

Bus weight and torsion stiffness optimization

A. Gauchia, V. Díaz, M.J.L. Boada, B.L. Boada

*Mechanical Engineering Department, Carlos III University
Avenida de la Universidad. 28911 Leganés (Madrid). Spain
{agauchia, vdiaz, mjboada, bboada} @ing.uc3m.es*

ABSTRACT

Nowadays, significant efforts have been carried out by bus manufacturers in order to reduce bus production costs. One of the possible solutions is weight reduction of the bus body structure. Weight reduction can be achieved by either changing conventional steel by composite or aluminium materials, or by reducing the weight of the beams of the bus structure (1). In this investigation it has been considered the latter, due to the fact that a change of conventional steel of some parts of the bus structure may lead to extra costs due to joining technology. However, bus safety and handling may be penalised if during the weight reduction process, stiffness is not considered. Both, bending and torsion stiffness influence directly on comfort, handling, rollover and lateral stability (2). Therefore, in this investigation weight optimization has been carried out in a real bus structure taking into account torsion stiffness. Optimization has been carried out on beam thickness of the bus structure beams, due to the fact that it is one of the parameters that allow significant increases in torsional stiffness (3).

In the first place a finite element model of a real bus structure has been created. The finite element has been carried out in Ansys, as shown in Figure 1, by means of a parametric file that allows changing beam thickness. The beams of the bus structure have a rectangular hollow cross section.

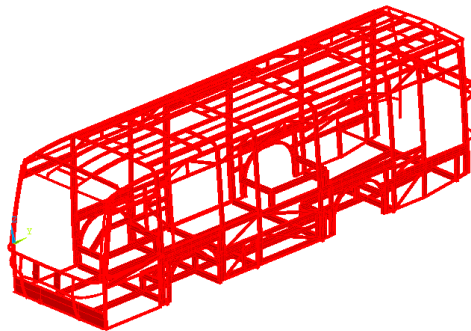


Figure 1. *Finite element model of the optimized bus structure.*

Optimization has been carried out by means of a genetic optimization tool provided with Matlab. However, Ansys and Matlab are different software and because several iterations were needed to achieve a solution, a new file management process was developed, as depicted in Figure 2. Because of computer costs, a sensitivity analysis was employed to identify the beams in which a change of its thickness was more important in terms of torsion stiffness. Two sensitivity parameters were defined: torsion and weight sensitivity. The sensitivity analysis allowed to identify eight beams, over which optimization could be applied. Furthermore, the optimization process was carried out in those beams.

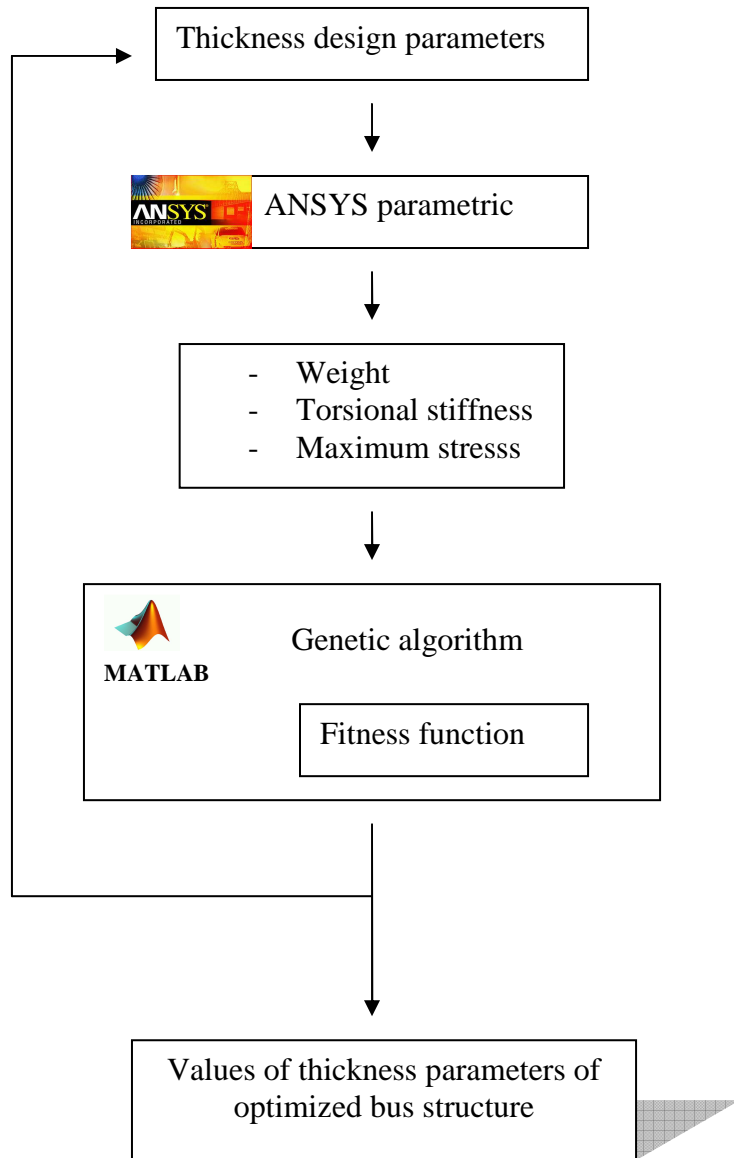


Figure 2. *Developed optimisation process.*

The thickness variation of one of the optimized beams is depicted in Figure 3.

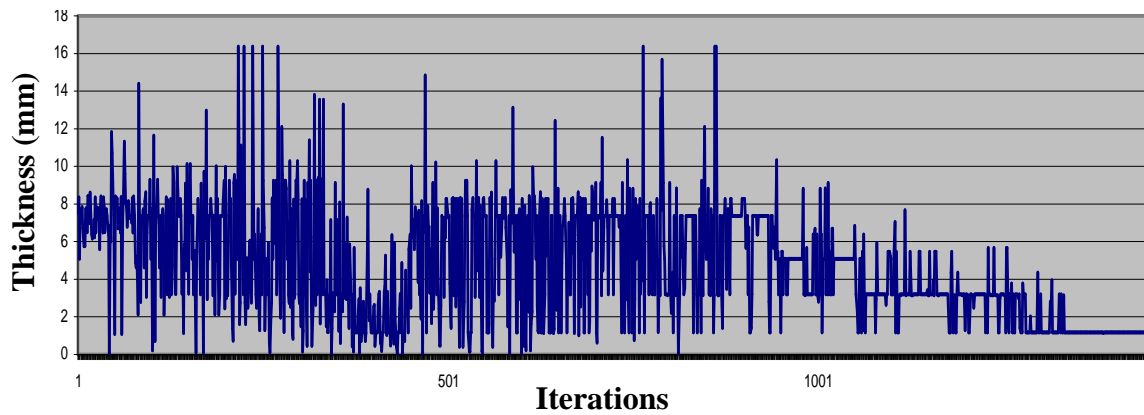


Figure 3. *Thickness variation during optimization process.*

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REFERENCES

- (1) F. Lan, J. Chen, J. Lin. Comparative analysis for bus side structures and lightweight optimization. Proc. Instn. Engineers, Part D: Journal of Automobile Engineering, 2004, Vol. 218, pp. 1067-1075.
- (2) B. L. Boada, M.J.L. Boada, A. Gauchia, Carolina A.Caldás, V. Díaz. Fuzzy based vehicle lateral stability in crosswind. Fisita World Automotive Congress. 2006. Yokohama (Japan).
- (3), M.M.K. Lee, T. Pine, T.B. Jones. Automotive box section design under torsion. Part 1: finite element modelling strategy. Proc. Instn. Engineers, Part D: Journal of Automobile Engineering, 2000, Vol. 214, pp. 347-359.