Optimising E-Fence Porosity for Sediment Retention: A Case Study in Micro-Tidal Beaches

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Abstract. Micro-tidal sandy beaches are prone to erosion due to limited natural sediment replenishment, and sand fences are commonly used as a sustainable mitigation measure for coastal erosion, promoting sediment deposition. In 2022, Effective Sand Fence (E-Fence) structures with a 6 cm porosity were introduced at Pantai Batu Rakit, Terengganu, to address ongoing shoreline retreat. However, there is no standardised guideline for optimal porosity design, particularly in monsoon-dominated regions. By employing a 1:10 scale physical modelling approach, this study aims to investigate the effect of porosity on sediment retention under controlled wave conditions in a 2D wave flume. Two E-Fence configurations with porosities of 10 cm and 20 cm were tested in a 2-hour simulation using hydrodynamic parameters of 1.5 m wave height, 1.0 s wave period, and 3.02 m water level, which replicate the monthly extreme event. A high-resolution 3D Terrestrial Laser Scanner (TOPCON GLS-2000) was used to compare the profile changes between pre- and post-simulation, and sediment volume was analysed via Surfer software and Profiler 3.2 XL. The results showed that the 10 cm porosity trapped more sediment (0.128 m^3) than the higher 20 cm configuration (0.105 m^3), suggesting that lower porosity enhances trapping efficiency. These findings offer practical insights for optimising sand fence designs by adjusting slat spacing to improve coastal resilience.