



Lighter, leaner and greener

While the world's politicians argue over how to tackle global warming, a UK consortium is doing something about it with a new breed of double-deck trailers that will cut CO₂ emissions and boost operating efficiency. Brian Weatherley reports

Cambridge University's engineering department, SDC Trailers, Lawrence David and Tesco are developing a new breed of lighter, more efficient double-deck trailers. The first examples of these are currently being trialled on UK roads on everyday distribution operations. The group is tackling two key goals: shave two tonnes off the kerbweight of a standard Tesco double-deck trailer, optimising its carrying-capacity, and achieve a 14% combined reduction in its drag coefficient, thereby saving fuel and cutting CO₂ emissions. The first has already been achieved; the second will be verified on the road over the coming months.

Under the project, which has been running since 2017, membership subscriptions to the Centre for Sustainable Road Freight (SRF) – the collaboration between Cambridge and Heriot-Watt Universities and the freight transport industry – are paying for research conducted by Cambridge University PhD students into aerodynamic improvements and lightweighting components. The cost of building the prototype trailers, incorporating technologies examined by the Cambridge researchers, as well as the operational field trials, is being half-funded (50%) by government agency Innovate UK, with the remainder met by the three industry partners. The trio already has a close relationship, as

SDC Trailers is the chassis supplier to Lawrence David, which builds the body on the double-deck trailers for Tesco. SDC Trailers and Tesco are also SRF members.

Cambridge researchers have already wind-tunnel tested proposed aerodynamic interventions on the prototype double-deckers, including a revised front top moulding (developed by Aerodyne) and a vertical central 'blade' on the front bulkhead (pictured above), as well as a modified version of the tapered rear end (pictured p34) developed by the researchers and implemented in Lawrence David's existing FuelSave body design. The new version features sides that taper in 4.5°, starting 1.48m from the rear of the trailer.

“The main thing the fin does is reduce the air cross-flow when the truck is moving along the road and the wind is coming from the side”

Isabel Vallina-Garcia

Using a one-tenth scale model, the researchers created a flow visualisation by filming the movement of wool tufts attached to the combination in the airstream. Pressure measurements were also taken at the front and rear of the trailer. Data generated so far suggests the new top moulding and vertical blade offer a combined 6% reduction in the trailer’s drag coefficient (C_d), while the tapered tail adds a further 3.4%. How that equates to improved fuel economy and operating efficiency will be determined by the ongoing field trials.

Tesco Distribution’s fleet engineering manager Cliff Smith confirms that the supermarket is looking to verify a number of issues. “One is to really understand the total benefit and advantages to Tesco, from a fuel-saving and increased payload perspective. In the longer term, it’s also to understand the longevity of these products, because we’re using new materials.”

The 2m-long vertical GRP (glass-reinforced plastic) blade protrudes 353mm from the trailer’s front bulkhead. Its design was proposed by the researchers, and the fitment was prompted by project lead Andy Richardson, Lawrence David’s chief design officer. So, what exactly does it deliver? One of the PhD research students looking into the prototype’s aerodynamics is Isabel Vallina-Garcia. She explains: “The main thing the fin does is reduce the air cross-flow when the truck is moving along the road and the wind is coming from the side. This is advantageous because, when the wind is coming in at an angle, on the leeward side of the trailer it creates a separation region, which results in drag. What we see in the wind tunnel with the flow visualisation is that the separation ‘bubble’ is smaller with the fin. So, with less momentum [in the air flow] being lost, the drag originating

from the tractor-trailer gap is reduced as well.” Vallina-Garcia reports it works even when there is no cross-wind, although its effectiveness naturally improves as the yaw angle increases. Again, that will be tested out on the road. Moreover, it doesn’t interfere with trailer articulation.

Regarding the lightweighting, 2,530kg has already been shaved off the 11,330kg tare weight of the Lawrence David/SDC standard double-decker built for Tesco. Richardson reports: “We were aiming to save 2,000kg, and we got that little bit extra through clever design.” Those savings come from



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a number of changes made by both SDC to its step-frame chassis, and the bodywork construction undertaken by Lawrence David.

SAVING MORE THAN A TONNE

SDC's head of engineering Jimmy Dorrian confirms that 1,215kg alone was removed from the regular step-frame double-deck chassis. He states: "We were tasked with removing a tonne from the chassis and we beat that." It was no mean feat. Fortunately, finite element analysis (FEA) proved invaluable when it came to seeing where weight could be saved. "Initially we were sceptical," admits Dorrian, "until we got into the FEA of it. It provided a different approach to the design of the suspension, and where we used the floor as a structural member - we'd never normally do that." Equally important, FEA confirmed the lighter chassis could be built using existing high-tensile steel, rather than more exotic alternatives. "The thing was to keep it production friendly," confirms Dorrian. "If the trial is a success, we want to be able to produce the new chassis as easily as we're currently producing them."

Major changes were also made to the prototype's running gear. Earlier versions of Tesco's double-deckers have twin wheels and tyres; the lightweighted chassis has 445/45 rims and wide single tyres that not only help reduce rolling resistance, but also save a significant

amount of weight. Furthermore, switching to wide singles allowed SDC to increase the standard trailer's axle-beam centres from the normal 965mm to 1,200mm, with consequent benefits. Until now, the regular double-deck trailer chassis has required a heavy-duty suspension to combat body roll. But by increasing the beam centres, "we've not only gained more stability, but also reduced the weight of the suspension arm we needed to use," Dorrian reports. He continues: "Now we just fit a regular nine-tonne suspension arm. So it's actually like a hybrid, with a medium-duty spring, but with standard-duty axle; that's cut quite a bit of weight out, too."

Meanwhile, Lawrence David chose a lighter material to replace the regular GRP-skinned plywood panels used on Tesco's double-deckers (see also pp37-38). Ultimately, Lawrence David opted for Tata Steel's Coretinium steel/honeycomb polypropylene composite panel for the sidewalls, front bulkhead, rear doors, main floor and second (fixed) deck of the lightweighted



prototypes. Compared with the conventional 20mm GRP/ply panels, the Coretinium panels are noticeably thinner, too, at 10mm.

Saving two tonnes on a double-deck trailer's kerb weight has presented Tesco with new opportunities to fully maximise its trailers' carrying capacity. Currently, its standard Lawrence David/SDC double-decker can accommodate a maximum of 75 roll cages. However, a Cambridge University analysis of Tesco's double-deck loadings on regular operations showed they typically weighed-out well before that number. Cambridge's team leader professor Michael Sutcliffe confirms that the figures were systematically below capacity. But by reducing the trailer weight by two tonnes, Tesco's planners could then increase their cage capacity to 75.

As well as increasing operational efficiency, the trailer's potentially higher payloads also mean a lower emissions-per-tonne figure (see box, left). However, as the Tesco prototype double-deckers are currently being used on store delivery work - rather than primary trunking operations - any potential

LIVE ROAD TRIAL RESULTS UPDATE

Tesco is conducting a year-long evaluation of the prototypes using eight 13.6m long/4.85m high Lawrence David/SDC double-deck tri-axle step-frame box trailers. Two are standard versions; two have aerodynamic changes only; two have lightweighting only; and two have both aerodynamic changes and weight-saving interventions.

Early results are promising. A recent day-long head-to-head trial found that the lightweight-aerodynamic combination would consume 11.2% less diesel per tonne-km of transport work than the standard trailer (9.1% due to increased payload; 2.1% from aerodynamics). The test compared two artic-trailer combinations, pulling fully loaded trailers, while cruising at 80kph.

"It's helping the industry, it's helping us and it's helping the world"

Andy Richardson



payload gain will depend on a store's delivery requirements.

Sutcliffe is overseeing the ongoing road trials of the new trailers. "What we're aiming to do is collect data from the baseline trailers and these novel trailers and compare them. We want to evaluate the benefits and build a business case for Lawrence David, SDC and Tesco, so the hard data is there."

While live-load trials have revealed some further work is needed on the prototypes, the results so far are encouraging. Smith reports: "We're already seeing some reworking needed on some floors, so it's early days at the moment. But I don't think anything we've seen so far is a major hurdle."

Meanwhile, Richardson insists that

the project has implications far beyond its current goals, not least in terms of reducing greenhouse gases. "It's helping the industry, it's helping us and it's helping the world." His point is echoed by Smith, who confirms the double-deck trailer project will play a part in Tesco's long-term ambition to be a zero carbon business by 2050, not least through its road transport operations, where it has committed itself to an ambitious target of reducing CO₂ emissions per-case-of-goods-delivered by 25%, set against a 2011/12 baseline. [TE](#)

FURTHER INFORMATION

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'The lean queens' – www.is.gd/onojoq

'Trailer slipstreaming' – www.is.gd/qimolo

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