Approval by simulation

Current European vehicle approval legislation enables the replacement of some physical experiments with virtual experiments performed by computer simulation

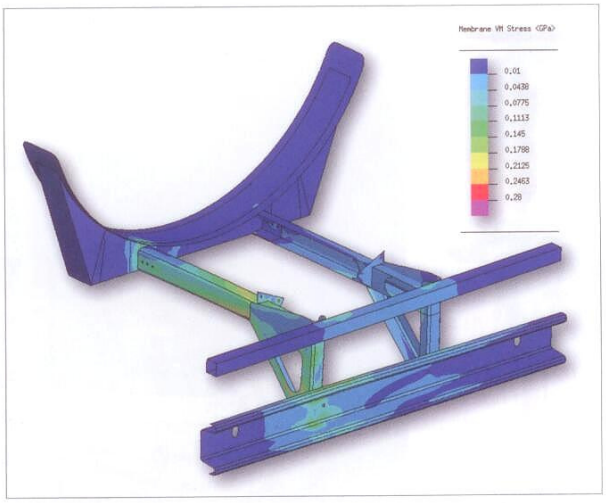
TÜV SÜD Auto CZ
Tel: +420 239 046 980
Email: ondrej.vaculin@tuv-sud.cz
Web: www.tuv-sud.cz

Every vehicle intended for the European market, whatever its category, must comply with a series of United Nations Economic Commission for Europe (UN ECE) regulations or directives from the European Commission (EC). In many cases the approval certificate is issued based on experiments, in which the vehicles or its components are destroyed during the tests.

Current methods in computer-aided engineering are able to substitute the physical experiments. This state-of-the-art is also reflected in the legislative requirements, which allow demonstration of legislative compliance by simulation. Moreover, it is expected that the number of regulations and directives which accept numerical simulation will increase in the near future. Simulation methods can reduce both time and costs for the customer. TÜV SÜD Auto CZ is very experienced in simulation and offers a wide range of approvals based on advanced computer simulation.

Simulation is advantageous particularly in cases where the vehicles or their components would be destroyed during a physical experiment. This can save the value of vehicles which would be destroyed in the physical experiment.

Another case where the customer can benefit from simulation is the approval of many versions of a similar vehicle. This could apply to buses of the same type but different lengths. Perhaps these do not physically exist, or would only be made in small quantities.



LEFT: Rear underrun protection loaded with 100kN

Simulation requires only a limited number of verification experiments which are less complicated and therefore less cost-intensive. Another important advantage is that computer simulation can guarantee the repeatability of results, because the conditions are well defined and stored.

Creation of the models is not complicated these days, because the manufacturers and their suppliers already have CAD models available. These can be easily transformed into computer simulation models.

In some cases the vehicle, or its component, will be modified to attain better results. If computer simulation is be applied, the cost and time-saved is multiplied – no new samples for physical experiments need be manufactured, only the existing computer model has to be modified.

The computer model attempts to mimic the behavior of the real component. However, the computer simulation should be considered as conservative to keep the safety margins. Particularly tolerances and material properties need to be thoroughly considered.

Computer simulation is not a universal solution which will replace all physical experiments. In specific cases the computer simulation could require more resources than the physical experiment, particularly if the samples are not to be destroyed.

One of the well-known examples of approval-by-simulation is the rollover of a coach, in which the price savings are very significant.

This is not the only regulation allowed to be fulfilled by the simulation. Simulation is accepted also for CNG- and LPG-tank holders, mechanical coupling devices, trailers or underrun protective devices, and many others.

The testing of rear underrun protective devices is a typical example in which the customers can profit from computer simulation. The current legislation requires loading the rear underrun protective device with quasistatic forces at five symmetrical positions.

The magnitude of the loading forces is up to 100kN. Usually under such forces the plastic deformation occurs. The computer model can indicate compliance, and also identify the weak point of the design being tested.