- Maintenance Issues
- Benefits and Evaluations
- System Threats

Deliverables

- Brochure / Presentation / Documentation
- Web Site - Clearinghouse for Cable Barrier Information

http://www.ncdot.org/doh/preconstruct/traffic/reports/AASHTO/

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Questions ?