The DAF Lightweight Future Truck Chassis Concept (FTCC) Project

DAF Trucks’ FTCC ‘Proof-of-Concept’ Demonstration vehicle

1) Project Overview
DAF Trucks, in partnership with Leyland Trucks, has successfully completed a development project to trim an impressive 500kg from a standard unladed 12-tonne box-bodied DAF LF rigid. Thanks to its innovative construction, DAF Trucks’ Future Truck Chassis Concept (FTCC) also delivers lower fuel consumption and lower CO₂ emissions. Based on DAF’s LF cab and driveline configuration, this remarkable weight saving has been achieved at the same time as retaining key product attributes, such as competitive load-deck height, tight turning circle, body start position and the LF’s inherent class-leading handling characteristics.

The research project was co-funded by the British Government’s Innovate UK (formerly the Technology Strategy Board) low carbon vehicle programme with Leyland Trucks leading the project alongside its partners Sapa Profiles UK (suppliers of the new aluminum extrusions) and the Canadian Standards Association Group who conducted vehicle and rig-based testing. Simulation work has demonstrated that the weight saving delivers a 3-to-6% reduction in fuel use.

2) Background and Project Aims
The basic design of truck chassis has changed little in nearly 80 years of development, i.e. a steel ladder frame with I-beam front axle, leaf spring suspension and a separate body sub-frame. Despite this long-standing and generally accepted design, DAF Trucks and its sister company, Leyland Trucks, embarked upon the FTCC project - an ambitious venture, no less, to overturn this convention. The result is a commercially viable truck with at least a 30% weight-saving. As DAF Trucks now offers both chassis cab and fully bodied vehicles, the project set out to deliver a more integrated solution. FTCC is a weight saving solution that does not compromise vehicle reliability and durability for the customer.

3) Design Solution Achieved
Aluminum plays a key part in the FTCC’s make-up; not only was it used for the frame ladder, but also for much of the front suspension, body flooring and front underrun protection. The concept also includes two newly patented chassis design innovations. First, the front underrun protection is mounted on a patented front frame module. This is attached to the side members, which don’t go to the front of the vehicle thus optimising chassis packaging. The second is the body floor structure; this is integrated into the chassis frame design, by incorporating the body sub-frame into the main chassis side members. Additionally, the Proof-of-Concept vehicle includes additional advanced features such as independent front air suspension with rack-and-pinion steering allowing Leyland Trucks’ engineers to evaluate its benefits in terms of ride quality, steering precision and vehicle packaging improvements.

Advance features such as structural component bonding were used throughout the design. Extensive use of aluminum extrusions was used throughout, complemented by the use of components machined from solid aluminium on the initial Proof-of-Concept
demonstration vehicle. A limited number of steel components were used in the chassis structure when stress levels prohibited the use of aluminum. Composite components were considered during the design concept but none could currently achieve the required cost targets.

The main picture below shows the FTCC ladder frame. The extensive use of aluminium can be seen, as only the black items are not manufactured from aluminium.

4) Analysis and testing carried out
The finalised design underwent a large number of design iterations, involving detailed CAE (computer aided engineering) stress analysis. More CAE analysis tools were used to optimise stress levels in individual components and frame integrity, to ensure the design met the product durability required by the vehicle’s duty cycle. Also, the design of the frame structure had to take into account various load inputs from the independent front suspension, compared to today’s leaf spring suspension design.

The proposed design solution was also subject to ‘ADAMS’ dynamic vehicle handling work in the virtual world to compare its improved performance to today’s design.

Once the design had been finalised, a number of prototype units were produced for vehicle testing to test reliability and durability. The independent front suspension design was subject to a five-axis rig test to build design confidence in later vehicle tests. This test was followed by a complete vehicle examination on a four-poster ride/durability simulator. The results from these tests were very positive.

Towards the end of the project a fully driving ‘Proof-of-Concept’ vehicle was built to assess improvements to ride and handling. This vehicle was tested by DAF Trucks and Leyland Trucks master drivers on various tests tracks, including MIRA, Millbrook and the DAF proving ground in The Netherlands. Improvement in the vehicle ride, handling, and steering ‘feel’ from the rack-and-pinon set-up, was evident.

The view below shows the front end module with independent front air suspension, which utilises double wishbone design.

5) Improvements delivered
The project, now complete, has been hailed a success. The final solution delivered on the weight target totalling a 500kg increase in vehicle payload on a standard 12-tonne GVW LF chassis. The FTCC vehicle also showed an improvement in the vehicle’s ride and handling compared to the equivalent standard LF product, bearing in mind the LF ride and handling characteristics are already class leading. It also retains the DAF LF key vehicle
attributes such as low deck height and excellent turning circle

The FTCC Proof-of-Concept demonstration vehicle is being exhibited to demonstrate DAF Trucks’ and Leyland Trucks’ commitment to developing highly efficient commercial vehicles for the future. At this point the FTCC project remains a research assignment but the knowledge gained through its development will continue to evolve and to optimise DAF products in the future.

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