Concrete Barriers

Designed to redirect, slow, or stop an errant vehicle from causing a more severe crash, crashworthy concrete barriers come in a variety of shapes and heights that affect crash performance. The crash performance of barriers also depends on the type of vehicle, speed, and other variables. Understanding these variables enables highway agencies to select the most appropriate type of barrier to address specific safety concerns.

Safety Shape Barriers

Safety shape barriers are designed to mitigate the energy of crash impacts. These barriers begin with a 3-inch vertical face at the pavement level, then break to a sloped face, changing to a nearly vertical face at the top of the barrier. The overall height is at least 32 inches above the pavement. When a vehicle impacts a safety shape barrier, a significant portion of its energy is absorbed in the climbing or lifting action that occurs when the tires roll up the lower sloping face. In low-speed impacts, the vehicle may redirect with no sheet metal contact with the face of the concrete wall. In medium speed impacts there is likely to be damage to the vehicle, but the force experienced by the occupants will be minimized. In high speed impacts there will be significant vehicle damage and minor to moderate injury potential to the occupants.

Source: FHWA

Jersey Barriers: Jersey barriers are the original and most widely used safety shape concrete barriers. The only difference between Jersey barriers and F-shape barriers is that the distance from the ground to the slope break point is 13 inches in Jersey barriers, versus 10 inches for F-shape barriers. In high speed impacts, there is a greater likelihood that a small car will be rolled by a Jersey barrier than by an F-shape barrier.

F-Shape Barriers: The F-shape barrier was specifically engineered to limit the potential for small cars to rollover upon impact. The F-shape barrier begins with a 3-inch vertical face at the pavement level, then breaks to a sloped face that rises to a height of 10 inches, before changing to a nearly vertical face at the top of the barrier. F-shape barriers are <u>not</u> shaped like the letter "F." They get their name from the research study that analyzed the performance of barrier design parameters, where barrier configurations were labeled A through F, and F was the best-performing design.

Single- or Constant-Slope Barriers

9.1 Degree Single-Slope Barriers: The 9.1 degree single-slope barrier, developed in California, has a constant-slope face that makes an angle of 9.1 degrees with respect to the vertical. It performs comparably with the F-shape barrier, with little potential for rollover. However, the single slope barrier will absorb none of the crash energy by lifting the vehicle, so there is always sheet metal damage, and the occupants feel the full force of hitting a concrete wall.

Constant-Slope Barrier: The constant-slope barrier has a constant-slope face that makes an angle of 10.8 degrees with respect to the vertical. It performs comparably with the Jersey barrier.

Vertical Barriers

Like single- or constant-slope barriers, vertical concrete barriers are not designed to absorb crash energy, and there is added potential for an occupant's head to hit the wall if the wall is high enough. However, crash tests have demonstrated that vertical concrete parapet walls can perform acceptably as crashworthy traffic barriers.

Truck Barriers

Higher concrete barriers are sometimes used as truck barriers and to provide an integral glare screen on concrete medians. The New Jersey Turnpike Authority has crash-tested and developed a 42-in high concrete median barrier that can safely contain and redirect tractor trailers to an upright position. The Ontario Tall Wall is another crash-tested truck barrier option.

Source: FHWA

Overlay Considerations

A benefit of the constant slope, single slope, or vertical barriers is that multiple overlays can be applied without affecting the geometry, or performance, as long as the total height remains adequate. "Safety shapes" allow for no more than 3 inches of overlay unless constructed taller than 32 inches to accommodate the additional pavement.

For More Information

AASHTO-AGC-ARTBA Online Barrier Hardware Guide: **http://aashtotf13.tamu.edu/**

Charles F. McDevitt: "Basics of Concrete Barriers," *Public Roads*, Vol. 63 No. 5, March/April 2000:
http://www.fhwa.dot.gov/publications/publicroads/00marapr/concrete.cfm

FHWA Crash Test Acceptance Letters for Longitudinal Barriers:
http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/barriers/

Frequently Asked Questions: Barriers, Terminals, Transitions, Attenuators, and Bridge Railings:
http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/qa_bttabr.cfm

Roadside Design Guide , AASHTO, 2006: **https://bookstore.transportation.org/Item_details.aspx?id=148**

Nicholas Artimovich
FHWA Office of Safety
Roadway Departure Team
nick.artimovich@dot.gov
202-366-1331

http://safety.fhwa.dot.gov/index.cfm

Safe Roads for a Safer Future
Investment in roadway safety saves lives

U.S. Department of Transportation
Federal Highway Administration