Axles for the New Audi Q5

When axles for the Audi Q5 needed to be developed, the target was to set new standards in the SUV segment. The construction principle and the components of the axles are taken from the modular longitudinal component system that also supplies them for the A5 and A4 model series. Even at the concept stage for this axle modular system, care was taken to ensure that typical SUV running-gear characteristics such as ground clearance, traction and strength were taken into consideration, as well as the familiar brand-specific attributes such as comfort, sportiness and dynamic stability. The Audi Q5’s chassis thus bridges the gap between the sporty model, for day-to-day driving and the off-road vehicle in unique style.
1 Design Configuration

For the modular longitudinal component system, the latest development methods were used and new tools developed or existing ones optimised, in order to improve development quality and shorten the development cycle. All axle components were designed with the aid of finite element methods for optimising topology and shape, the aim being to minimise the amount of material used. Figure 1 shows the front-axle steering knuckle as an example of how the area between the wheel bearing connection and the lower control arm level was designed in several steps. Peripheral conditions such as the force input when the vehicle is in motion and the maximum installation space available are first specified, after which topological optimisation generates the weight-optimised 3D geometry. Taking peripheral technical production aspects into consideration, Computer Aided Design (CAD) is then used to obtain a weight- and function-optimised component. For the first time a CAD database system was used here to supply inter-divisional, up-to-date CAD axle data including the geometry of the surrounding area, with all the necessary movement information. The Custom Animation tool was developed for the CAD Pro/Engineer system; it allows extensive investigations and simulations to be performed in CAD. Custom Animation is used to insert movement information derived from ADAMS axle kinematics simulation into the axle assemblies and link it to the components. In this way, all the axle operating positions can be located and investigated in CAD. This tool automatically generates dynamic component envelopes, not only absolute envelopes in the system of vehicle coordinates but also envelopes relative to adjacent components. Distinct improvements were also obtained in clearance and collision investigations, since the analyses could be carried out and documented automatically. These virtual development methods allowed the chassis to reach a high level of maturity in the early stages of development. Despite of the development time being short, there was therefore sufficient scope for fine-tuning and optimisation.

The ground clearances needed for off-road capability and the typical appearance of an SUV were primarily achieved by the large-diameter wheels and the positions within the generous spring travel when the suspension is extended. Table 1 and Table 2. The centre of gravity of an SUV is higher than that of a conventional passenger car, and the Audi Q5 is no exception. To compensate for the resulting increased tendency to roll, the spring, shock absorber and anti-roll bar settings were modified and the momentary centres at the front and rear axles located reasonably high. The wide front and rear tracks make the static stability factor extremely favourable.

In addition to ground clearance, an important dimension for the chassis’s traction potential off-road is diagonal axle offset. This is determined with two ramps placed in front of diagonally opposed wheels. The vehicle is driven on to the ramps until one of the unloaded wheels is about to lose contact with the ground. The wheel contact point in relation to the original road surface is defined as the diagonal axle offset. At 160 millimetres, the Audi Q5 achieves a value...