

Pre-Verification of the development of the Deco Bezel specification steering wheel through Analysis

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KEY WORDS : Steering Wheel, Leather, Manual leather stitching, Deco Bezel, FEA

While the steering wheel is a core steering component that controls the vehicle's direction of travel, it has evolved alongside the advancement of the automotive industry beyond a simple mechanical control device into a representative sensory component through which the driver and the vehicle come into direct contact. This is because drivers perceive not only the vehicle's movement, road conditions, and driving stability but also the vehicle's sense of quality through the steering wheel.

Early automotive steering wheels were made of materials such as wood, metal, and hard plastic. Although these materials were advantageous in terms of structural strength and productivity, they had limitations, such as causing hand fatigue during long drives or feeling unpleasant to the touch in high or low temperature environments. Furthermore, metal or hard plastic surfaces could become slippery when hands sweated, necessitating improvements in driving stability and handling feel. To address these issues, the method of wrapping the steering wheel rim in leather was introduced. Leather feels soft to the touch, provides appropriate friction, and creates a visually luxurious image. In particular, since leather used in car interiors is a material that consumers directly touch and evaluate, it has a significant impact on tactile satisfaction and the formation of a sense of luxury. In particular, the leather wrapping technology for steering wheels initially originated for the functional purposes of enhancing grip and preventing slippage; however, it has since established itself as a means of enhancing driving sensibility, interior luxury, and brand differentiation, particularly in luxury and sports cars. As various materials such as plastic, polyurethane, synthetic leather, and natural leather are applied to steering wheels, and features like airbags, switches, heating elements, and haptic feedback are integrated, the leather wrapping process has evolved into a complex manufacturing technology that must simultaneously satisfy structural, emotional, and quality requirements.

Leather wrapping for steering wheels requires the technology to precisely cut the leather surface, wrap it without wrinkles or lifting, and sew it with consistent tension. Consequently, labor costs for this sewing technique are substantial, and there are high defect rates and field claims. This is a task that cannot be automated. To address this, we began researching a steering wheel with a "Deco Bezel" specification, which involves wrapping the leather without a seal and finishing it with a Deco Bezel.

The Deco Bezel Steering Wheel consists of an Armature core, Grip, Inner Bezel, and Deco Bezel. Here, the Inner Bezel serves as a mounting hook for the Deco Bezel and a finishing element for leather insertion (securing the leather), while the Deco Bezel prevents leather detachment and acts as an exterior design element through painting (serving as a decoration for the steering wheel). The Inner Bezel and Deco Bezel were reviewed under three concepts, and one concept was finalized through Modal, FRF, and Inclined Load Analyses. The structural concept of the Deco Bezel Steering Wheel could be pre-verified and analyzed through vibration and stiffness analyses. Furthermore, pre-verification through analysis allowed for a reduction in costs and time during the development phase. A preliminary mock-up product was manufactured based on the single reviewed concept, and basic and heat resistance cycle tests were conducted; satisfactory results were obtained without the Deco Bezel separating or lifting.

The Deco Bezel Steering Wheel developed in this study as a replacement for the manual leather stitching process is expected to reduce the defect rate and labor costs associated with manual leather stitching.

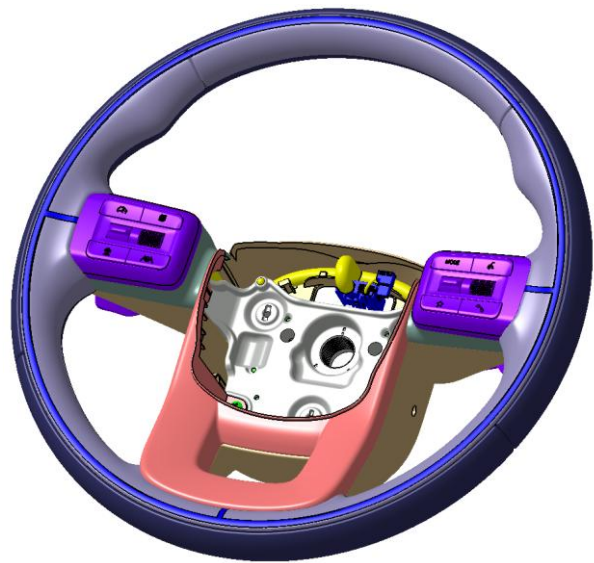


Fig. 1 Deco Bezel Steering Wheel