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## Non-spherical single cone bit mechanics analysis and tooth load test

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The non-spherical single cone bit is a new type of cone bit designed on the basis of the spherical single cone bit; the new cone bit performs rock breaking by shocking and scraping to achieve a good effect on hard strata. Mechanics analysis is performed, and the kinetic equations are established in the drilling process to study the law of rock breaking of the bit. The tooth load of the bit, which is linked to the bit dynamic equation, is tested using a full-scale drilling test bench for different weight on bit (WOB) and rock. The test results demonstrate that the tooth is most easily damaged when the end of cone tooth-row tooth has the highest peak load. Axial force is greater than the tangential force and the radial force on the same tooth. The tooth load increases approximately linearly with the WOB increasing. The tooth load when drilling into sandstone is lower than that when drilling into limestone under the same WOB. In the process of the tooth rock breaking, the directions of the axial force and the tangential force remain constant, whereas the radial force direction changes. The study not only deepens the understanding of the rock breaking mechanism of a non-spherical single cone bit but also offers some guidance on the design of the bit.

*Keywords:* Non-spherical single cone bit; Kinetic equation; Tooth load test; Load changing regularity

### 1. Introduction

The spherical single cone bit is most frequently used at the drilling site because it is small, cheap, simple in structure and able to adapt to high speed; as a result, it has broad application prospects in slim hole drilling (Xia et al., 2002; Zhang and Yue, 2001; Langford, 1999). The tooth trajectory of a spherical single cone bit is mesh-cutting trajectory, which breaks rock via

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