New Innovations in Geosynthetics – Sustainable Approach for Indian Highways and Civil Engineering Applications by IIT Indore & IIT Hyderabad

Researchers at the Indian Institute of Technology Indore, led by Dr. Baadiga Ramu and his research team, namely BS Praveen (Doctoral Scholar) and P Sai Meghana (UG Scholar) from the Department of Civil Engineering and Prof. Umashankar Balunaini from IIT Hyderabad, Department of Civil Engineering, have developed new geogrids that could help to construct pavements on soft soils.

The research team has developed two new geogrids designed to surpass the existing geogrids in the market in terms of superior strength. These geogrids belong to the geosynthetics family, including geotextiles, geocells, and others. These two innovations drew inspiration from nature, particularly from the Indian star tortoise and the architecture of the Taj Mahal. These new designs were developed in Dr. Ramu's & Prof. Umashankar's research laboratory and have been filed for patent and industrial design registration in India.

India, with its extensive road network stretching over 6.671s million kilometers, faces significant challenges in managing the massive volumes of crushed stone aggregates required for such infrastructure. In alignment with India's commitment to the UN Sustainable Development Goals—particularly those focused on innovative, resilient, and sustainable infrastructure (Goals 9, 11, 12, and 13)—the technology developed at IIT Indore marks a significant advancement. This new technology addresses climate change, resource scarcity, and waste management issues. With the government investing heavily in road infrastructure annually, the introduction of these innovative geogrids promises to reduce both long-term carbon footprints and construction costs by utilizing locally available waste materials.

The geosynthetic industry currently offers a range of geogrids, including uniaxial, biaxial, triaxial, and multiaxial designs, with some even featuring hexagonal shapes from various manufacturers. Ongoing research is focused on developing superior geogrids that outperform existing ones in terms of strength, durability, and overall performance. The current innovations, namely Multiaxial Diamond Anchored Octagonal Geogrid (MDAOG) and Multiaxial Concentric Octagonal Geogrid (MCOG) are recent breakthroughs designed to push the boundaries of geogrid technology and set new standards in the industry.

Geogrids are becoming crucial in sustainable engineering due to their ability to reinforce soils and reduce the environmental impact of construction. By improving the durability and efficiency of roads, embankments, landslides, and other structures, geogrids help reduce the need for thick layers of aggregate or soil, making projects more resource efficient. Their role in load distribution minimizes localized failures, reduces pavement deformation, and enhances long-term stability, contributing significantly to reducing the carbon footprint of construction by lowering material use and energy consumption.

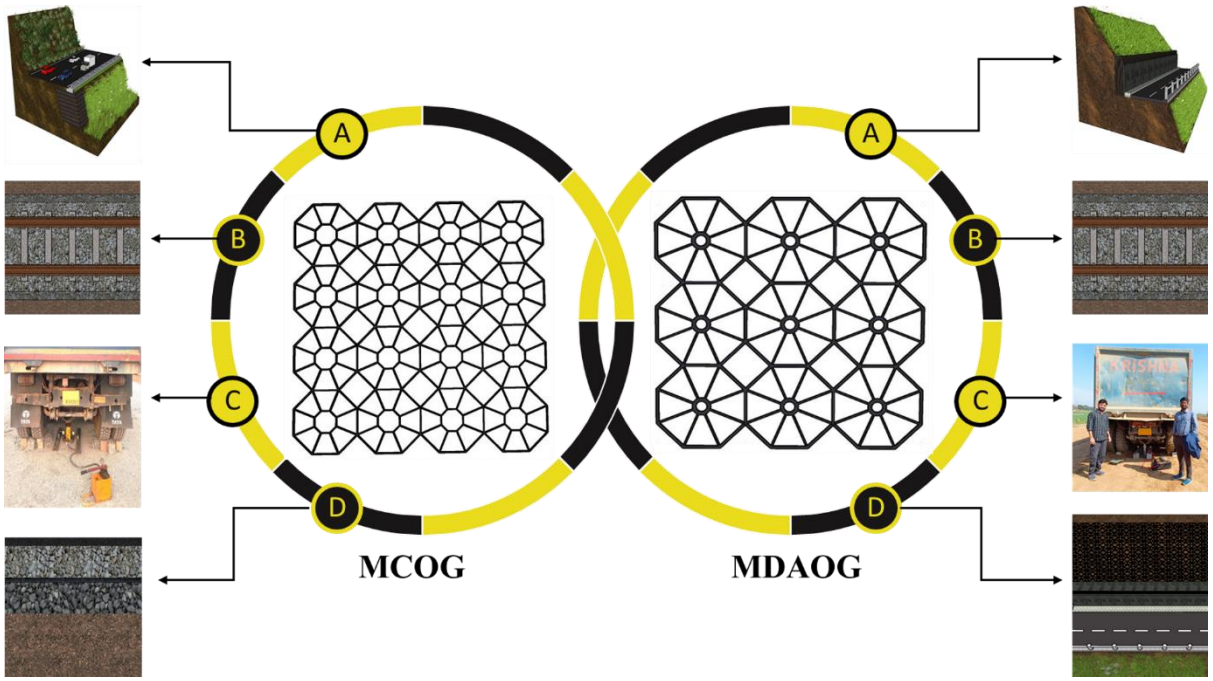
Additionally, geogrids can be produced from recycled or waste materials, such as post-consumer plastics, addressing solid waste management challenges while supporting a circular economy. This reduces the need for virgin materials and cuts down greenhouse gas emissions during production. By stabilizing soils, preventing erosion, and enhancing infrastructure

resilience, geogrids help mitigate climate impacts like flooding and rising sea levels, making them essential in building climate-resilient infrastructure.

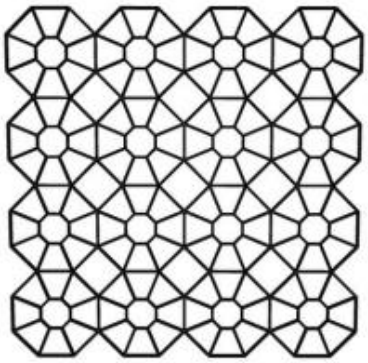
MDAOG and MCOG geogrids are expected to have diverse civil engineering applications, including the construction of flexible pavements, especially highways. They also enhance airport runways and railway track beds, provide support in tunnel construction and underground mining, and reinforce foundations, embankments, and slopes. Additionally, they are vital in retaining walls, bridge abutments, riverbank protection, and soil erosion control, making them crucial for sustainable civil engineering projects.

The ultimate goal of this research is to provide new superior geogrids that are sustainable for climate-resilient civil engineering applications, especially in weak soils. These innovations aim to help civil engineers tackle the challenge of building stable, eco-friendly infrastructure in changing environmental conditions.

Interested parties are encouraged to contact directly to *baadigaramu@iiti.ac.in* (Dr Ramu Baadiga); *eo-ctr@iiti.ac.in* (Ms. Priyanka Kimmatkar) or *buma@iith.ac.in (Prof. Umashankar B)* for more information on technology transfer, commercialization, and collaboration opportunities.

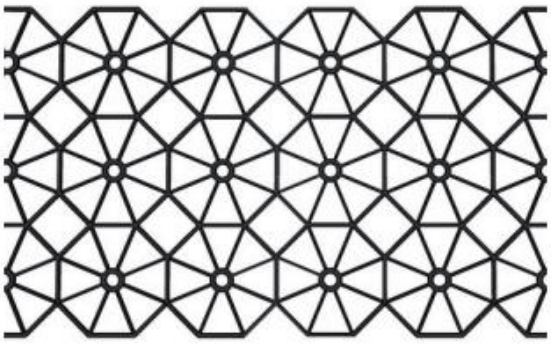


Inspired from central chamber of the Taj Mahal



MCOG

Naturally Inspired from Indian Star Tortoise



MDAOG