Comparative Analysis and Optimisation of Machining Parameters on Boring Bars for Minimum Vibrations

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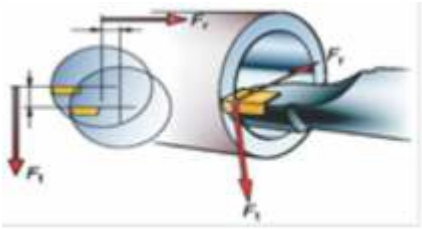
Abstract:

Vibrations are inevitable and undesirable for structures in order to achieve stability, durability, performance and quality. Reduction in vibrations can be achieved by increasing the damping ratio or by increasing the stiffness of the structure. In a boring operation, the boring bar deflects due to the tangential and radial forces acting on the tool. The major force acting here is the tangential force. This force increases when the boring bar is clamped at longer overhangs causing deflections. Conducting an analysis on the boring bar is the aim in the project with and without reinforcement to achieve set of optimized parameters given from Taegu Tec, Bangalore. Vibration reduction is a challenge and working on the analysis made it interesting for my selection of the project.

The aim of the project is carrying out a comparative analysis and optimization of machining parameters of two boring bars of diameter 40 mm with and without reinforcement. Tungsten carbide is used as the reinforcement. To conduct the analysis, two static tests and a dynamic test is planned for the project at different overhangs or L/D ratios of 3D, 4D, and 5D. The scope is to find out the minimum deflections and the natural frequencies at static condition and the accelerations or displacement of the boring bars at dynamic conditions. A Universal Testing Machine is used to capture the minimum deflections at defined load. A Fast Fourier Transform analyzer is used to convert the time to frequency used to measure the natural frequencies by modal analysis. Finally the deflections are measured at six sets of parameters and concluding with the best surface finish measured by roughness tester and minimum displacement plotted by the FFT analyzer.

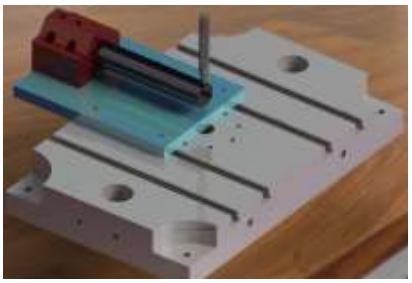
The analysis is conducted and the reinforcement boring bar stands out to be the stable one with better roughness values held at 160 mm overhang at a defined set of parameters. Design of experiments was conducted to find the optimized set of parameters. The steel boring bar reinforced with tungsten carbide is found out to be more stable than the solid steel bar by improved surface finish and lesser deflections.



Axle housing

Steel bar

Steel bar reinforced with Tungsten carbide



Static test

Modal analysis

Dynamic test

Roughness measurement