

Placement of crash cushions

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Preamble

Crash cushions are end treatments used to safely terminate an installation of longitudinal safety barrier. While crash cushions must meet crash testing requirements, often the recorded crash test occupant risk values at the connection between the longitudinal safety barrier and the crash cushion are relatively higher than those for the longitudinal barrier and can be near the maximum values specified in the AASHTO Manual for Assessing Safety Hardware (MASH).

Audience

- Road Agencies,
- Road Designers.

Background

The connection between a longitudinal safety barrier and a crash cushion generally results in a transition from a more flexible system to a stiffer one. Impacts in this area, if not designed and installed appropriately, can cause vehicles to pocket or snag and produce high occupant risk values and severities.

AS/NZS 3845 Road Safety Barrier Systems and Devices prescribes MASH as the basis for crash testing procedures for crash cushions. Multiple performance criteria must be satisfied including occupant risk parameters. A 'preferred' and a 'maximum' limit for occupant risk are specified. It is desirable that occupant risk indices not exceed the preferred limits and recommended that they not exceed the maximum values.

The Austroads Safety Barrier Assessment Panel assesses the proposed connection of longitudinal road safety barriers to crash cushions. This assessment reviews full scale crash testing and endeavours to document the risk of occupant values exceeding those prescribed in MASH. This can include risk mitigation strategies e.g. speed restrictions. However, the assessment cannot thoroughly consider all site specific conditions that may be encountered during deployment.

Redirective crash cushions

The rear of a redirective crash cushion includes a stiff backup structure, required to resist frontal impact loads. As a result, it is a requirement of AS/NZS 3845 that crash testing is undertaken at the connection between the longitudinal safety barrier and the backup structure using Test 37.

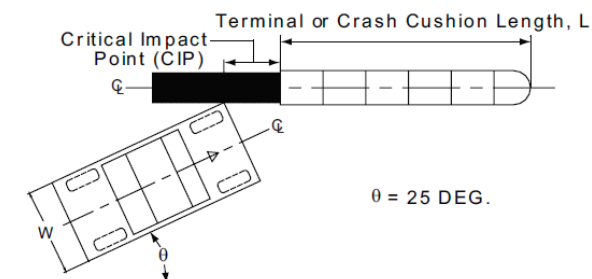


Figure 1: Test 37

Source: AASHTO Manual for Assessing Safety Hardware

Test 37 examines the behaviour of redirective crash cushions during reverse direction impacts including vehicle stability and occupant impact outcomes. When tested at 100 km/h, the occupant values are often nearing or at the maximums specified in MASH.

Water filled crash cushions (non-redirective devices)

Water-filled crash cushions are commonly used in temporary traffic management. Water-filled crash cushions have no redirective capacity. It is a requirement of AS/NZS 3845 that crash testing is undertaken at the connection between the freestanding water-filled unit at the rear of the cushion and the longitudinal safety barrier using Test 44.

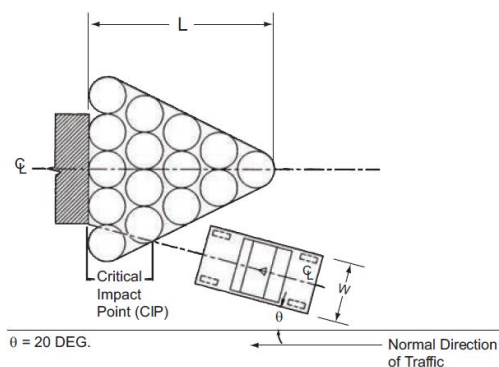


Figure 2: Test 44

Source: AASHTO Manual for Assessing Safety Hardware.

Non-redirective crash cushions are not designed to safely attenuate this impact for occupants and at higher speeds (> 80 km/h) occupant risk parameters may exceed maximum limits. As a result, occupant values are not part of the formal evaluation criteria for Test 44 but are reported as a means to assist Road Authorities and Installation Designers in understanding the potential operational risks.

Commentary

Full scale crash testing has demonstrated that there is a higher risk of injury if a vehicle impacts the connection between a road safety barrier and a crash cushion, than an impact along the longitudinal barrier length. Therefore, appropriate consideration of the location of the connection should be undertaken to manage the likelihood of an impact. The likelihood of an impact is influenced by multiple factors. Generally the largest influence on the likelihood of an impact, that can be controlled, is the lateral offset and the longitudinal location of the crash cushion interface with respect to the geometry of the roadway.

The connection between a road safety barrier and a crash cushion should be located at an appropriate distance from the carriageway edge (refer to Austroads Guide to Road Design Part 6) and along road lengths without compromised geometry i.e. moving a crash cushion away from minimum road curvature to a section of straight alignment is preferred.

Where the location of the connection cannot be managed, a reduction in speed should be considered to mitigate the severity of an impact.

Recommendations

It is recommended that the location of the connection between a road safety barrier and a crash cushion is purposefully considered with a view to identify locations where the likelihood of an impact can be managed. The Installation Designer should undertake a risk assessment to document the decision-making process for the site specific considerations.

Water-filled crash cushions are not recommended where the operating speed cannot be managed to 80 km/h or less.