The latest program of the international steel consortium is more ambitious than its predecessors. With the introduction of the ULSAB "Advanced Vehicle Concepts" Program (ULSAB-AVC), the steel consortium presents overall vehicle concepts instead of the previous programs, where individual optimised systems were presented.

Both customers and legislators expect the automobiles of the 21st century to meet increasingly stringent demands for safety, performance and affordability. Together, 33 international steel manufacturers and Porsche Engineering Group, as the development partner, concluded that an intelligent combination of new, high strength multi-phase steels, modern steel products, sophisticated manufacturing processes and innovative design concepts can meet the requirements of 2004. The interaction between these four pillars as a means of achieving safer, more environmentally friendly, affordable vehicles resulted in the ULSAB-AVC concepts.

Platform Strategy
The decision to develop a common platform for vehicles in the European compact class (C-class) and the American mid-size class (PNGV-class) was driven by cost and represented a major challenge due to the different vehicle class dimensions. From a European point of view, the results for the C-class, in particular, are of great interest. After all, this class – also referred to as the “Golf class” – makes up a third of the market volume in Europe. The platform versions were defined as front wheel drive vehicles with a powertrain and chassis configuration that can take either a diesel or a gasoline engine. The front end
structure of both vehicles is practically identical. The wheelbase differs by 85 mm and the overall length by 570 mm. The common front end results in the use of 22% common parts related to the body weight. An additional 22% of weight is made up of common die parts, parts produced by the same tools but with trimming operations for the dimension difference between the C-class and PNGV-class.

Front End Structure

The design of the front end structure is primarily oriented towards energy absorption in a frontal crash. The outer load paths of the front rail members into the rockers and the A-pillars, as well as the inner load paths into the tunnel and the dash crashbox provide a good and even distribution of forces into the structure, thus ensuring an intact occupant cell and a high level of occupant protection.

The central elements of the underbody, Figure 4, are the hydroformed tailored tube front rail members. Energy management, in the event of a crash, is controlled by the different material thicknesses (1.50 mm/1.30 mm) of the tailored tubes. The innovative chassis concept, in which the shock absorbers are supported on a sub-frame, allowed an upper longitudinal member to be eliminated. The tunnel crossmember is an integral component of the floor structure, connecting the seat cross-members and the rail members.

The use of new multi-phase steels in the front rail members makes it possible to comply with two crash regulations that are in themselves contradictory – US-NCAP (100% frontal impact at 35 mph into a rigid barrier) and Euro-NCAP (40% overlap offset frontal crash at 64 km/h into a deformable barrier).

For the US-NCAP frontal crash, the rail members must absorb a high amount of energy to ensure a low crash momentum. On the other hand, the Euro-NCAP offset frontal crash demands a minimum footwell intrusion, thus requiring stiffer rail members, which in turn results in a higher crash momentum. The use of new multi-phase steels and the higher strain hardening effect that they exhibit offers the ideal solution in the event of a crash. During the US-NCAP crash event, the engine is pushed into the specially designed tunnel instead of intruding into the vehicle interior. In order to comply with the different criteria, a total of seven of the most serious crash load cases were simulated on the basis of the New Car Assessment Program (NCAP). The excellent results, such as a stable occupant cell, low footwell intrusion, and low steering column and A-pillar displacement, demonstrate the great potential of this structure. In addition to issues concerning occupant protection, the question of pedestrian safety was also considered. This is ensured by the low mounting position of the engine and the lack of shock/spring towers. As a result, there are no hard points directly under the hood, which is necessary for optimum deformation in the event of a pedestrian impact.

Side Structure

The central element of the side structure, Figure 7, is the hydroformed body side member, which runs to the rear end area to form the C-pillar. The tailored blank reinforcement of the B-pillar acts at the same time as a rocker rear reinforcement, thus reducing the number of parts. The lower area of the B-pillar has a flat reinforcement, which serves to increase the...