Post-Occupancy Evaluation Report on Fettes College Study Rooms

Transforming Timber

CONTENTS

OVERVIEW

Fettes College in Edinburgh required additional study rooms for non-boarding sixth formers. Using the UK's first full-scale homegrown Cross Laminated timber (CLT) panels with natural fibre installation, 6 volumetric terrace row Study Pods were constructed.

They were designed by Page/Park and manufactured by EcoSystems Technologies. After construction, Innovate UK funded two post-occupancy evaluations (POEs) on the structures. Making use of in-situ testing and user surveys, these POE reports focused on user satisfaction in two areas: building comfort performance and acoustic performance. The reports reveal important insights into real-world use of these innovative timber products.

PERFORMANCE ASSESSMENTS

Building Research Solutions (BRS) began the comfort performance assessment of the Study Pods three months after construction was completed, and about three weeks after the secondary school students occupied the Pods. The assessment measured three comfort factors using standard building performance evaluation (BPE) apparatus and techniques: thermal envelope, occupants' perceived level of internal hygrothermal comfort, and indoor air quality.

RMP Acoustic Consultants assessed the acoustic performance and occupant satisfaction of the Study Pods for a two-week period. The assessment focused on the areas of airborne sound insulation, impact sound insulation, ambient noise, façade sound insulation, and reverberation control. In addition, the site measurement results were compared to BB93:2015, Acoustic design of schools: performance standards, which is a guidance document used for good practice that is often a condition of contract.

METHODS

The full reports provide detailed floor plans as well as information about the Pods' mechanical systems and equipment, details on the type of assessment undertaken and its relevant standards, as well as the location, type of sensor, and monitoring period. They also specify instrumentation for the assessments described below.

1. Comfort performance

The thermal envelope of the pods was tested through U-value measurements, InfraRed thermography, Air tightness tests, and energy consumption data. Occupants' perceived levels of comfort were assessed by measuring ambient air temperature and ambient relative humidity, and through a building user survey completed by 19 secondary school pupils who answered questions about temperature, air movement, lighting, and sound/noise. Indoor air quality was tested by measuring levels of metabolic carbon dioxide emissions, air change rates, and ambient relative humidity for surface condensation.

2. Acoustic Performance

Airborne sound insulation is required to control noise from adjoining rooms to avoid distraction and/or protect speech privacy, and was assessed through several methods. Impact sound insulation was assessed using tapping machines, since it is associated with footfall, doors/windows closing, and switch and plug use. Ambient noise, including break-in noise from outside or building services noise, was monitored under different conditions for an extended duration through the installation of a sound level meter and an external weather station. Façade sound insulation testing, which assesses compliance with design intentions and addresses performance or detailing concerns, was conducted with a loudspeaker placed 7m from the building façade.

Reverberation time (the duration a sound takes to decay), is critical in ensuring good intelligibility for live speech and audiovisual equipment, and was tested using impulsive pink noise. Finally, key performance requirements were mapped to a standardised questionnaire and given to the 19 students.

FINDINGS

1. Comfort Performance

No anomalies were found in the building's thermal envelope, and the U-Value, a measure of the rate of transfer of heat energy through a structure divided by the difference in temperature across that structure, was lower (better) than as required by Scottish Building Standards, and lower than the As-Designed value. Five of six measured corners were above the critical value set as a metric to avoid surface condensation and associated mould growth. The Pod's internal thermal comfort level has been taken as 19.5C, well within the thermal comfort range of 15.4 to 23.23 C. The internal relative humidity for each monitored Pod was consistently and constantly below the upper limit of 60% (the rate when occupants on average report that the air feels humid and damp) and were within the hygro-comfort range between 76% and 97% of the time. These levels were consistently and constantly below (better than) the 70% RH critical threshold set by the CIBSE design guides and British Standards for the entire monitoring period. CO2 levels fell within the best practice to acceptable ventilation range, and were less than 1500ppm for 94-98% of the monitored period.

While the ambient internal temperature resonated within the defined thermal comfort range, a great deal of temperature fluctuation occurred, which may be attributed to metabolic and equipment heat gains having a larger influence on the temperature profile than would otherwise be seen in larger classrooms. These fluctuations can lead to the environment being perceived as uncomfortable, and the majority of responding occupants felt that the Pods were cold, with fluctuating and uncomfortable temperatures.

2. Acoustic Performance

The airborne sound insulation comfortably met requirements of the standard in BB93; the CLT construction detailing has provided both good separating and external wall sound insulation. Where there are continuous structural elements between dwellings as can occur within CLT construction, impact sound insulation is especially relevant, and it was comfortably below the reference floor impact requirement and high sensitivity room standard. While all the Pods met the BB93 reverberation requirement, results indicate some variance which is likely the result of slight differences in student furnishings, which in such small room volumes will have a large impact on results.

Noise from the ventilation units was subjectively inaudible, and noise from weather fell comfortably within requirements including during a period of heavy rainfall. Given the measured sound insulation, it is unlikely noise from adjoining pods would be at levels considered disturbing unless the sources of noise are excessive. Even where the ambient noise level/masking noise is removed from consideration, conditions remain suitable for the intended activities. Occupants reported that generally sound from outside generates the greatest annoyance, and sound from ventilation provides the least. Positive responses indicate a suitable ambient noise level for concentration.

CONCLUSION

Taken together, these POE reports on comfort and acoustic performance of the volumetric CLT Fettes College Study Pods reveal insights about the real-world performance of homegrown biogenic offsite manufactured (bio-OSM) products and showcase the potential of these materials to be used in educational contexts.

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