From Crisis to Reconstruction: Integrating UAVs, LiDAR, and Bathymetric surveys for climate-resilient infrastructure remediation. A case of the St John's River Bridge accident.

Paa Kwesi Ezanetor Akuffo Owusu-ensaw (Ghana), Samuel Botchway, Raphael Atimbire, Cecilia Akrong, Ernest Obiri Yeboah and Portia Addo Gyemfah;

Key words: Bridge surveying; Deformation measurement; Engineering survey; GNSS/GPS; Hydrography; Laser scanning; Low cost technology; Photogrammetry; Positioning; Remote sensing; Young surveyor

SUMMARY

In October 2023, a rail incident in Duo, Bong County, Liberia, resulted in the collapse of a key bridge, along the rail tracks of ArcelorMittal's critical rail network, across the St. John's River, highlighting the need for rapid and innovative geospatial solutions. This case study explores the integration of UAVs, aerial and terrestrial LIDAR scanning, and bathymetric surveys to design and implement a climate-resilient remediation strategy. The project began with aerial surveys using UAVs (Mavic 2 and Mavic 3E drones) to capture high-resolution imagery and generate point clouds for detailed damage assessment. Terrestrial LIDAR scanning provided precise 3D models of the damaged piers, abutments, and surrounding topography. Complementary topographic and bathymetric surveys mapped river depth, rock outcrops, and potential flood zones, spanning 2 km on either side of the bridge. These geospatial datasets informed the design of a 6-meter-high retaining wall, reinforced with gabion baskets and engineered fill to withstand potential climate-induced flooding. The use of geospatial technologies ensured accuracy in surveying, setouts, and monitoring throughout the project lifecycle. Monitoring pins and level instruments tracked deformation and settlement, while our aerial videos captured weekly progress to aid in construction management and stakeholder communication. The project's success relied on collaboration among engineers, surveyors, environmental scientists, and community stakeholders, demonstrating the value of multidisciplinary approaches to infrastructure challenges. This study illustrates how the strategic application of UAVs, LIDAR, and bathymetric surveys can enhance climate resilience, optimize construction workflows, and provide replicable solutions for infrastructure restoration in developing regions.
