



## **Application of engineering mechanics and biomechanics in transport at improvement of passive safety and comfort of occupants.**

### **Aplikace konstrukční mechaniky a biomechaniky v dopravě pro zvyšování pasivní bezpečnosti a komfortu cestujících**

The project described in this document was realized in close cooperation among companies S&T Ltd (project leader), Czech Technical University in Prague, West Bohemian University in Pilsen, Skoda Research Ltd (industrial partner) and their partners. It has instituted a part of TANDEM project of Ministry of Industry and Trade. Specialists have aimed at legislative review, experimental tasks, calculations and other activities. These activities resulted in large work supporting future development of safer vehicles, comparable to the European level.

There were many subtasks included, aiming primarily to the engineering mechanics and biomechanics application to increase passive safety and passenger's comfort. The tasks were divided into rail, road transportation and other affected areas.

First part of the project led to a deep analysis of legislation and passive safety regulation in the field of rail transportation, taking into account even future development. Based on the analysis, new conditions of collision situations, based on human injury criteria, were set.

Meanwhile, the material research was conducted and material database updated. This database includes recent metallic and non-metallic materials, suitable for vehicle constructions, taking into account minimization of negative features on passengers.

Respecting pedestrian's, driver's and passenger's (grown-ups or children) needs, the rail dummy ROBBY was updated. New knee model was implemented, suitable for measurement of kinematics modeling in case of crash situation. New scaling formula based on age was developed. This formula was used for injury criteria analysis in case of pedestrian-vehicle or vehicle-vehicle analysis.

Respecting passenger's comfort, there was a new 1D model developed, aimed to analyze vibrations transferred on passenger.

Based on the road transportation tasks, solved during the project period, the activities were instituted in the same scheme:

- Legislation analysis, including past status and developments for future
- Road transportation safety analysis, including road accident statistics, including main causes and results of the accidents

- Simulations and experiments leading to values for mathematic modeling
- Collision process modeling, leading to collision causes and effects analyses in theory and possibility of real experiment replacement with simulation
- Passive and active safety design possibilities and solutions
- Technical solution aimed at stepless motorcycle sitting position change and possible airbag implementation in future.

The significant project output is available database of the crash scenarios between collision partners of many vehicle categories (car, bus, truck, tram, train). The crash tests, realized during project, provided the simulation process with validation data in some cases.

The project inspired education process in both Universities and many PhD and diploma theses are inspired by the research methodology and the project results. The ad-hoc team worked very efficiently and will continue in close cooperation in industrial and research projects.

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