

# **Design and Optimization of a Lead Screw for Lathe Machine Applications**

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## **Abstract**

This study presents the design, analysis, and development of a lead screw intended for lathe machine applications, with emphasis on enhancing precision and durability. The project followed the Informed Design Process (IDP), beginning with the identification of design specifications and constraints, including load capacity, vibration control, material feasibility, and cost-effectiveness. Comparative analyses of square, ACME, and trapezoidal thread profiles were conducted, evaluating stress distribution, torque transmission, and efficiency using analytical calculations and finite element simulations. A trapezoidal lead screw with a 10 mm diameter and 2 mm pitch, fabricated from AISI 316L stainless steel, was selected as the optimal solution due to its superior stress management and torque performance.

Stress simulations under a 2 kN load yielded axial and bending stresses of 116 MPa and 203 MPa, respectively, with verification showing less than 10% deviation from theoretical results. While experimental validation was limited by equipment availability, the verification outcomes confirm the design's reliability. The work highlights the effectiveness of integrating computational tools and design optimization in developing high-performance machine components.

### **Keywords**

Lead screw design; Lathe machine; Trapezoidal thread; Finite Element Analysis (FEA); Stress analysis.

### **Biographies**

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