

Challenge 1: The RTA Crash Barrier Challenge

BACKGROUND

The ongoing maintenance program of the road network in NSW requires considerable resources. Unlike the construction of new roads, road workers undertaking maintenance works are in a close proximity to traffic. Statistics from the RTA state: in 2007 there were 467 crashes at roadwork sites in NSW. 14 people were killed and 271 were injured. Injuries to road workers in NSW cost millions of dollars each year, but the financial and human toll could be much lower if drivers slowed down and observed road work speed limits. (RTA, 2007)

Due to the high volume of traffic using the road network, large numbers of road workers are required to perform ongoing maintenance. Your role is to design a (scaled) prototype crash barrier device to protect these workers from wayward vehicles. Currently, large road works are well-lit and have signs warning motorists of the changes ahead. These often involve flashing lights and reflective signs to ensure drivers are aware of the hazards and personnel ahead. Road works of extended duration generally have concrete barriers to protect the workers. During minor or intermittent works, concrete barriers may not be appropriate due to their weight and the resources required to set them up. A new type of barrier is to be designed by your team of consultants which can be easily transported on a flat-bed truck. Your team's scaled prototype design will be tested by a single head-on crash involving a model car. Your design will be assessed on the final location of the vehicle and barrier after impact (did it stop the vehicle effectively?), weight of the device (lighter devices allow easier handling) and footprint of the device (smaller devices take up less room on the truck).

MATERIALS (RULES FOR)

Each team may use any materials which are available and comply with the following rules:

1. No materials with stored energy. Examples include (but not limited to) springs, rubbers bands, falling masses or pressurised gases.
2. No liquids.
3. No adhesives may be used between the device and the track. Examples include (but are not limited to) double sided tape, glue, Blu Tack.
4. No objects that deliberately cause damage to the car or track.
5. Maximum weight of device to be 1000g.

RULES OF THE COMPETITION

1. Results will be based on three criteria:
 - a. The weight of the device.
 - b. The footprint of the device.
 - c. The distance the device and/or car travels before coming to a complete stop.
2. Devices must be no larger than 120mm (wide) x 300mm (long). A maximum height of 300mm is allowed.
3. Teams will be able to test their device once only.
4. Teams will be disqualified if in the opinion of the judges their device damages either the car or the track.
5. The car will be driven down the track and impact with the device near point (A) shown in Figure 1.
6. All judges' decisions are final.



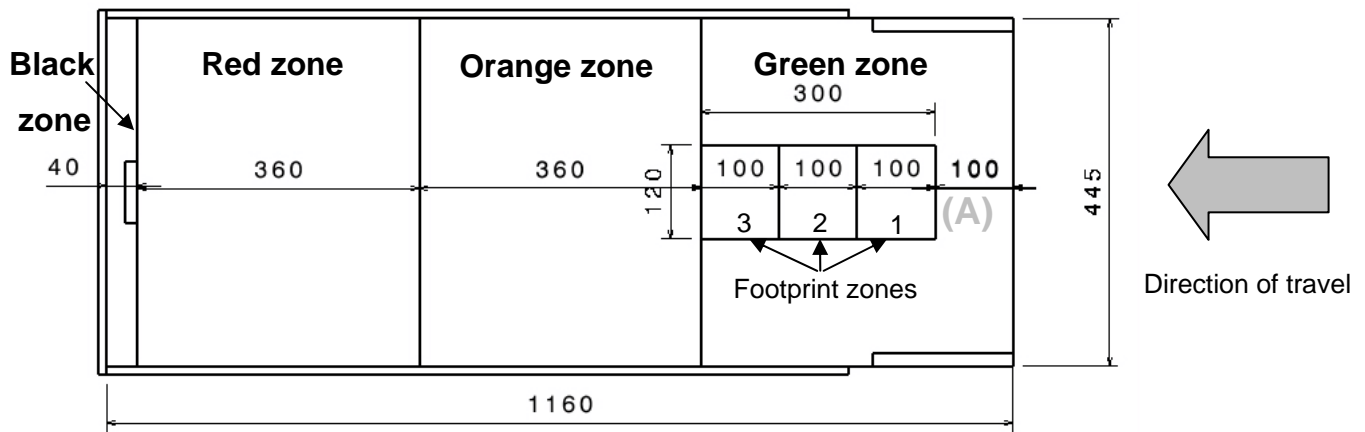


Figure 1: Location of zones on the crash board

TESTING

1. Teams will have their device weighed on the scales provided prior to testing.
2. Teams will have their device measured. If the device exceeds the specified envelope 120mm (wide) x 300m (long) x 300mm (high) the device shall receive a score of zero.
3. A representative from the team is then to place their device behind the line of the first footprint zone – point (A).
4. The judge(s) will determine whether the device resides in or over 1, 2 or all 3 footprint zones (the greater the number zones your devices covers, the lower your overall score).
5. A judge will start the car and the electric circuit will cut power to the motor 100mm from the start of footprint zone 1.
6. Once the car and device have stopped moving the judge(s) will make a determination on which zone (green, orange, red or black) the furthest point of the car or device ends up at.
7. In the event that either the car or the device enters into the black zone at any point, the final result will be recorded as being in the black zone (even if the car or device leaves the black zone).

SCORING

Scores will compromise of three elements each normalised to be out of 1000 then given a weighting.

1. The weight of the device.
 - a. The weight of the device is referred to as 'g'.
 - b. Devices over 500 grams will score zero.
 - c. The expression used to determine the score is: $1000 - 2g$.
2. The footprint of the device.
 - a. Devices entirely in footprint zone 1 score 1000.
 - b. Devices entirely within footprint zones 1 and 2 score 700.
 - c. Devices entirely within footprint zones 1, 2 and 3 score 300
 - d. Devices exceeding all three footprint zones score 0.
 - e. Devices taller than 300mm at any point score 0.
3. The distance the device and/or car travels before coming to a complete stop.
 - a. If the device and car both stay entirely within the footprint zones the score is 1000.
 - b. If the device and car both stay entirely within the green zone the score is 1000.
 - c. If either the car or the device enter the orange zone the score is 500.
 - d. If either the car or the device enter the red zone the score is 150.
 - e. If either the car or the device enter the black zone the score is 0.

The overall score is calculated by substituting the values from items 1 – 3 into Equation 1 where appropriate:

$$\text{Equation 1: } 0.2 \times (\text{Score for weight}) + 0.3 \times (\text{Score for footprint}) + 0.5 \times (\text{Score for distance})$$

REFERENCES

RTA (2005) Road Office – road worker safety (Accessed June 2007)
<http://www.rta.nsw.gov.au/roadsafety/advertisingcampaigns/roadworkersafety.html?rsfid=worksite>

