ARTSA's Brake Test Investigation – Part 3 Roll-Stability Control Effectiveness

This article, which is Part 3 in the series of four articles, describes testing that ARTSA commissioned to investigate the effectiveness of roll-stability control on a semi-trailer. The tests provide a basis for the recommendations in the ARTSA brake code.

Stopping tests were conducted using a semi-trailer that was braked to stop on a sealed, dry, flat and curved roadway having a 'J-turn' radius of 46m (150 ft). The test semi-trailer driver attempted to follow the 'J-turn' within a 3.7 m lane, at a constant speed. The maximum entry speed that could be achieved without the trailer rolling over was determined. Rollover was judged to have occurred when the outrigger safety-wheel touched the roadway. The same driver drove all of the 99 test runs and the driver did not apply the brakes until the performance had been determined.

Testing was conducted with truck Electronic Stability Control (ESC) on or off and with the trailer Electronic Braking System (EBS) on or off. Both the ESC and EBS have a roll-stability control feature. Because the tests did not involve any sudden evasive maneouvers, there was no ABS intervention and no differential ESC intervention. The only response that could be triggered was for the roll-stability control feature to apply the brakes and slow the vehicle for tests with the electronic control system turned on.

The prime-mover was a Volvo FH 6x4 and the trailer was MaxiTRANS with a BPW tri-axle set. (See article 2 for additional vehicle details). Volvo and BPW provided the test vehicles without charge and the financial support of the Queensland Department of Transport and Main Roads is also gratefully acknowledged. The tests were conducted professionally by the Australian Road Research Board (ARRB) at DECA's Shepparton test track.

A useful ESC intervention on the prime-mover is shown in Figure 1. Both runs are for the fully-loaded vehicle. Without any stability control active, the trailer tipped over when driven in at 50 km/h. With stability control active on the prime-mover and trailer, the same truck safely travelled the curve at an entry speed of 55 km/h; its speed being automatically slowed to ~ 40 km/h by roll-stability control.

The graph shows the results for all conditions. The likelihood of roll-over is greatest when fully laden as might be expected. In the half-laden condition, the semi-trailer is more likely to roll-over when the load is above the drive-group than above the trailer-group. When the trailer EBS is turned on there is about a 5 km/h (10%) increase in the entry speed that can be tolerated. When the prime-mover ESC is turned on there is about a 10 km/h (20%) increase in the entry speed that can be tolerated without rolling over. Note that the roll-over threshold (SRT) for the fully laden vehicle without stability control intervention can be calculated from the test results: SRT ~ 0.394.

It is not practical to retrofit ESC to a truck whereas it is practical to retrofit EBS to a trailer. So trailer EBS provides an attractive option for operators to protect against roll-over if the prime-mover does not have it. These results are not the full story because ESC and EBS also improve the brake balance when the combination is lightly laden which helps when evasive maneouvers are made. These additional benefits will be considered in Part 4 of this series of articles.

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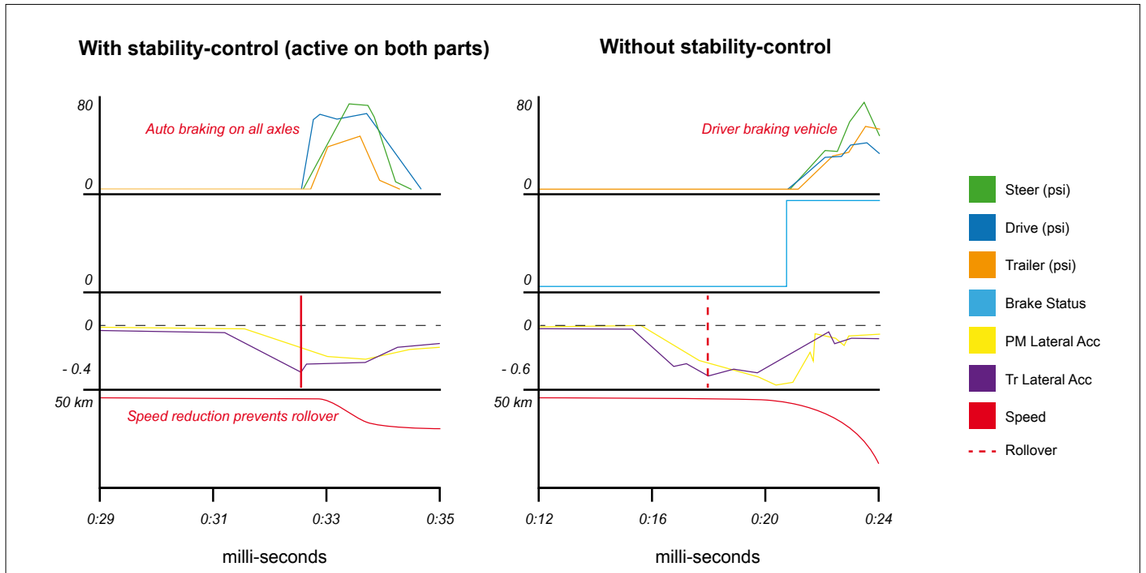
ARTSA Chairman

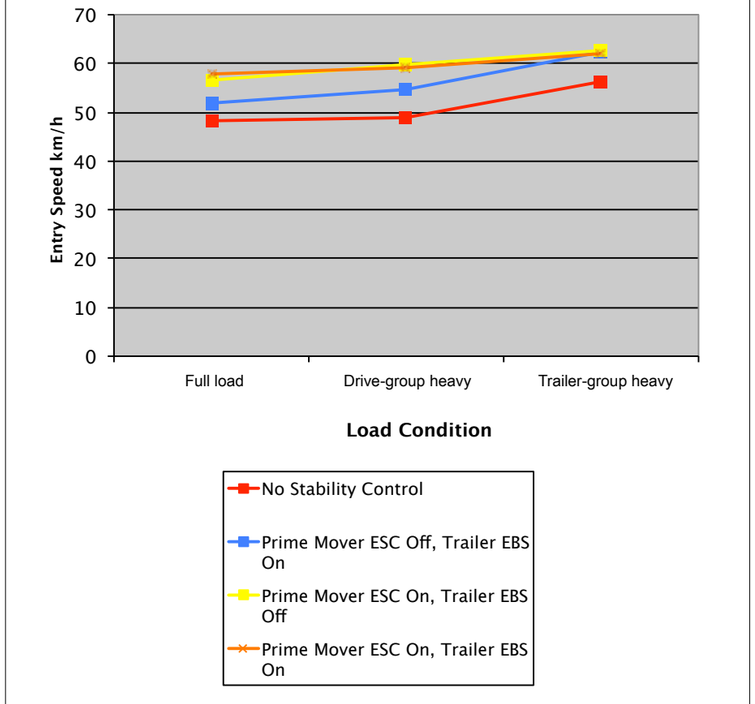


Actual test traces for the same load case. (Figure 1)

Correction: The identifiers on the graph published in the previous Chairman's Technical Article are incorrect and should have been swapped. The deceleration achieved with the Antilock OFF was higher than with the Antilock ON. The description in the text is correct.

Tests Conducted with three different load levels:

FULL LOAD	STEER AXLE WEIGHT	DRIVE-GROUP WEIGHT	TRAILER-GROUP WEIGHT	TOTAL VEHICLE WEIGHT
FULLY LOADED	6.15 T	16.35 T	19.50 T	42.00 T
½ LADEN, DRIVE-GROUP HEAVY	6.25 T	17.35 T	12.05 T	36.65 T
½ LADEN, TRAILER GROUP HEAVY	6.40 T	9.90 T	18.95 T	35.25 T
UNLADEN (UNTESTED)	5.15 T	8.83 T	8.65 T	22.63 T



Results for the three load conditions. Note that for practical reasons 62 km/h was the maximum entry speed. (Figure 2)