



Silvertip Design

Carl Henderson, the talented engineer who runs Richmond, North Yorkshire-based engineering consultancy Silvertip Design, has already chalked up considerable success at BTAC trials. In 2005 his Steering Correction Mechanism (SCM), a self-steering system for semi-trailers, demonstrated how a 16-metre trailer could stay comfortably within steering-corridor limits governing current 13.6-metre trailers. Mr Henderson proved that it is possible to achieve a manoeuvrable and stable 18.75-metre articulated outfit offering 18 per cent more deck length than current configurations. The SCM went on to win top prize in the "concept" category of the pan-European Trailer Innovation awards at the huge 2006 Hanover commercial vehicle show (*Transport Engineer* October 2006).

At this year's BTAC event Mr Henderson set out to explore the potential for improving articulated vehicle roll stability. Research in the US, Australia and New Zealand suggests typical tractor/semi-trailer outfits have a roll threshold of between 0.35 and 0.4g of lateral acceleration. A rule of thumb suggests that any truck with a roll threshold lower than 0.3g is unacceptable. Analysis of truck rollover accidents shows a clear correlation between theoretical rollover thresholds and involvement in real-life accidents. Hence Mr Henderson's interest. Supermarket chain Morrisons provided him with a tractor and semi-trailer for test work. Jost provided a modified fifth wheel coupling and turntable.

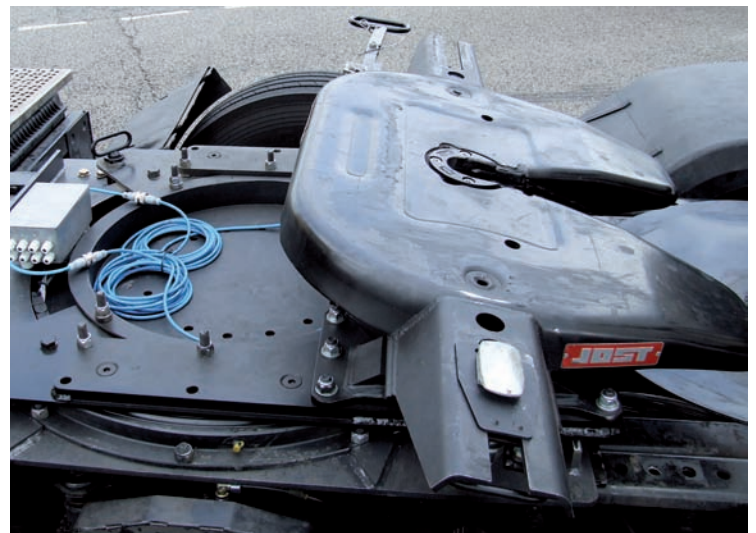
Mr Henderson is focusing on the fifth-wheel coupling and its contribution to an artic's overall rollover threshold. His proposal is an adaptation of the conventional kingpin and fifth-wheel coupling. Both those components remain as the mechanical link between the two parts of the outfit, but they are relieved of their articulation duty. A turntable does that instead. The turntable straddles the tractive unit's main chassis members, just ahead of where the fifth wheel would normally sit. There is a tail on the turntable on which is mounted the fifth-wheel, positioned so that it sits in pretty much the same point on the chassis as usual, complying with the overall length limit. The fifth wheel has a pair of wing-like extensions, slotted to take twist-locks on Mr Henderson's working prototype. When the trailer has been coupled up in the normal way, the twist-locks are slid into place so that they clamp the fifth-wheel to the trailer's main rails. Thus, the fifth wheel now turns with the trailer, not the tractor. The coupling's fore-and-aft pitching movement between top plate and pedestals is still possible, but the normal lateral roll due to kingpin "lash" (free play before the kingpin's flange prevents the trailer pulling it upwards and outwards from the fifth wheel during cornering) is no longer there.

Mr Henderson explains that he is trying to improve roll stability in two ways: "We are stiffening up the trailer with the tractor unit, by eliminating lash in the fifth wheel." Not only does the tractor add extra stability, but stiffening the connection means that more of

the trailer's roll movement is transmitted through to the tractor, so the driver is more aware of the trailer's behaviour. One of the common observations made by drivers involved in rollover accidents is that they had little sensation or forewarning that their trailer was about to overturn.

The second roll-stability benefit from Mr Henderson's set-up is harder to grasp. It stems from the fact that the fifth wheel's pedestals (and hence pitch axis) are some 400mm behind the turntable centre. This becomes a sideways offset during cornering. Mr Henderson says the combination of the offset and the vertical forces imposed on the pitch axis produces an inwards roll moment when cornering, countering the normal outwards roll.

All in all, Mr Henderson believes this turntable system is capable of improving a vehicle's roll threshold by 20 to 30 per cent. Removable locks on both the fifth wheel and the turntable allowed comparison of the vehicle with its normal coupling and with the turntable, running on Mira's ride and handling track. "It generally felt smoother and more comfortable with the turntable, particularly as we went into and out of the dips in the track," says Mr Henderson. On the key question of roll, little difference was felt by



the driver. "That's because we have less roll, but the driver feels more of it, so on balance it feels much the same as usual, but there is an extra margin of safety," explains Mr Henderson. He expects data from accelerometers and strain gauges on the vehicle to support his hypothesis.

Mr Henderson now plans more track testing using a trailer with safety outriggers, enabling roll threshold to be explored. But better roll stability is not the only benefit of this turntable coupling, he points out. "It makes automatic coupling possible as well," he says, explaining how the fifth-wheel's clamping wings could also carry electrical and air connectors that would spring up to engage in corresponding sockets in the trailer's running plate. "That would eliminate the suzies and you can close up the cab gap because you don't have to leave room for the driver to get onto the catwalk," says Mr Henderson.

