

SPOTLIGHT ON INNOVATION

Improving productivity, safety or efficiency in processes by implementing a simple change is any business's dream. *Diesel* Editor **TIM GILES** finds that small innovations can result in big gains.

It's true that some innovations in equipment come from pure inspiration. An idea pops into an engineer's head and, with a little experimentation, the practicality – or otherwise – of the idea can be gauged. Then comes the process of moving from an idea to a proven end product.

However, for the development of some innovations, the process comes from looking at what you already have and considering the problem from a slightly different angle, then working to improve or adapt the existing technology. This month, in *Diesel's* Smart Innovation feature, we look at two products that seem obvious once you've seen them, but neither had been tried before.

Both of the people we talked to about the development of their new ideas asked why nobody had thought of it before

when the design was tested. One is a rethinking of the way we mount agitator barrels on a truck and another is how we use curtain-sider trailers.

In one case, Boral's Merv Rowlands was in the Mack Modification Centre looking at something else when he noticed

a couple of Boral trucks. That set him off to ask a number of questions about the basic design of the vehicles and, after going down a process to look for a vehicle which was safer and less likely to roll over, Boral has have a truck which is safer, lighter and costs the same – a win/win/win. Driving the two agitators, one of the old design and one of the new, showed just how effective the changes have been. Looking at them side by side, it just seems so obvious.

In the other case, the team at Freightler had done the hard work and developed a new kind of curtain, but failed to immediately grasp the other developments that were possible. There was a simple buckle solution waiting to happen, and it had to wait for eight years to actually appear, making the Freightler team ask themselves, "Why didn't we think of that before?" **IID**



KEEPING TRUCKS UPRIGHT

Some truck operations make it difficult to design a truck to do the job safely. One application which causes particular difficulty is the concrete agitator, with its high centre of gravity. *Diesel* Editor **TIM GILES** talks to Boral about an all-new agitator design that enhances safety and stability.



There is more than one way to skin a cat, according to the old saying, a sentiment displayed by Boral when looking for a way to improve the safety outcomes in its agitator fleet. The quest for a safer truck led the team working on the design to come up with a solution which not only improved safety, but also lowered the tare mass of the truck, with no increase in cost.

The task of thinking about what could be improved in the way Boral builds its agitators fell to Merv Rowlands, Fleet Engineering Manager – Logistics at Boral. The problem to be solved was the overrepresentation of agitators in the number of rollovers experienced in the Boral fleet. Not a problem unique to Boral of course, but a challenge for the concrete industry nationally.

In a diverse fleet like the one Boral operates, the issues are many and varied. Tippers can be susceptible to rollover, especially when unloading on site, but when it comes to rolling over on the highway, agitators are more likely than other vehicles.

In fact, the on-road rollover rate per truck in Boral is virtually the same across the entire fleet. However, the agitators do

far fewer kilometres than the tippers and tankers. The rollover rate per kilometre is highest in the concrete fleet.

Boral has developed a very strong safety culture within its business and its quest to improve safety has been a collaborative process, where all stakeholders get involved in working out the best solution to perceived safety issues.

"It's all about improving safety margins," says Merv. "In any given situation, we need to ensure that drivers keep a healthy distance between where they take a truck and that truck's safe limits. Our work on procedures and behavioural safety training push the drivers in one direction, while our work on improved vehicle design tries to push the truck in the other direction."

During each acquisition round, the company specifies safety enhancements truck manufacturers must include to be considered as possible vehicle suppliers. Most of the enhancements have been around avoiding slips and falls. This includes improved step designs, correctly placed grab handles, high-visibility seat belts and many more small – but important – elements in a truck's design.

The emphasis now has shifted towards improving fundamental vehicle dynamics.

The process Boral has gone through to develop this new concept involved examining the way agitators are designed and built, using a clean sheet of paper and considering all of the options. The solution was to target a lower centre of gravity and a higher static rollover threshold and, as a consequence, reduce the likelihood of a rollover.

There is a traditional design used by just about every concrete business in Australia that has served the industry well over the years. The constant quest for a lower tare has sent companies heading down the route of using lighter spec chassis, for instance, only to see cracked ones as a result. Getting more concrete on board has often led to durability issues.

At the heart of this project for Boral, however, was a drive to improve safety even if it meant coming out at the same tare mass. The emphasis was on making a better mousetrap, not necessarily a lighter one.

A quick look at the typical agitator shows us where one of the issues lies. The agitator barrel is mounted on a subframe, which is bolted onto the top of the chassis

rails. The whole unit sits proud of the chassis and well above the truck. It looks inherently unstable. Add to this a rotating barrel and a constantly shifting load. Follow one around a roundabout and you can see the sway as the high centre of gravity works the rear suspension hard.

The other aspect of the design identified as affecting the rollover tendency was the relative flexibility built into the chassis and suspension. The conventional thickness chassis rails do flex and the airbag suspension allows the whole vehicle to tip when turning.

Diesel took a trip to Boral Concrete's Enfield batching plant in Sydney to have a look at and experience the difference between the traditional agitator and Boral's new low-rider design being trialled there. This plant is one of many in the Sydney area working at full capacity as a series of major infrastructure projects have increased demand for concrete.

REDESIGNING THE AGITATOR

"What we wanted was a better handling truck, to start with," says Merv. "The three areas of focus for us were the chassis stiffness, the roll characteristics of the suspension and the centre of gravity for the whole package."

Starting with the chassis – on the Mack, it is made from 8mm steel, but some have been specified at 7mm thickness. This introduces flexibility into the frame itself. By going up to 9.5mm, Boral reintroduced stiffness into the chassis. To further enhance stiffness, the cross members were also beefed up.

Looking at the suspension, Boral found a Volvo suspension with an inverted leaf steel spring set-up, which can be fitted on Mack trucks. This particular five-leaf suspension has been approved by the road authorities as road friendly. This latter aspect is an important consideration in the concrete game, where payload is paramount.

Added to this, a roll bar was included at the rear of the chassis, beefing up the rollstiffness even further. The chassis height, in relation to the axles, was lowered a further 50mm with the use of a lowering block in the chassis mounting.

One of the issues around rollovers is the feedback given to the driver by the suspension in the moments before a rollover. The airbag suspension was found to give the driver little idea the truck was about to tip. With the steel suspension, the feel from the driver's point of view is much improved.

Another change was to go to 275/70 tyres. This brought the chassis height down to 68mm below the standard used in the past.

The next step was to get Cescio, manufacturers of the agitator mixers used by Boral, to design one without a subframe. The intention was to use the improved stiffness and strength in the chassis as the subframe for the mixer.

"The beam fitted as a subframe on the mixer doesn't actually add a lot to

torsional strength," says Merv. "I don't like using U-bolts, so what we've done is fit chassis angles front and back onto the chassis rails, similar to those used to hold a trailer turntable on a prime mover.

"Then we got Cesco to design the pedestals so they sit on the chassis angles. Importantly, it puts the stress and the load where it should be. The chassis angle is designed to transfer weight onto the web of the frame rail rather than onto the top flange. On a normal mixer, that's where the weight sits. It now spreads the load out and it holds it down really, really firmly. There's no U bolts twisting and moving.

"Cesco could redesign the front and rear pedestal. This enabled them to drop the barrel down as low as possible. However, when you look at the overall height of the rear of the agitator barrel, it's not a lot different. When the truck backs onto something like a pump it needs to be at the same height."

In fact, the barrel has been angled up, going from 13.5° to 16°, increasing the rake of the whole thing. This has led to a number of changes to the chutes, but ended up with the concrete pouring out of the barrel at about the same height as before. At the same time, the change in angle has brought the centre of gravity down.

One of the unforeseen advantages of the redesign is a reduction in the chance

of spillage out of the back of the agitator. The steeper angle holds the concrete further from the lip of the barrel. Currently, Boral has to cut back loads with a high slump of concrete to avoid spillage en route to the job. With the new barrel position this is no longer necessary.

The whole new set-up ended up slightly – around 100kg – lighter than the previous design, however, going to a Hardox barrel has seen the overall weight saving well over 300kg. This constitutes a considerable saving in a sector of the industry where tare weight is king.

"This new 8x4 twin steer truck tared at 8.04 tonnes, a standard one is 8.4 tonnes," says Merv. "That's really important in concrete. There's a lot of steel in those subframes and the front pedestal is much bigger on the old design.

"The price of the truck is all but the same. So, we have got a vehicle which has a much tougher chassis, steel spring suspension with less to go wrong and, overall, a vehicle which has got no real downside. It's lighter and it's the same price.

"We haven't built something where we tried to save weight and made something lighter and more fragile. We've gone the



Merv Rowlands, Fleet Engineering Manager - Logistics at Boral.

other way and ended up with a lighter vehicle. It's been a win/win for us."

Concrete agitators in the Boral fleet are run for ten years, with just the barrel being swapped after five. Of the 1,500 agitators running under Boral colours, half are company trucks and the other half are what the company calls 'LOD trucks' where Boral owns the mixer, but the truck is owned by an owner driver. The renewal process should work through the fleet over the next five or so years.

The redesign also gave Boral a chance to look at other aspects of the set-up on the rear of the agitator. By sitting the



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mixer on top of chassis angles, it has been possible to develop a removable splash tray under the barrel. This means the truck chassis can now be readily and regularly cleaned and not suffer from a build-up of concrete debris.

In the development process, Boral had ARRB do some computer modelling to assess the original concept. The company looked at static rollover threshold and load transfer ratio and predicted that the lowering of the centre of gravity alone would improve rollover performance by 10 per cent. The case was presented to senior management at Boral in order to get funding for a prototype.

Once the truck was built, Mack had to calibrate the electronic stability control system. Testing was done at the DECA track at Shepparton where the truck was fitted with an outrigger frame to keep it safe.

"The testing revealed a massive improvement in the handling," says Merv. "We couldn't get it to tip all the way over onto the training wheels at Shepparton. While the modelling had focused on the centre of gravity, the new chassis and suspension increase the difference between the old truck and the new truck even more, in terms of the handling."

"From both points of view, from computer modelling and from seat-of-the-

pants testing, it was really good. Driver feedback is telling us it not only has better roll stability, but also better straight line stability."

HOW WELL DID THE NEW AGITATOR PERFORM?

To get a handle on the improvement, Diesel took two agitators out to a job. The first was the conventional agitator built in the past, and the second was the new design. Apart from the new layout, every other aspect of the truck was the same.

Anyone who has steered an agitator at all will reaffirm the inherent instability of the platform. It's a bit like being on roller skates – you have the feeling that one false move will make you fall over. This makes the driver keep well within the parameters of safety, especially on roundabouts and other sharp turns.

Jumping into the truck for the second delivery was a complete contrast. The truck felt just like any other, it could have been a fully loaded tipper or box truck. Even in a straight line, the improved stability was obvious. When it comes to corners and roundabouts, the driver feels in full control.

At the same time there is great feedback from the truck. The seat-of-the-pants feeling tells you just how the rear end is reacting. The result is a much

more secure feeling at the wheel. You are no longer riding on roller skates, but a normal stable truck.

The resulting truck from what has been a two-year process is a revelation. The prototype went on the road in April 2016, and has been progressively moved around New South Wales to gain a range of responses. All of the drivers in the depot who had a go with the truck wanted to drive it rather than their own.

Looking at the principles behind this new design, it seems obvious when you look at it. However, no one seems to have even thought about this in recent years. The question is, just what made Merv start thinking about this issue in a new way?

"I was visiting Mack's Mod Centre in Brisbane, where they make all the company-specific changes," says Merv. "I was looking at some agitators which were for us, and the nature of the suspension and the cross members I saw just didn't look right to me."

"Within Boral Logistics, we only use Primaax suspension on all of our tippers and tankers. Then we looked at what they do in America and Europe. There's no



This particular five-leaf suspension has been approved by the road authority as road friendly.

way they would fit air suspension on agitators. Their chassis start at 9.5mm and go up, they even use double-wall chassis. They clearly see the hardest job for a chassis is to carry an agitator.

"You can see it on our older agitators. Many will have a subframe crack. That will disappear now, because there is no

subframe to crack.

We are now having a lot more thoughts about what we are going to do in the future."

By the time you read this, Boral will have nine such low-rider agitators on the road, including four in a 10x4 configuration. **HD**

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