

New window system cuts sound levels by 26 decibels, achieves four times better ventilation

February 4 2021



Honorary Fellow Dr Lee Siew Eang (left) and Dr Eddie Lau Siu-Kit (right) from NUS School of Design and Environment, with the acoustic friendly ventilation window installed at the NUS-CDL Smart Green Home. Credit: National University of Singapore

Home owners, especially those in noisy districts, can look forward to greater living comfort with a new invention by researchers from the

National University of Singapore (NUS) School of Design and Environment (SDE) that reduces outdoor noise and improves indoor ventilation.

Called the acoustic friendly [ventilation](#) window (AFVW), this novel system cuts environment noise levels by 26 decibels (dB), which is approximately more than a fourfold reduction in terms of a human's perception of loudness. It can also achieve four times better ventilation than an open conventional window.

Urban noise has long been a problem for high-density cities such as Singapore where the average outdoor sound level is about 69.4 dB. To prevent outdoor noise, an enclosed air-conditioned space would be an ideal solution. However, this would mean increased energy consumption and reduced natural ventilation. At the same time, as the global spread of COVID-19 continues, more attention has also been paid to redesigning built environment and spaces to ensure sustainability, physical well-being and emotional wellness.

With a focus on improving wellness, aural comfort and [indoor air quality](#), Dr. Eddie Lau Siu-Kit from the Department of Architecture and Honorary Fellow Dr. Lee Siew Eang from the Department of Building, had developed the AFVW together with former colleagues Dr. Du Liangfen and Mr Martin Konrad Danzer, who had both worked on the project while they were with SDE.

Better noise reduction and ventilation

Adopting labyrinth air path and sound absorption techniques that have better noise reduction at a broader range of frequencies, the AFVW was fabricated and installed at the NUS-CDL Smart Green Home for testing since December 2019.



Lead researcher Dr Eddie Lau Siu-Kit from the NUS School of Design and Environment installing the mechanical ventilation system for the Acoustic Friendly Ventilation Window, which is able to achieve four times better ventilation than an open conventional window. Credit: National University of Singapore

Measuring height 1.8m by width 0.88m by thickness 0.15m, the AFVW consists of two layers of glass panes with two staggered vents and a mechanical ventilation system. The glass panes are designed 0.6 cm thick and are set 8.5 cm apart. In order to achieve better sound insulation performance, sound absorbers are installed along the sides between the glass panes.

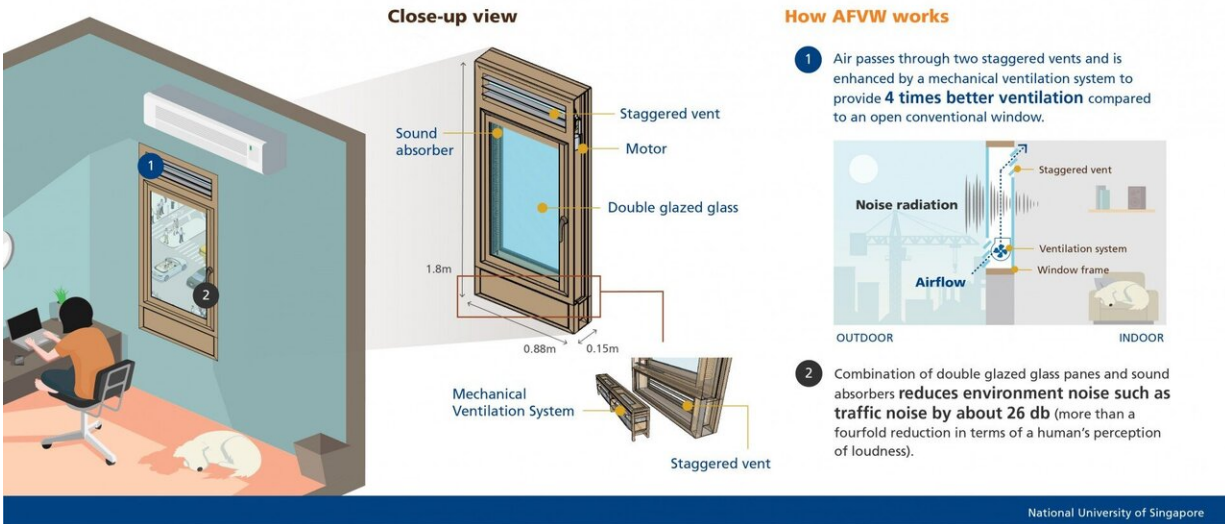
Sound tests based on international standards conducted at the NUS-CDL Smart Green Home showed that the combination of the double glass panes and the sound absorbers was able to reduce typical traffic noise by 26 dB. This effectively means that the human's perception of loudness is reduced by more than four times. Every 10 dB reduction in sound levels is about half of the human's perception of loudness.

While keeping the noise out, the AFVW is also able to provide natural ventilation through two open vents. Air flow passes through a staggered vent at the bottom of the window and out through another staggered vent at the top. A mechanical ventilation system is installed in between the [glass panes](#) to enhance the indoor air change. Using tracer gas simulating as a "pollutant" which was injected into a room installed with the AFVW and another with an open conventional window, the team found that the concentration of tracer gas, i.e. the removal of the "pollutant," decreases four times faster for the AFVW than for open conventional windows.

This means that the system could potentially improve thermal comfort with minimal [energy consumption](#) compared to natural ventilation. A dust particle filter, similar to those used in air-conditioning units, can also be added to the system to filter dust particles or pollutants.

"The AFVW provides additional ventilation as well as sound insulation for the indoor environment, and this is particularly important for improving indoor air quality and potentially mitigating the spread of infectious diseases," shared Dr. Eddie Lau, leader of the research team.

Acoustic Friendly Ventilation Window (AFVW) achieves better noise reduction and ventilation



Credit: National University of Singapore

Pilot trial at CDL premises

The AFVW prototype will be installed at City Developments Limited's (CDL) premises for test bedding and system refinements to make it viable for commercial and residential living applications. This is part of a partnership under two NUS-CDL platforms: the NUS-CDL Smart Green Home and Tropical Technology Labs.

Esther An, CDL chief sustainability officer, said, "Through championing leading-edge innovation, CDL continues to implement creative sustainable solutions that further the quality of the homes we develop. Our focus on green building and technology applications ensures we provide even more wellness and comfort to cater to the needs of today's homeowners. We are excited for a successful pilot of the AFVW, which

could potentially see its application pioneering at our future developments."

Contributing to sustainability research at NUS-CDL Smart Green Home

The NUS-CDL Smart Green Home is a unique indoor test-bed environment that serves as a platform for holistic and innovative experimental studies on smart features, [green building](#) technologies and design for sustainable living.

Situated in SDE4, Singapore's first new-build net-zero energy building, NUS-CDL Smart Green Home is a 100 m² full-size [home](#) designed for plug-and-play experimentation of new smart materials, systems and finishes.

"The AFVW is one of SDE's many research outcomes strategically aligned with our 'Well & Green' vision that emphasizes a people-centric integrated design approach. The NUS-CDL Smart Green Home allows customisation to facilitate cross-disciplinary research and development, ultimately creating a well-designed and healthy indoor environment," said SDE Dean Professor Lam Khee Poh.

Provided by National University of Singapore

Citation: New window system cuts sound levels by 26 decibels, achieves four times better ventilation (2021, February 4) retrieved 1 May 2024 from <https://techxplore.com/news/2021-02-window-decibels-ventilation.html>

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