Determination of load cases and rigidities for ZF concept study

ZF presented the potential that intelligent networking of individual chassis, propulsion and driver systems bring in its Advanced Urban Vehicle at the 2015 International Motor Show (IAA), providing an extremely versatile, locally emission-free concept networked with the driver and the environment. TECOSIM assisted in the project by determining different load cases and dynamic rigidities in the axle sections and battery installation locations.

CHALLENGE
The Advanced Urban Vehicle exhibits innovative solutions for personal transport in the small and compact vehicle segment. ZF’s established stringent standards for close-to-production solutions were applied during the vehicle concept development. ZF was faced with the following challenges:
- Ensuring the greatest possible manoeuvrability in urban traffic thanks to newly designed front axle with a 75-degree steering angle
- Integrating an innovative, eTB (Electric Twist Beam) rear wheel drive, installed close to the wheels
- Networking semi-automated assistance functions

SOLUTION
TECOSIM enabled conflicting requirements to be fulfilled in the short period of time thanks to simulation of crashes, the chassis and other aspects. The CAE experts incorporated the results from the re-defined load cases and dynamic rigidities into the axle geometry reorientation and the related battery installation location. The individual solutions were optimised to ensure that the behaviour of the ZF prototype was formulated in a similar way to the selected, unmodified basic series-production vehicle.
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Battery installation location
The strength of the battery mounts needed to be guaranteed when exposed to the acceleration effects of bad road surfaces (pothole behaviour). To do so, TECOSIM ran through different weight scenarios using 85 and 60 kilograms respectively.

Chassis design
The complex re-design of the front and rear axle required a driving performance analysis. TECOSIM secured the wheel hub motors on the rear axle and the complex double wishbone axle with a steering angle of 75° in the front of the vehicle. Using the FE solver NASTRAN, the CAE specialists calculated 30 typical chassis load scenarios and determined dynamic and static rigidities for all other chassis connections.

Strength of the front vehicle
TECOSIM re-calculated the strength of vehicle greatly modified by the change in the axles. Both longitudinal beams were subjected to a load of 43 kilonewtons. This is based on the typical load levels for low speed crashes in small, standard serial-production vehicles.

CLIENT BENEFIT
TECOSIM impressed as a solution-oriented project partner, helping enormously to ensure that ZF was able to present a concept vehicle to trade experts which was ready for series production in terms of crash safety design and driving performance. The vehicle was completed based on ZF requirements within an ambitious time frame.

RESULTS

- Battery load cases non-critical in different weight scenarios
- Influence of electric chassis compensated
- Chassis and its connections to series-production vehicle level
- Vehicle front load values achieved for low speed crash

TECOSIM COMPANY PROFILE

TECOSIM is a leading development partner in computer-aided engineering (CAE) on the global market with twelve locations on five continents. This specialist in numerical calculation and simulation completes challenging tasks in structure simulation, fluid dynamics, multi-body simulation and systems simulation with its 440 employees worldwide.

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