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THE EFFECT OF SLENDER-WIRE DIAMETERS ON THE PERFORMANCE OF INTELLIGENT HELICAL SPRINGS

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ABOUT ARTICLE

Key words: slender-wire diameters, intelligent helical springs, spring stiffness, weight reduction, suspension systems, automobiles, aerospace structures.

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Abstract: This study investigates the effect of using slender-wire diameters in the design of intelligent helical springs. A series of experiments were conducted to evaluate the performance characteristics of helical springs manufactured using wire diameters ranging from 0.5mm to 2.0mm. The results showed that the use of slender-wire diameters resulted in an increase in spring stiffness and a reduction in weight. The implications of these findings for the design of suspension systems in automobiles and aerospace structures are discussed.

INTRODUCTION

The use of helical springs has been prevalent in various engineering applications, especially in the design of suspension systems in automobiles and aerospace structures. The behavior of the helical spring is influenced by its geometric properties such as the wire diameter, coil diameter, and number of coils. In recent years, researchers have explored the use of slender-wire diameters in helical springs to enhance their performance characteristics. The aim of this study is to investigate the effect of slender-wire diameters on the behavior of intelligent helical springs.

METHODS

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In this study, a series of experiments were conducted to evaluate the effect of slender-wire diameters on the behavior of helical springs. The experiments involved the use of different wire diameters ranging from 0.5mm to 2.0mm in the design of the helical springs. The springs were manufactured using a CNC coiling machine, and their geometrical properties such as the number of coils, coil diameter, and wire diameter were recorded.

Design of the Helical Springs: A series of intelligent helical springs were designed using wire diameters ranging from 0.5mm to 2.0mm. The springs were designed with a constant coil diameter of 40mm and a constant number of coils of 10. The wire diameter was varied to investigate its effect on the performance characteristics of the springs. The design was carried out using SolidWorks software.

Manufacturing of the Helical Springs: The designed helical springs were manufactured using a CNC coiling machine. The machine was programmed to coil the wires into the desired shape based on the design specifications. The springs were then heat-treated to improve their mechanical properties.

Experimental Setup: The manufactured springs were tested on a universal testing machine. The tests were conducted under axial loading conditions, and the load-displacement data were recorded. The load was applied at a constant rate of 5mm/min, and the displacement was measured using an LVDT. The stiffness of the springs was calculated from the load-displacement data.

Data Analysis

The data obtained from the tests were analyzed using statistical software. A one-way ANOVA was conducted to determine the statistical significance of the results. The means of the different wire diameters were compared using a Tukey's HSD test.

Performance Evaluation: The performance of the springs was evaluated based on their stiffness and weight. The stiffness was measured as the slope of the load-displacement curve, and the weight was measured using a digital balance.

Error Analysis: The measurement errors in the tests were estimated using a standard error analysis. The sources of error were identified and their contributions to the overall measurement error were quantified. The results were reported with a 95% confidence interval.

RESULTS

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The results obtained from the experiments showed that the use of slender-wire diameters in the design of helical springs resulted in enhanced performance characteristics. Specifically, the use of slender-wire diameters led to a significant increase in the spring stiffness, which is a measure of the spring's ability to resist deformation under load. Additionally, the use of slender-wire diameters resulted in a reduction in the weight of the spring, which is an important factor in the design of lightweight structures.

DISCUSSION

The use of slender-wire diameters in the design of intelligent helical springs has significant implications for the design of suspension systems in automobiles and aerospace structures. The increased stiffness of the slender-wire helical springs can lead to improved vehicle handling and stability, while the reduced weight can lead to improved fuel efficiency and reduced emissions. Furthermore, the use of slender-wire diameters can lead to reduced material costs and manufacturing time, which is an important consideration in the mass production of springs.

CONCLUSION

In conclusion, this study has demonstrated that the use of slender-wire diameters in the design of intelligent helical springs can lead to enhanced performance characteristics. The increased stiffness and reduced weight of the slender-wire helical springs have significant implications for the design of suspension systems in automobiles and aerospace structures. Further research is required to explore the full potential of slender-wire helical springs in various engineering applications.

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