

Novel diamond-cutting blade

Advanced tunnel development technology

Element Six's leading patented polycrystalline diamond (PCD) cutting technology, combined with Master Drilling's fully mechanized services for the mining, infrastructure, and energy sectors





“The innovative technology has been tested under both underground and surface conditions in the UK and South Africa with several end-users in mining and infrastructure industry, demonstrating higher performance compared to traditional rock excavation methods”

Koos Jordaan
Executive Director, Master Drilling

The opportunity

This novel diamond-enabled cutting technology increases tunneling development speed, reduces costs, and minimizes the environmental impact of construction for mining, infrastructure, and energy sectors.

Element Six (E6), a pioneer in the development and manufacturing of PCD and ultra-hard materials, and Master Drilling (MD), a global leader in drilling technology solutions, have collaborated to combine E6’s leading patented PCD cutting technology with MD’s fully mechanized services for the mining, infrastructure, and energy sectors. The innovative technology has been tested under both underground and surface conditions in the UK and South Africa with several end-users in the mining and infrastructure industries, demonstrating higher performance compared to traditional rock excavation methods.

The challenge

Despite its importance, building tunnels poses technical and environmental challenges such as geological unpredictability, water ingress, high costs, waste generation, and safety concerns. The E6 and MD project introduces a groundbreaking diamond-enabled solution designed to tackle these challenges and significantly increase tunneling development speed, reducing costs, and minimizing the environmental impact of tunnel construction.

Why tunneling

Underground tunnels provide access to critical mineral resources, create efficient transportation routes, and house essential utilities, all while minimizing surface disruption. In mining, tunnels are key for accessing mineral resources and providing transportation and ventilation networks for underground operations. In transportation, they shorten routes through difficult terrain or urban areas. In construction, tunnels house utilities underground, and in energy, they support hydroelectric plants and pipelines.

Why diamond

> 17%

less waste rock generated compared to traditional tunneling operations

The solution

E6 blade with integrated PCD cutters

E6's innovative rotatable disc cutter system is designed for use in various excavation applications, including mining, construction, trenching, and tunnel boring. This advanced system features E6's PCD cutting edges, mounted on tool holders around the disc's periphery, allowing for both horizontal and vertical cutting orientations. The cutting assembly, equipped with multiple disc cutters, works in tandem with a rock breaker tool to efficiently cut and break rock formations.

The results

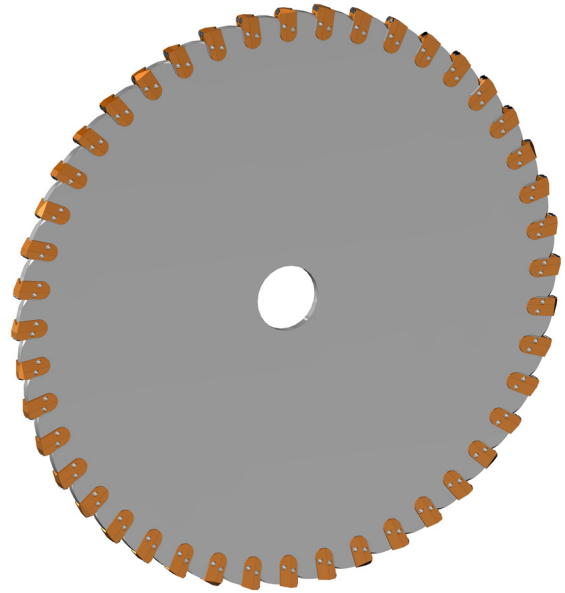
The result is a novel synthetic diamond cutting technology that increases tunneling development speed, reduces costs and minimizes environmental impact, with over 17% less waste rock generation, compared to traditional tunneling operations.

The laboratory and field-pilot trials have demonstrated the cutting disc system's impressive ability to cut and break various types of concrete and hard rock, such as granite, chromite and limestone, with compressive strengths up to 350 MPa. The system achieved an advance rate of up to 60 meters per hour, with or without coolant. Remarkably, the blade consumed just 70 kW of energy.

This innovative technology can function independently for face or side cutting on a mobile carrier or be integrated into a tunnel boring machine (TBM) for mechanized underground excavation.

“Synthetic diamond innovation holds immense potential to shape the future of industrial applications. By extracting a lower amount of rock during tunnel development, the solution we developed in partnership with Master Drilling will significantly reduce waste and environmental impact, ensuring a better tomorrow for generations to come.”

Siobhán Duffy
CEO, Element Six



Above: E6 blade with integrated PCD cutters

The E6 blade consumes just

70 kW

of energy



Left: example of tunnel excavation using the E6 blade
Right: example of surface cutting using the E6 blade



Element Six is a global leader in the development and production of synthetic diamond and tungsten carbide solutions. For over 70 years, our innovation expertise has enabled a wide range of industries, from aerospace and mining, to semiconductors and sensing. Part of the De Beers Group, our primary manufacturing sites are located in the US, UK, Ireland, Germany and South Africa. Our sites in Ireland, Germany and South Africa are ISO 50001 certified.

Through the De Beers Group, Element Six is a member of the UN Global Compact (UNGC). The UNGC drives business awareness and action towards the UN Sustainable Development Goals (SDGs), focussing on 10 principles around human rights, labour, environment and anti-corruption. Element Six works within the De Beers Group Building Forever commitment and Science Based Target Initiative (STBi), which is also based on the UNGC principles.

We incorporate and take responsibility for these principles through the Element Six Code of Conduct, Our Values, Responsibilities and Policies.

At Element Six, we have active communities working towards sustainability from a variety of angles, such as environmental impact, inclusion, diversity and community outreach, both internally and externally.

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