A Coastal Underwater Seabed Waste Bin: Design, Development, and Stability Analysis

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Devices placed on the seabed in shallow coastal waters must remain stable under waves and near-bed currents. In this project, I developed a coastal underwater seabed waste bin that serves as a stationary collection point for waste collected by divers. The main engineering challenge was to design a system that stays stable without sliding, overturning, or lifting off the seabed, while also meeting practical constraints such as internal capacity, safe interaction with marine life, low cost, compact shipping, and simple deployment. I modeled the bin as a rigid structure resting on the seabed and studied three failure modes: sliding, overturning, and upward movement caused by buoyancy and wave action. Coastal conditions were described using wave height, wave period, water depth, near-bed current velocity, and bin geometry to estimate underwater forces. Buoyancy, vertical lift effects, seabed friction, and load distribution across the base were considered to determine the minimum submerged weight needed for stable placement and to prevent uplift. Practical design constraints were also addressed. I built the bin as a modular structure that can be packed into a small transport volume, allowing easy and low-cost shipping and simple on-site assembly and deployment. Materials and geometry were chosen to reduce the risk of marine animals entering or becoming trapped. The internal layout was designed to keep collected debris inside the bin, including microplastic-sized waste. Stability is achieved using locally available ballast. From the analysis, I determined ranges for ballast mass and structural dimensions that allow the bin to remain stable under different coastal conditions.

Awards Won:
Fourth Award of $600