Abstract ID 454

OPTIMIZING ORNAMENTAL STONE CUTTING AND MACHINING EQUIPMENT THROUGH MASS DECOMPOSITION ANALYSIS

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Keywords: mass decompounding; lightweight; regression analysis; stone; industrial equipment

Summary: Ornamental stone cutting and machining equipment is widely used in the construction and decorative stone industries due to its high precision and ability to produce intricated stone products. However, the machines are typically characterized by their high robustness, which results in significant weight. Reducing the weight of such equipment without compromising structural integrity is a key challenge in engineering design.
This study proposes a mass decomposition analysis to better understand how the mass of the cutting head influences the overall mass of the other subsystems of the equipment. By identifying these relationships, it becomes possible to predict potential secondary mass reductions when modifying primary components, such as the cutting head.
The methodology applied in this research is based on a regression analysis that establishes correlations between the masses of different subsystems and the total mass of the equipment. This approach allows engineers to determine how reductions in the mass of one component propagate throughout the entire structure. By analyzing these interdependencies, we can strategically redesign specific elements of the machine to achieve weight reduction while maintaining mechanical performance and durability. By quantifying these relationships through regression models, the study provides a predictive framework for optimizing mass distribution across the entire system.
The outcome of this research includes a systematic approach to designing ornamental stone cutting and machining equipment that is lightweight while maintaining functionality.
Lighter equipment may offer advantages in terms of fabrication, transportation, installation, and maintenance, further enhancing its economic and environmental benefits. The findings can serve as a foundation for future advancements in machinery design, promoting a shift toward more sustainable manufacturing practices.