



Highway Traffic Barriers – Testing, Performance, and Design

An Online Continuing Education Course for Engineers

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Credit: 2 Hours / 2 PDH / 2 CPD

Highway Traffic Barriers – Testing, Performance, and Design

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Purpose

The purpose of this course is to instruct highway engineers, safety experts, forensic engineers, public works officials, and other professionals on the principal criteria used in the testing and design of highway traffic barriers. For five (5) basic types of roadside barriers in common use, information is provided on how they performed in full-scale crash testing and in actual service. The history of their development is included to show how the types of barriers evolved in response to problems experienced in real-world crashes and during performance testing.

Many earlier designs continue to perform as intended but have become obsolete due to changes in the common fleet of vehicles to be served. The most significant changes resulted from the popularity of SUVs and recognition of the need to handle greater numbers of vans and pickup trucks on the road.

The course also should lead to an understanding of how and why many real-world crashes differ from theoretical design conditions and from full-scale crash testing. The concept of Impact Severity is explained as a means of comparing crashes at different speeds and impact angles. It is assumed that the student will have a basic understanding of calculations for kinetic energy. It will be explained how to calculate minimum turn radius, critical speed, and maximum impact angles for real-world crashes.

Examples are given of two (2) major vehicle crashes, which became court cases, and these are used to demonstrate the analytical methods covered in the course.

Outline

- 1. Definitions and Primary Function of Roadside Traffic Barriers**
- 2. Historical Testing of Guide Rail (GR) as Roadside Barriers**
- 3. Modern Testing and Performance Measures**
- 4. Barrier Types, their Historical Development and Performance Levels**
- 5. Examples of GR Penetration in Real-World Crashes**

1. Definitions and Primary Function of Roadside Traffic Barriers

This course will focus on the major types of roadside traffic barriers in common use except for concrete median barriers and safety shapes. The American Association of State Highway and Transportation Officials (AASHTO) defines a roadside barrier as a "longitudinal system used to shield vehicles from hazards in the roadside." The roadside barriers discussed herein are guide (or guard) rails. We can simplify the discussion by using the term "GR" to represent such roadside barriers. Other types of traffic barriers include impact attenuations (crash cushions), which are normally used in gore areas, toll booths, and similar locations. These will not be covered here.

Roadside barriers are installed to prevent vehicles from encountering some roadside hazards and to safely redirect the vehicle back onto the roadway. It is tempting to think of preventing the vehicle from reaching the hazard as the overriding objective, but this would be misleading (attorneys sometimes try this when their claimant's vehicle speeds through a guide rail and encounters some hazard). If the overriding objective was just to keep a vehicle from hitting some hazardous object or going over an embankment, we would just build a vertical wall that could not be penetrated.

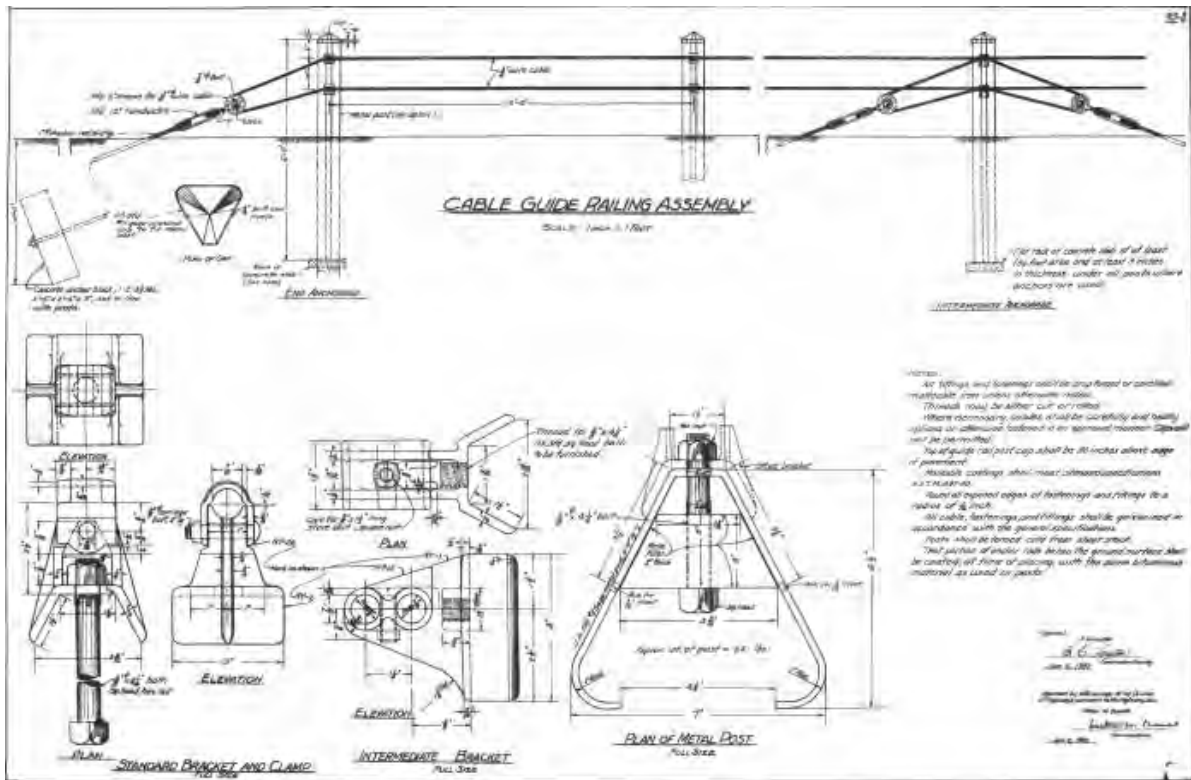
The primary function of any traffic barrier is to reduce the potential for injuries or fatalities to motorists using the highway when a safe recovery area cannot be provided. This requires some compromise or trade-off between the strength or rigidity of the barrier and its ability to yield enough to keep deceleration rates within safe levels of human tolerance.

2. Historical Testing of Guide Rail (GR) as Roadside Barriers

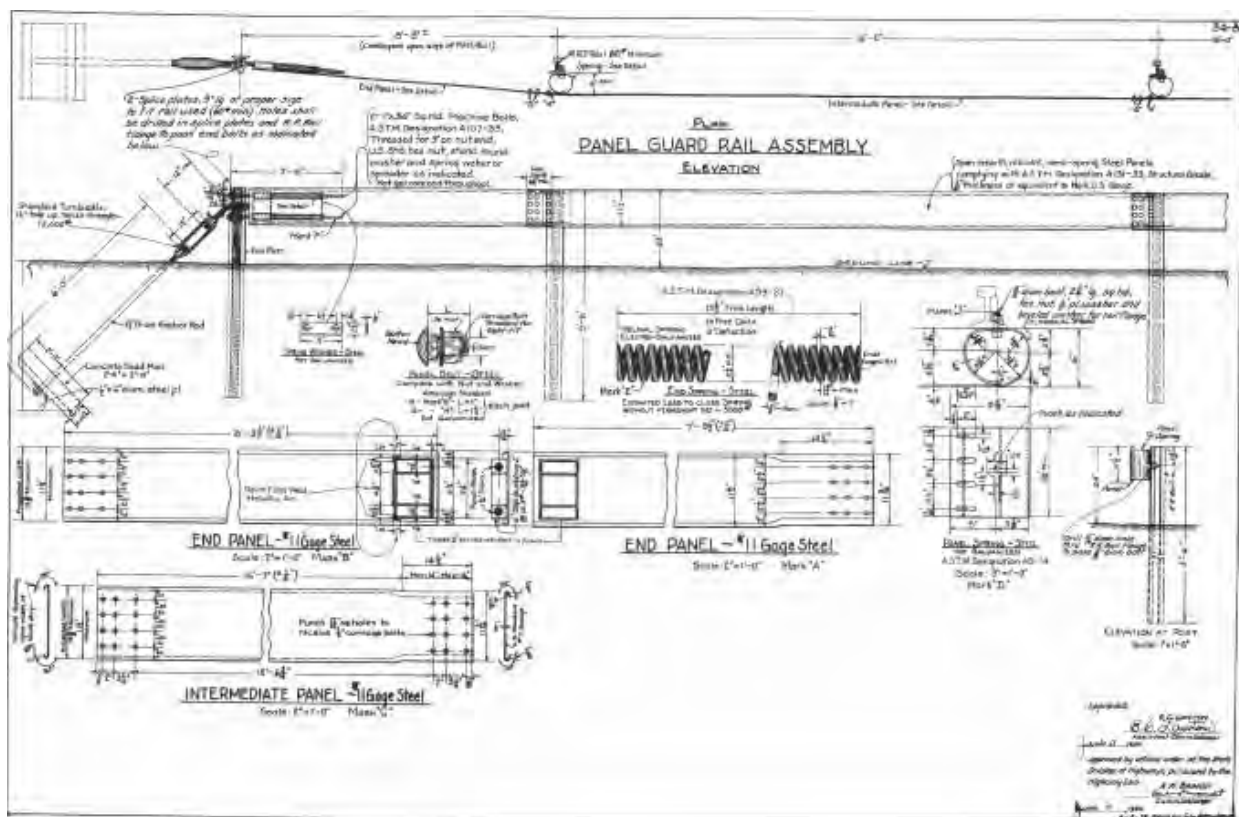
In 1931 and 1938, the American Road Builders Association published extensive reports on the earliest GR designs and testing that had been done. These listed the types of GR then in use, some of which remain in place today. A cursory review of this and other early publications revealed more than 30 different types or styles of GR were in use during that era. For example, New York State once used Boulder Guide Rail, Wooden Guide Railing, Panel Guard Rail, cable above a wood beam, Concrete-Wood Guide Railing, and Tuthill Deep Beam, among others.

The US Bureau of Public Roads reported on GR types in 1924 and provided specifications on wooden and wire GR in 1927.

Initially, GR was used mainly to identify the limits of the roadway and prevent vehicles from entering steep embankments or bodies of water. By the late 1930s, it was felt that GR should also be designed to deflect vehicles back onto the roadway without injury to occupants. There also was concern about the danger of overturning the vehicle. Designs such as Boulder Guard Rail and concrete posts were used (and still exist) but clearly could not serve most of these purposes. There were plate, beam, masonry wall, and wire mesh designs that at least had some re-directive capability and would have been easier on occupants.



NYS Cable GR (1932)



NYS Panel GR (1934)

Early designs were tested by static loading. Tests were also done by rolling heavy cars and trucks down a hill to gain speed and impact the installation. The impact angle was normally 20 deg., with test speeds around 30 MPH.

3. Modern Testing and Performance Measures

Standards for testing and evaluating the performance of traffic barriers improved substantially as new methods of guidance, measuring, filming, and mathematical analysis came about. Research, scientific analysis, and full-scale crash testing have been carried out over the years by various institutions, including the Texas Transportation Institute, the Midwest Roadside Research Facility (Nebraska), and the Southwest Research Institute. It also was done by numerous states, notably California, New York, and Texas.

The results of these tests are contained in the numerous publications of the American Association of State Highway and Transportation Officials (AASHTO) and the Transportation Research Board. The Board was formed in cooperation with the Federal Highway Administration and the Department of Transportation oversight for the National Highway System.

Testing Criteria

Comprehensive testing criteria were established in 1960 (Highway Research Board, Guidelines for Testing Traffic Barriers, issued by AASHTO in 1977 as the Guide for Testing Traffic Barriers). The recommended crash test conditions:

