Before construction work could commence on a large multi-storey apartment building in central Auckland, China Construction NZ Ltd. (CCNZL) was required to provide assurance to Auckland Council that the proposed work would not damage or compromise an adjacent heritage listed building dating back to 1876.

The heritage Britomart Hotel (known as The White Rabbit), is a two-storey, unreinforced, bluestone masonry structure and its overall condition was poor due to its age. There was concern that the building would be vulnerable to structural damage while the new apartment building was being developed, particularly during the early excavation and piling phases, which tend to shake the ground. These vibrations can undermine the footings and cause significant structural damage. CCNZL adopted a partnering approach with key stakeholders which included representatives from the local council and heritage consultants, to ensure that the best possible outcome was achieved under the project's consent conditions.

CCNZL contracted Mainmark to help track any movement and structural change of the historic building by using STRAAM (STructural Risk Assessment And Management) real-time structural monitoring technology. STRAAM was able to measure the unique dynamic signature of the building, allowing for a structural health check, before work on the neighbouring site commenced. The technology was then used on an ongoing basis to monitor the building throughout the construction phase. The ongoing monitoring alerted the company and key stakeholders in real-time if there was a point where the work could compromise the structural integrity of Britomart Hotel building.
Objectives

CCNZL required Mainmark to provide an initial STRAAM baseline dynamic assessment report of the Britomart Hotel building to accurately record its structural health prior to commencing demolition and construction works nearby. The project’s engineers had deemed the building unstable and there were serious safety concerns for the CCNZL workers who were required to access the site.

Continuous monitoring was then required on an ongoing basis, 24 hours a day, 7 days a week to track any movement and vibrations that could cause structure risk throughout the project. CCNZL sought a solution that could deliver immediate alerts in the event construction work was found to be causing harmful structural movement. Continuous monthly reporting outlining the building movements over time was also required; available for council and other stakeholders as necessary to view if any damage had occurred incrementally during the CCNZL development.

Solution

Mainmark used STRAAM to establish a baseline building dynamic signature (BDS) for the Britomart Hotel building. The BDS utilises data from sensitive accelerometers placed at strategic points within the building to effectively create a structural cardiograph (SKG).

The specific output data for each location reports on:
- Dynamic signature of the structure
- First and higher order translational and torsional modes of vibration in each plane
- A ‘risk ratio’ that compares the structure to comparable structures

Mainmark undertook a full day carrying out the initial monitoring tests at the Britomart Hotel site, obtaining accelerometer recordings from the roof and all levels of the building. The baseline dynamic assessment report detailing the structural integrity of the building was provided to the client prior to the commencement of the adjacent construction works, providing a ‘snapshot’ of the building current structural condition and health state.
Mainmark then installed permanent sensors and equipment including shielded, long-term accelerometers, to the rooftop of the Britomart Hotel building to capture data 24/7. This continuous monitoring system is able to provide automatic alerts to the client when certain structural thresholds are surpassed due to the effects of the adjacent construction site. The recorded measurements include acceleration, peak particle velocity, power spectrum density and tilt. The data is accessible via an online portal at any time and also presented in monthly reports to summarise the buildings movement and any specific areas of note.

STRAAM is the most sophisticated live structural monitoring and analysis system in the world; allowing clients to make informed objective decisions rather than relying on less accurate, traditional surveying methods. CCNZL is able to utilise the continuous STRAAM data to gain insight into the changing risk profile of the Britomart Hotel structure over time and respond appropriately and quickly should construction limits be reached.

According to Mike Nunweek, Senior Site Manager at CCNZL, “We have been absolutely amazed by the STRAAM technology and its ability to help address a number of complex issues. The intuitive nature of STRAAM’s real-time alerts and reporting has saved us a considerable amount of time and money compared to traditional surveying methodologies. Not only is it helping us preserve a valuable heritage building, it is addressing the council’s requirements and, most importantly for us, we have great comfort knowing that our workers are safe and can be evacuated if required.” “The support we’ve received from the Mainmark team has been second to none.”

The BDS report for the Britomart Hotel building was undertaken on August 26, 2017, and continuous 24/7 monitoring commenced on September 7, 2017. The monitoring is expected to continue until September 2019, providing ongoing data of the integrity of the Britomart Hotel building throughout the construction phase.