



EXPLORATION FIXED TANK VEHICLE ROLLOVER STABILITY

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Abstract The ECE R111 is the international regulation regarding the rollover stability of tank vehicles of category N2. The rollover stability of the vehicle shall be such that the point at which overturning occurs would not be passed if a lateral acceleration of 4 m/s² has not been reached. The calculation of the maximum lateral acceleration of a vehicle takes into consideration many factors which influence its rollover stability. Some of the most important are the height of the center of gravity, the suspension roll stiffness and the tires vertical rate. Based on experimental data of the laboratory, the correlation of these main factors is investigated in depth and curves illustrating their correlation will be presented.

Keywords: Tank Vehicles, Lateral Dynamics, Tire Vertical Stiffness, Roll Stiffness, ECE R111

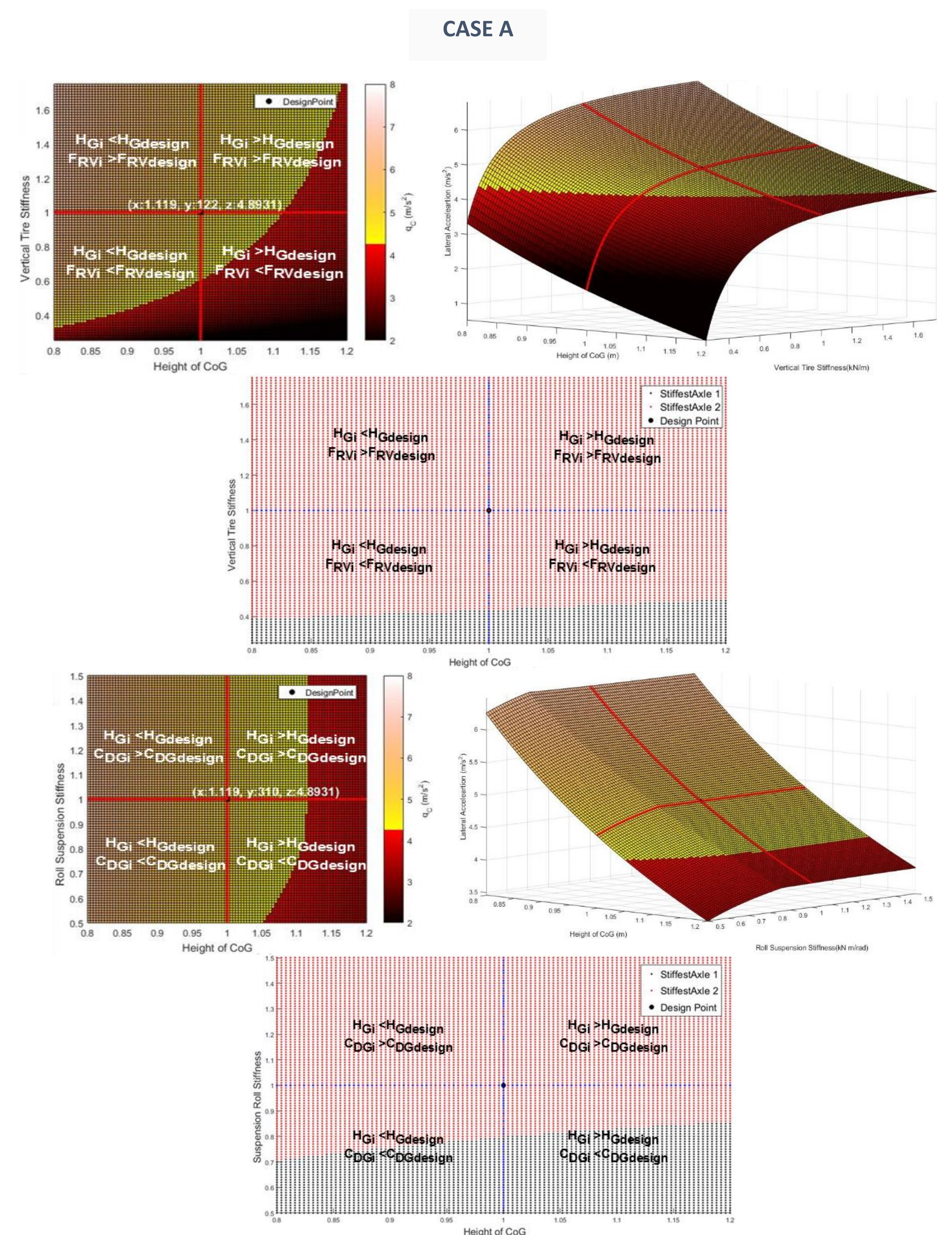
Introduction Tank vehicles are, many times, used for the transportation of hazardous materials (flammable, toxic, corrosive etc). International regulations, with respect to the required specifications for the approval of these vehicles, are becoming stricter in order to minimize the possible accidents by ensuring a better design of the heavy vehicles. Such international regulations are the UNECE Regulation No. 111, which applies to the rollover stability of HCT vehicles of category N2, N3, O3 and O4 intended for carriage of dangerous good.

The steady-state rollover threshold (SRT) is the maximum severity of the steady turn, i.e. lateral acceleration, which a vehicle can sustain without reaching the rollover threshold. This performance measure has been strongly linked to rollover accidents of heavy vehicles [12, 13]. The SRT performance measure is also used for regulation of tank vehicles in Europe, according to UNECE Regulation No. 111 (UNECE 2001)^[1].

Materials & Methods 3 N2 vehicles (tested by the Vehicles Laboratory of NTUA for its conformity with the Regulation 111). The characteristics of the vehicles were (a) Measured, (b) Evaluated or (c) Provided by the manufacturer of the vehicle.

The influence on the rollover stability of a vehicle of (a) the height of the center of gravity of the complete vehicle (HG) was set [80% - 120%], (b) the vertical tire stiffness (FRV2) was set [25% - 175%] and (c) the suspension roll stiffness (CDG2) was set [50% - 150%].

Results & Discussion Indicative nomograms



Conclusions

- **qC regarding FRV and HG**
In all Cases: Increase of HG results to values of qC close or below 4 m/s² | Highest risk Area 4 | Safe Area 1
Per Case: Case A more sensitive to variations of HG and FRV | Case B safer in terms of rollover stability | Case A presents change of the stiffest axle from rear to front
- **qC regarding CDG and HG**
In all Cases: Increase of HG results to values of qC close or below 4 m/s² | Highest risk Area 4 | Safe Area 1 | The singularity in the 3rd figure coincide to the change of the stiffest axle
Per Case: Case A more sensitive to variations of HG and CDG | Case B safer in terms of rollover stability | Case A presents change of the stiffest axle from rear to front

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