**5. H. Al-Thairy, Y.C. Wang , Simplified FE vehicle model for assessing the vulnerability of axially compressed steel columns against vehicle frontal impact, Journal of Constructional Steel Research 102, November 2014, 190–20.**

**http://www.sciencedirect.com/science/article/pii/S0143974X14001941**

**Abstract**

The main objective of this study is to present and validate a simplified numerical vehicle model that can be used to simulate the effects of vehicle frontal impact on steel columns by using the commercial finite element code ABAQUS/Explicit. The simplified numerical vehicle model treats the vehicle as a spring-mass system. This model has in fact already been exploited by other researchers in the preliminary stages of vehicle design and occupant safety assessment. The proposed model consists of three parts: an indeformable body representing the total vehicle mass; a spring or connector with nonlinear force-deformation relationship to represent the dynamic stiffness of the vehicle and a rigid but weightless plate to generate the contact between the spring-mass system and the impacted column. The dynamic load-deformation characteristic of the spring is assumed to be bilinear: the initial linear elastic part simulating the vehicle deformation until it has reached the vehicle engine, followed by a near rigid relationship. This concept has been validated by comparison of simulation results of steel columns under different impact velocities, axial load ratios, boundary conditions, and slenderness ratios using the full- scale vehicle model and using the proposed simplified spring model. Having validating the proposed model, this study presents the derivations and validations of an equation to predict the equivalent linear stiffness of vehicle that can be used either in this numerical simulation model or in an energy based analytical model. Validation results have shown the feasibility of the proposed equation.

**Key words:** Vehicle impact, simplified model, numerical simulation, structural columns, axial loads.