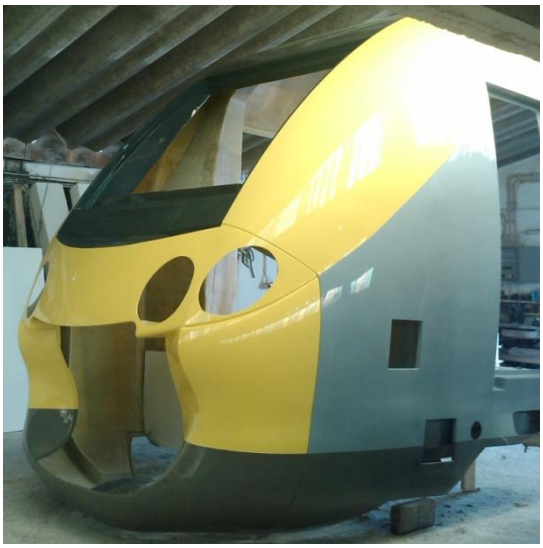
newrail

Research Case Study

D-CAB: a breakthrough in cab design



NewRail, the railway research centre at Newcastle University, in partnership with Bombardier Transportation and AP&M, has recently completed a technology demonstrator for a lightweight, crashworthy rail vehicle driver's cab.

Named "D-CAB", the full-scale prototype employs advanced sandwich material technology for the main cab structure and crash energy absorption devices. The resulting design is lighter than a conventional steel-framed cab and has fewer component parts, yet retains the necessary performance levels for key aspects such as proof loadings, crashworthiness and missile protection.

A fresh approach

Conventional rail vehicle cab structures are typically based on welded steel assemblies, often with a thin non-structural fibreglass cover. They are therefore relatively heavy. Furthermore, current cab designs tend to be very complex, high part count assemblies with fragmented material usage. This is because they must meet a wide range of demands including proof loadings, crashworthiness, missile protection, aerodynamics and insulation. Assembly costs are high, and there is little in the way of functional integration.

By contrast, D-CAB is an innovative modular design based on advanced sandwich material technology. It provides structural, crash, missile protection, aerodynamic, and insulative functionality within a single lightweight integrated package.

The reduced mass and integrated nature of D-CAB's design yields savings in assembly and outfitting costs, as well as in-service reductions in energy consumption and operational costs.

Materially different

The basis for D-CAB's novel design is the advanced sandwich materials that are used for its construction.

The lightweighting and crashworthiness benefits of high performance composite materials have been well demonstrated in other sectors. However, the relatively high cost of structural composites has precluded their widespread use in rail vehicle applications.

By focussing on affordable fibres, resins, honeycombs and foams, and by combining them in a novel, highly integrated fashion that significantly reduces part count, D-CAB is able to simultaneously exploit the lightweighting and energy absorption benefits of these materials whilst providing savings in assembly, outfitting and operational costs.

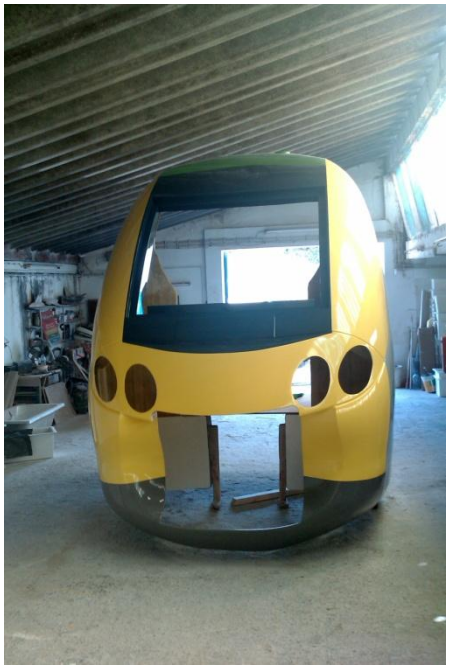
Modular design

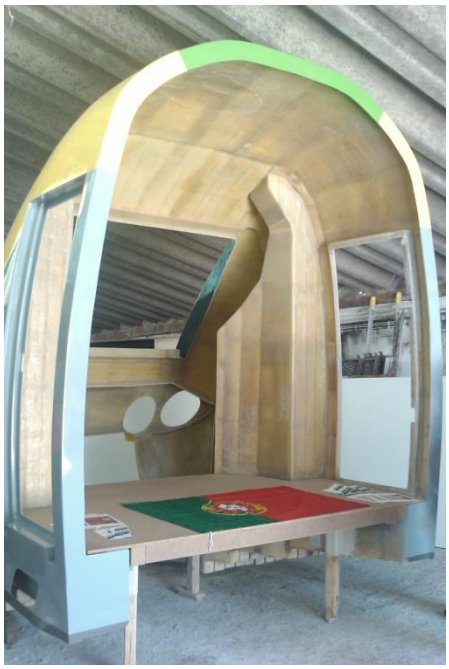
A key aspect of D-CAB's design is the three-stage modular construction that has been employed to facilitate assembly, inspection, maintenance and repair.

The frontal nose section, which is the area most likely to suffer incidental in-service damage, has been designed to be easily removable for repair or replacement. Removing the nose also provides easy access to the primary energy absorbing devices for inspection or replacement purposes.

Behind the nose is the main crush zone that houses the primary energy absorbing devices for compliance with EN 15227. Again, this is a self-contained module that can be removed and replaced if necessary.

The driver sits within the third "survival" zone, a strong module that is designed to resist proof and crash loadings without suffering permanent deformation or damage.





Prototype

A full-scale prototype has been manufactured to demonstrate the feasibility of the proposed design. This prototype is based on the cab for Bombardier's *SPACIUM* 3.O6 commuter train. The D-CAB prototype retains the same outer profile as the *SPACIUM* cab. Furthermore, the positions of key components (energy absorbers, driver's desk, doors and windscreen) have also been maintained. But the construction materials and methods of assembly are radically different, with the *SPACIUM* cab's welded steel structure and separate fibreglass shell replaced by a single, integrated multi-layer composite sandwich. The energy absorbers have also been redesigned as multi-layer aluminium honeycomb sandwich components.

Although the first prototype has been targeted at the *SPACIUM* vehicle, the underlying material and design technology is generic and could be applied to a wide range of rail vehicles. The concept could also be adapted for intermediate ends between carriages.

Moving forward

The current prototype has been produced as a technology demonstrator; an illustration of design and manufacturing feasibility.

In order to advance the concept towards commercial exploitation, the development team are hoping to produce a second refined prototype for full-scale crash testing.

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