

# AUDI'S BIONIC FUTURE

A NEW APPROACH TO MATERIAL USE WILL MEAN LIGHTER CARS – AND GOOD NEWS FOR KEEN DRIVERS. JOHN BARKER REPORTS

Nature does not waste material. Look at the human skeleton or an insect's wing and you'll see that there is just enough of what's needed, in the right place, to get the job done. Now this 'bionic' strategy is informing Audi's approach to developing cars, in particular their body structures, and is the reason it claims that all its new models will be lighter than their predecessors.

This has already happened with the TT and the new A6 and, says Audi, the next Q7 could be a massive 400kg lighter than the current model, all thanks to a variety of familiar materials used in an unfamiliar way.

Audi is the world's most prolific builder of aluminium-intensive cars – 600,000 and counting – but it has a pragmatic approach to materials. The A1 is all steel, the new A6 has a steel spaceframe clad in aluminium, and the TT has an aluminium front end with steel doors, tailgate and rear floorpan. Even on the A8, the company's original all-aluminium car, the central pillar that joins the floor to the roof is made from steel. Why? Because it's the best material for the job. How can this be so, given that aluminium and steel expand at different rates and will react together, causing corrosion? That's the clever bit – where the materials meet there's usually a separating layer of sealant and special fixings.

Such issues are multiplied in Audi's future because its bodyshells will combine aluminium, steel, carbonfibre and magnesium in various forms: sheet, extrusion, die-cast and forged.

Deep inside Audi's Lightweight Design Centre in Neckarsulm, the bare shell of a small prototype saloon reveals blue steel abutting silvery aluminium and carbonfibre, and there are die castings and extruded sections, seam welds, rivets and a scattering of unusual fixings. The saving over a similar shell in pressed steel is said to be 100kg – around a third.

Audi believes that a lighter bodyshell is the key to a lighter car, the impetus for a virtuous circle: a lighter body means less inertia which means smaller tyres and brakes, which allows more slender suspension components, and because lighter loads are being fed into the shell, the shell can be lighter... and so it goes on. A lighter car uses less energy too, and can have a smaller engine, or can accelerate faster with the same power. Whatever, it's more agile, which is good news for us.

It's one thing to decide what the best material is for each part of a body, quite another to predict how the combination will perform. This has meant developing more sophisticated closed-loop design programs. Components or structures designed and tested on computer are then built and tested for real, and this information is fed back into the program, which allows the components to be optimised for weight. Time and cost are the main

**'THE SAVING OVER A SIMILAR SHELL IN STEEL IS 100KG'**



**SHEET ALUMINIUM** ■  
**CAST ALUMINIUM** ■  
**ALUMINIUM SECTIONS** ■  
**HOT-FORMED STEEL** ■  
**COLD-FORMED STEEL** ■

reasons carbonfibre hasn't yet been used for volume-produced cars, but at the Lamborghini factory in Sant'Agata we're shown what could be its future. The process is called Forged Composite (FC) and allows carbonfibre to be moulded in a heated metal press rather like a conventional thermoplastic.

We see a roll of resin and fibre about

the size of a cotton reel placed in a heated press tool and turned into a fully cured carbonfibre component in under five minutes. Using this process the Aventador's carbonfibre tub takes just 1.5 hours to create. Now imagine what else you can make this way – body panels, suspension arms, wheels. It looks like carbonfibre for the (well-heeled) masses is on its way.

## BODY/CHASSIS TYPES

### BODY-ON-FRAME

Used by: almost all cars in the early days but only pick-up trucks (and commercial vehicles) today. **Pros:** simple to design and build, easily modified, one frame can accept many different body designs. **Cons:** heavier than unitary or monocoque construction, doesn't crash as well and is not as torsionally rigid as a monocoque.

### STEEL MONOCOQUE

Used by: the majority of mass-produced cars. **Pros:** torsionally strong, space efficient, cheap to produce in large numbers. **Cons:** high initial investment in tooling, not as light as other materials, complicated crash repair.

### SPACEFRAME

Used by: Caterham, Ariel, TVR,

Lamborghini's Aventador is built around a carbonfibre passenger cell





Above: A6 body uses a combination of steel and aluminium. Left: A3 saloon concept could use an even greater mix of materials if it reaches production. Above right: raw materials for Lambo's Forged Composite process. Right: an FC component



many supercars of the '60s and '70s, many race cars. Pros: light and stiff. Cons: labour and skill intensive (not easily automated), tall sills.

#### EXTRUDED, BONDED ALUMINIUM

Used by: Lotus Elise and Evija, current Aston Martin range. Pros: lightweight, stiff, flexible architecture. Cons: not very space efficient.

#### CARBONFIBRE TUB

Used by: Lamborghini Aventador, McLaren MP4-12C. Pros: light, very strong for its weight. Cons: labour intensive, very expensive.

#### BACKBONE CHASSIS

Used by: Lotus Elan ('60s), Europa ('60s) and Esprit. Pros: simpler and cheaper than a spaceframe, accepts different bodies. Cons: tall

central tunnel, restricted side-impact protection.

#### ALUMINIUM SPACEFRAME/MONOCOQUE

Used by: Audi A8 and R8, Jaguar XJ and XK. Pros: Lighter than a steel monocoque and as space efficient, recyclability. Cons: Not yet a high-volume process, initial development costs.

## BRIBES



#### BAC TRACK SPECIAL

Meet the Briggs Automotive Company Mono. It's a new road-legal track toy from Cheshire that takes plenty of stylistic inspiration from its contemporaries, most notably the KTM X-Bow and Caparo T1. Unsurprisingly, there's a focus on lightweight carbonfibre construction, while the car also comes with adjustable pushrod suspension and AP Racing brakes.

The rear wheels are driven by a 280bhp, 206lb ft 2.3-litre Cosworth four-cylinder engine driving through a six-speed sequential gearbox. Weighing just 540kg, the Mono can hit 60mph in a claimed 2.8sec and go on to a 170mph top speed, while at 527bhp/ton, its power-to-weight ratio trumps the Bugatti Veyron's.

Priced at around £80,000, it's a far cheaper alternative, and it will be rarer, too – just 35 will be built, and ten are already accounted for.



#### RS PATROL CARS

If you're driving through France any time soon, keep an eye in your mirrors for the gendarmerie's latest high-speed weapon: Renaultsport Mégane 250 Cups. The French police force has just recruited a 70-strong fleet of Renault's hottest hatchbacks, and while the thought of such rapid machinery being deployed by the cops is mildly unsettling, we can't deny the blues 'n' twos-equipped Mégane looks pretty cool. There's a full picture gallery at [evo.co.uk](http://evo.co.uk)