

### **3. Development of High Durability Cutter Bits for Tunnel Boring Machines**

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The diameter and length of tunnels driven by the shield tunneling method have been on the increase in recent years. A major challenge in shield tunneling in the coming years, therefore, is to improve the performance of cemented carbide cutter bits because they can significantly affect the excavation performance of tunnel boring machines. Many studies have focused on the material and changing method of cutter bits, but few have looked at cutting edge configuration, that is, at the optimization of the flow of cut material and improvement of cutting performance and wear resistance. In this study, a series of model experiments using a 3D printer was conducted, and a friction measuring method using a 3D scanner was developed, and then a new type of highly durable, unconventionally shaped cutter bits ("Stamina Bit") were developed. The model experiments, which were conducted as a means of observing the cutting performance of cutter bits, have yielded satisfactory results. In the wear measurement, a technique for detailed measurement of bit shape by use of a 3D scanner has been established.

**Key words:** cutter bit, long-distance shield tunneling, 3D scanner, 3D printer