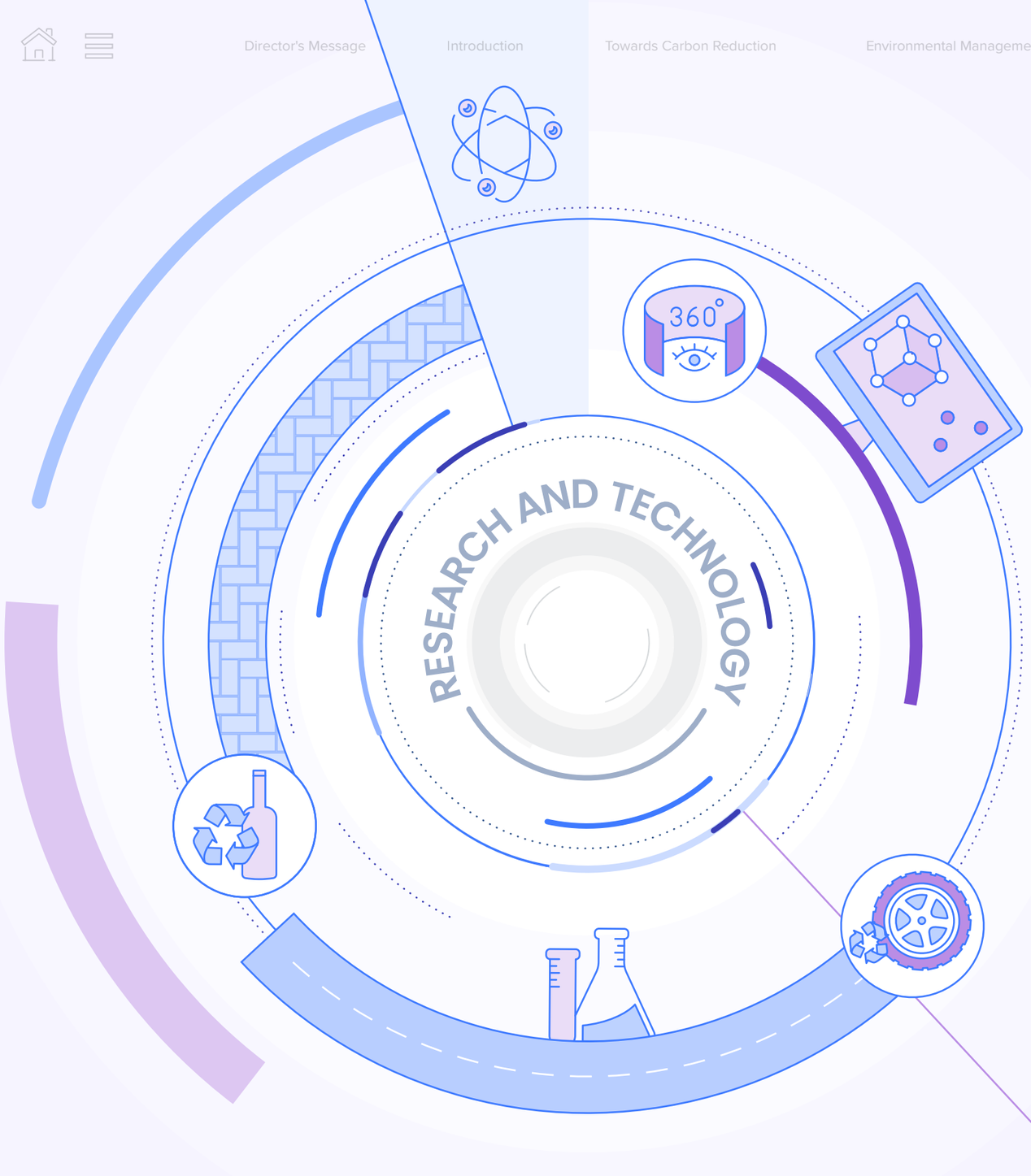


RESEARCH AND TECHNOLOGY

Application of Backpack Mobile Mapping System

Laser Scanning Survey for Generating 3-dimensional (3D) Point Cloud

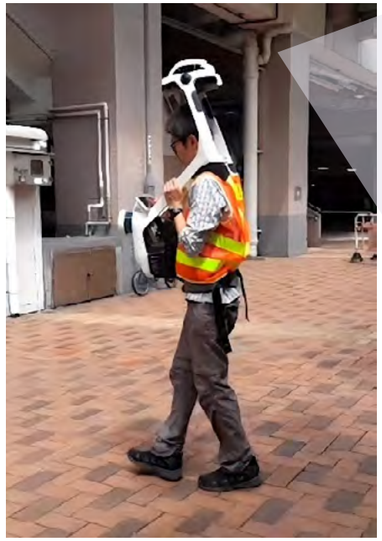
We continually strive to adopt new technologies that enhance work efficiency and reduce carbon footprints. In 2023, we introduced the Backpack Mobile Mapping System (MMS), a portable and wearable device utilizing the Simultaneous Localization and Mapping (SLAM) algorithm laser scanning technologies for efficient and large-scale data collection. This system outperforms the traditional Terrestrial Laser System (TLS) in terms of efficiency and mobility.

During data collection process, our survey officers may wear the portable Backpack MMS to collect spatial data as our officers move around, eliminating the need for occupying space for setting up survey stations like the traditional TLS method and hence reducing disturbance to the public. With the two built-in laser scanners, the Backpack MMS is capable of measuring up to 600,000 points per second with centimeter-level accuracy for engineering applications. Its SLAM algorithm also enables operation in Global Navigation Satellite System-denied areas like areas covered by dense vegetation and indoor area, making it adaptable to various environments. Since its introduction, the Backpack MMS has been utilized for different applications, such as stonewall tree survey, record survey, topographic survey and existing condition modelling (ECM).

Environmental Benefits

The adoption of the Backpack MMS does not only improve operational efficiency, but also reduces carbon emission in data acquisition. The traditional TLS is a bulky equipment, which requires extra personnel for equipment setup. Due to its stationary nature, multiple visits are often required when using the TLS to capture all necessary data, leading to increasing vehicle usage, fuel consumption and in turn carbon emissions. In contrast, the Backpack MMS, with the streamlined workflow and its simultaneous scanning capability, enables a single operation to collect the required data, thereby eliminating the need for additional manpower and energy consumption. The system also features with greater flexibility and mobility, allowing fast data collection within a day. As a result, vehicle-related carbon emissions could also be minimized.

With the use of the Backpack MMS, photos and point cloud data are stored digitally and can be published on a web-based Geographic Information System (GIS) for further inspection. This allows our colleagues to directly work on the 3D data through the GIS platform, thereby reducing the reliance on paper-based survey plans.



Backpack MMS in operation

ECM formed from the point cloud model

Point cloud model captured by the Backpack MMS

Point cloud model of Aberdeen Tunnel Toll Plaza

Point cloud model of a stonewall tree

Eco-pavers with Increased Recycled Glass Cullet Content

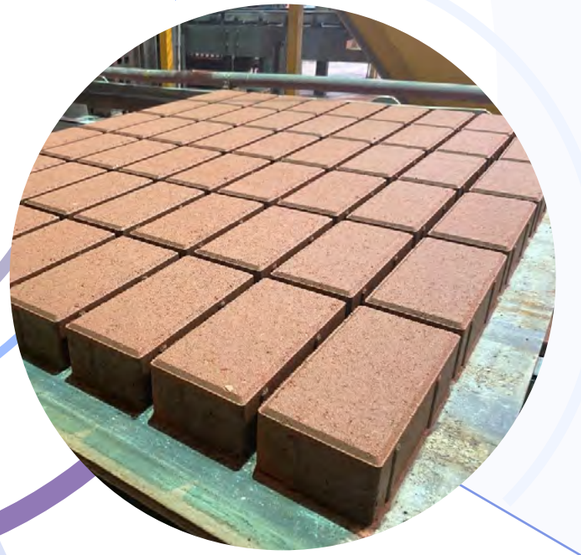
Waste glass bottles

Utilized about

2,200 tons

of recycle glass

for producing eco-pavers in 2023



Eco-paver with recycled glass cullet

We are committed to developing environmentally friendly paving materials for footways. Since 2004, the use of recycled aggregates, which are crushed concrete or rocks generated from construction or demolition works, in concrete pavers (eco-pavers) has been mandated. From 2010, we have taken a further step by requiring the inclusion of recycled glass cullet, comprising 20% to 25% by weight of the total aggregates in eco-pavers used in our road maintenance contracts. In 2023, approximately 2,200 tons of recycled glass, equivalent to over 4.4 million discarded glass bottles, were utilized.

To promote further utilization of recycled glass cullet, we completed the site trials of eco-pavers with recycled glass cullet content of 30% to 35% by weight of the total aggregates in 2023. With satisfactory results from these trials, the use of eco-pavers with higher glass cullet content was mandated in the road maintenance contracts starting from 2024.

Eco-pavers decrease the reliance on natural resources such as river sand by incorporating recycled aggregates and recycled glass cullet. This approach not only conserves significant amounts of raw materials but also helps reduce the amount of municipal solid waste. Furthermore, the use of eco-pavers contributes to lower carbon emissions. The production process of eco-pavers is more energy-efficient, requiring less energy compared to traditional materials, which makes them a more sustainable choice from the outset.

Rubberized Bituminous Pavement Materials

Site trial of rubberized bituminous pavement materials at Tung Chau Street

The disposal of waste vehicle tyres has posed a significant challenge for decades in Hong Kong. As a contribution to addressing this issue while delivering both environmental and engineering benefits, we collaborated with the Hong Kong Polytechnic University (PolyU) and completed two feasibility studies on the use of rubberized bituminous pavement materials in Hong Kong road network. The studies concluded and confirmed the technical feasibility of incorporating crumb rubber into conventional bituminous pavement materials, and the recyclability of the rubberized bituminous pavements at the end of their service lives.

To evaluate the performance of rubberized bituminous pavement materials in public roads, we commenced a site trial programme in 2021. Following the successful trial ended in 2023, where 42 trial road sections had been laid with these materials, an additional 18 road sections were laid with these materials in 2024. We are now embarking on a new study with PolyU aiming at increasing the proportion of crumb rubber and optimizing the production process of rubberized bituminous pavement materials, making them more environmentally friendly for wider application.

Waste tyres

Ground recycled crumb rubber

Crumb rubber modified bitumen in laboratory

Rubberized bituminous pavement

60
road sections have been completed