

Bachelor's / Master's Thesis

Development and Validation of a Strain-Gauge-Based Measurement System for Determining the Impact Energy of Demolition Hammers

Demolition hammers break up mineral materials by means of highly dynamic impacts. A key parameter describing their operating behaviour is impact energy. It can be determined from the strain wave transmitted through the chisel or working tool. For this purpose, strain gauges are applied to the tool and the resulting strain is recorded at high temporal resolution.

The measurement setup places high demands on the strain gauges, their application, and the measurement and evaluation system. The strain waves generated during an impact are very short and may overlap because of reflections at the tool ends.

The aim of this thesis is to develop and validate a strain-gauge-based measurement system for recording and analysing strain waves in the tools of rotary hammers and hydraulic breakers. Suitable strain gauges and measuring positions will be selected and an appropriate measurement chain designed for both applications. A rotary-hammer chisel and, if applicable, a hydraulic-breaker chisel will then be instrumented, and the measurement system validated theoretically and experimentally.

The recorded strain histories will be used to determine the impact energy in accordance with the EPTA method. The number of impacts required for a statistically reliable and repeatable determination of impact energy will also be investigated. Possible dependencies and correlations between successive impacts will be considered.

The following work steps are planned:

- Literature review of strain gauges, strain-wave propagation in circular rods, and methods for measuring impact energy
- Analysis of the measurement requirements
- Selection of suitable strain gauges, bridge circuits, measurement amplifiers, and data acquisition systems
- Protection concept to prevent strain gauges from detaching under acceleration forces
- Determination of the theoretical minimum tool length required to prevent incident and reflected strain waves from overlapping in the relevant evaluation interval
- Application of strain gauges to a rotary-hammer chisel and, if applicable, a hydraulic-breaker chisel
- Development of an evaluation method for detecting individual impacts and calculating the single impact energy
- Theoretical plausibility check and experimental validation of the results using wave travel times, wave amplitudes, and the energy balance
- Investigation of the variation in single impact energy for different demolition hammers and operating conditions
- Documentation and presentation of results

The exact scope will be adapted to the type of thesis. If you are interested, please feel free to contact me. Start date: From September 2026 or later.

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