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SHAPE AND SIZE OPTIMIZATION OF A COMPLEX EXTRUDED ALUMINIUM PROFILE FOR PROTECTION OF BATTERY TRAYS IN ELECTRIC VEHICLES

Debora Obkircher[1], Miguel Costas[1,2,*], Tore Børvik[1,2] and Odd Sture Hopperstad[1,2]

[1] Structural Impact Laboratory (SIMLab), Department of Structural Engineering, NTNU – Norwegian University of Science and Technology, NO-7491 Trondheim, Norway
[2] Centre for Advanced Structural Analysis (SFI CASA), NTNU, NO-7491 Trondheim, Norway

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The raise of electric vehicles entails new challenges related to weight distribution and structural performance. A balance between mass and crashworthiness is even more important in electric vehicles than in traditional fuel-powered cars because mass is directly related to range, and at the same time battery trays must be protected to minimise the risk of fire during a crash. That pursued balance motivates car makers to dedicate more resources to the design stages, and to use aluminium extrusions with complex geometries.

The starting point for this investigation is one of those complex profiles that is currently used to protect the battery tray of an existing electric vehicle. A material characterisation campaign was carried out to calibrate a proper constitutive model before a numerical optimization of the profile was run using a validated finite element model of a pole side crushing test. Different modelling approaches were explored (shells, plane strain and solid elements) because a balance between simulation time and quality of the numerical predictions is crucial when running an optimization.

Results provided an alternative shape with considerably lower weight and larger energy absorption than the original profile without modifying the outer shape of the profile. Moreover, the advantages and disadvantages of three different levels of complexity in the numerical modelling were revealed.

REFERENCES

[1] Ortmann, C., Schumacher, A.: Graph and heuristic based topology optimization of crash loaded structures. Structural and Multidisciplinary Optimization 47, 839–854 (2013).
[2] Costas, M., Morin, D., Hopperstad, O.S., Børvik, T., Langseth, M.: A through-thickness damage regularisation scheme for shell elements subjected to severe bending and membrane deformations, *Journal of the Mechanics and Physics of Solids* 123, 190–206 (2019).