

# A Study on the Finite Element Analysis for the Optimized Design of Bumper Towing Cap for Vehicles

**Gyuho Shim<sup>1)</sup> Teawon Kim<sup>1)</sup> Seungwon Jeon<sup>1)</sup> Geonhee Cheon<sup>2)</sup>**

*1) SECO ECOPLASTIC, Technology Research Institute*

*31, Gongdan-ro 57-gil(Hwangseong-dong), Gyeongju-si, Gyeongsangbuk-do, 38071 Korea (E-mail: sgheco@myeco.co.kr)*

*2) SECO SEOJIN, Technology Research Institute 169, LS-ro, Gunpo-si, Gyeonggi-do, 15808 Korea*

**KEY WORDS: Towing Cap, Bumper Cover, Opening and Closing Performance, Finite element analysis, Correlation.**

The towing cap is a critical aesthetic and functional component integrated into the automotive bumper assembly. A towing cap is a small exterior part, but it is required to satisfy styling continuity, secure retention during driving, and easy removal by a user at the same time. In current development practice, the design is often determined by past vehicle carry-over and engineer experience, and this approach has caused quality issues and field complaints when new bumper shapes, grille boundaries, and local package conditions are changed. In this study, the opening and closing performance of the towing cap was investigated to address quality issues caused by conventional empirical design methods. A representative evaluation framework was prepared as the first step toward optimization, and the consistency between test and analysis was examined. The representative models covered a flat type, a recessed split type, and a protruded type so that the main design patterns observed in production bumper systems could be included. The analysis results were compared with experimental data from three representative vehicle models to ensure correlation. The results showed that the test-first and analysis-correlation approach can explain the opening tendency of different towing cap designs and can provide a practical basis for later prediction and optimization studies. It was concluded that a validated component-level analysis model can reduce repeated prototype tuning and can support a more objective towing cap design process for future vehicle programs.