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Optimum Design of Plastic Spring Seat

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Plastic has recently been increasingly used as material for automobile parts, and accordingly there is an increasing trend of recognizing its importance. The merit of plastic as a material for automobiles is the low specific gravity or density allowing the manufacturing of light-weight parts, as well as the potential for improving design freedom by various molding methods that has been developed.

This research performed the development of a light spring seat, a component supporting the strut and spring of MacPherson strut type suspension, by carrying out the optimum design of a spring seat that uses plastic material instead of conventional steel material. The main issue of designing a plastic spring seat is load distribution method, because plastic material has lower stiffness than conventional steel in material property. So, in order to load distribution the plastic spring seat design, this research reflected two considerations into the design. As the first consideration, we introduced topology optimization. The maximization of static stiffness, that is, the minimization of compliance was considered as objective function, and volume was used as constraint condition, to deduce the result. According to the result of the topology optimization, the one side acts tension for the load while another gets compression. Reflecting the result of topology optimization, we designed it so that with the side of settling the spring as the reference, the upper stiffener acts the tension while the lower stiffness gets the compression. The second design consideration is adjusting the direction of the stiffener. Therefore, in order to prevent the load concentrated in the part where the spring and the strut are combined and to square the spring's centroid with the struts, it is needed to make the direction of the stiffener towards the strut's centroid. Applying the two design considerations mentioned earlier, we generated the optimum plastic spring seat model. The steel spring seat's mass is 0.451kg while the suggested plastic spring seat's mass is 0.275kg; thus, mass was reduced about 39%. Among the experimental data of the creep modulus considering the effect of aging to the suggested plastic spring seat model, the worst cases, 23℃ 10,000 hour and extreme load case, were applied for the analysis, and as a result, no break was confirmed.