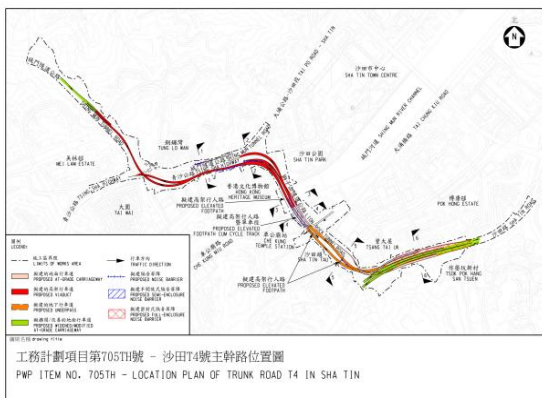# Vibration Monitoring for Heritage Application

- **CEDD Project :** Contract No. ED/2022/02 Trunk Road T4 and Associated Works

- **Consultant**
  AECOM Asia Company Limited

- **Contractor**
  CRBC – Build King Joint Venture

- **Monitoring Starting Date**
  26 August 2024

- **Location**
  Hong Kong Heritage Museum

- **Objective**
  Monitoring the vibrations in the Hong Kong Heritage Museum during construction work

- **Tools**
  - Vibration Meter
  - LORA Gateway
  - SMOS Monitoring Platform

Vibration Meter   LoRa Gateway

Background

The project's principal works comprise the construction of a 2.3 km dual two-lane trunk road with connecting slip roads to Shing Mun Tunnel Road, Tsing Sha Highway, and Shatin Road. This will be accompanied by widening a 150-meter section of Sha Tin Road near Pok Hong Estate from a dual two-lane to a dual four-lane carriageway. Ancillary works include extensive civil, geotechnical, and utility efforts, along with the implementation of environmental mitigation measures and a monitoring program.

Site Work

The construction project may result in vibrations that deform the artifacts in the Hong Kong Heritage Museum. To monitor the vibrations caused by the project as a preventive measure, 36 sensors are installed in different locations within the museum. The vibration sensors are connected to network gateways that transmit and store data on cloud. These data can be accessed and analyzed with the monitoring website.

YSF Corporation Ltd.

Challenge

- The Heritage Conservation Team require a fast-sampling rate (1-2 measurements/min) and uploading rate (Every 5 mins). The power consumption is high under this setting.
- A longer battery life is requested to reduce the battery replacement frequency.
- The signal between Vibration Sensors and LoRa Gateway in some warehouses are very weak. Mobile phone is difficult to get signal in this location.

Technology

Vibration Meter

- Utilize a 3-axis MEMS accelerometer
- Measure vibration levels in LAW/PPV and frequency
- LoRa technology
- Customizable through app or CMT Cloud
- Intelligent alert threshold – Uploading frequency will be changed to every minute when vibrations exceed the alert threshold. Therefore, we can keep low uploading rate in normal condition to save power.

4G Gateway

- Collect data from each Vibration Sensors using LoRa or LoRaWan radio
- Transmit data to internet (cloud server) via 4G network

SMOS Monitoring Website

- Display the real time and historic data, locations of the sensors, project information, network status, and alert messages
- Analyze the data values and the curves formed by the data, as well as the comparison of values between sensors to identify the vibration source