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Sustainable strategies for energy conservation in our built environment

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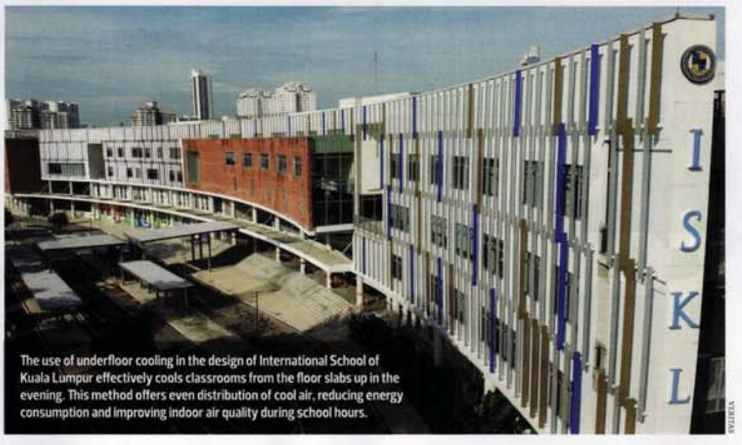

The use of underfloor cooling in the design of International School of Kuala Lumpur effectively cools classrooms from the floor slabs up in the evening. This method offers even distribution of cool air, reducing energy consumption and improving indoor air quality during school hours.

Sustainable strategies for energy conservation in our built environment

URBAN INSIGHTS BY ANDREW TIRTA

Our built environment, including buildings, infrastructure and urban spaces, significantly impacts energy consumption and environmental sustainability. With global energy demands rising and climate change concerns mounting, the need for energy conservation in the built environment has become highly important.

Designing energy-efficient buildings is crucial in our effort to reduce energy consumption. Key design principles include setting up the correct building orientation for natural lighting and ventilation, making appropriate use of high-performance building materials to respond to regional climate, and maximising passive design features such as shading devices and green roofs.

Passive solar design strategies for tropical climates aim to reduce the risk of indoor overheating by using natural sources such as daylighting, solar energy and natural ventilation. Materials we use for our building envelope can reflect, transmit or absorb the solar radiation. The heat produced by the sun causes air movement that can be predictable in our design process. These basic responses to solar heat lead to design decisions and material choices that can provide cooling effects in buildings.

Application of renewable energy sources such as solar photovoltaics (PV) in our built environment helps to reduce greenhouse gas emissions. Abundance of sunlight throughout the year in our Southeast Asian climate makes PV a great solution for on-site renewable energy production. Combined with the use of batteries, the use of PV enhances our resilience and sustainability in living.

In our tropical climate, the use of air conditioners is almost a basic necessity. We are thus faced with the air conditioning dilemma, the paradox that as the world gets warmer, more people would need air conditioning to stay comfortable and productive. However, air conditioning itself makes the planet hotter with its energy usage and heat pumps. Heating, ventilation and air conditioning (HVAC) systems commonly account for the biggest portion of energy consumption in buildings. Upgrading to energy-efficient HVAC equipment, employing advanced controls, occupancy sensors and zoning strategies can substantially reduce this energy demand while maintaining occupants' comfort and indoor air quality.

In a building's occupational stage, we also need to implement energy management systems that can allow for real-time monitoring and control of energy usage. This should also include the integration of smart building technologies, including Internet of Things devices and building management and automation systems. These systems may include sensors, metres and algorithms to optimise energy consumption by adjusting lighting, cooling and ventilation, based on occupancy patterns, external conditions and energy demand.

Lighting is the second-largest consumer of electricity in buildings, after HVAC systems. In commercial buildings, lighting can account for 11% to 40% of total energy consumption, depending on the type of building and lighting technology used. For example, lighting can account for up to 40% of electricity consumption in an office building and up to 80% in a retail store. Transitioning to energy-efficient lighting technologies, such as light-emitting diodes (LEDs), along with daylight harvesting and motion sensors, can significantly reduce electricity usage for lighting while prolonging lamp life and enhancing visual comfort.

Building demolition has significant environmental impacts that extend beyond the immediate removal of structures. Without proper control, the process would involve the release of various pollutants — including dust, particulate matter and hazardous materials such as lead, asbestos and mercury — into the air, soil and waterways. Moreover, the energy-intensive nature of demolition, including machinery operation and transport of debris, leads to significant carbon emissions and energy consumption. Additionally, the disposal of demolition waste in landfills further exacerbates environmental degradation and resource depletion. Consequently, building demolition not only disrupts local ecosystems and communities but also contributes to climate change and environmental degradation on a broader scale.

Adaptive reuse, the practice of repurposing existing buildings for new functions, is a sustainable alternative to demolishing buildings. By breathing new life into old structures, adaptive reuse minimises the environmental impact associated with new construction, reduces waste generation and, in many cases, preserves cultural heritage. Additionally, adaptive reuse often revitalises neglected neighbourhoods, promotes community engagement and fosters economic development by leveraging existing infrastructure and resources. This approach not only conserves energy and reduces carbon emissions but also celebrates the unique character and history of a place, creating vibrant and resilient communities for future generations.

On a larger scale from individual buildings, sustainable urban planning plays a big role in energy conservation and environmental sustainability. Compact urban forms, mixed land uses, efficient transport systems and green infrastructure promote energy-efficient lifestyles, reduce carbon emissions and enhance overall urban resilience.

Efforts to conserve energy in the built environment are essential for mitigating climate change, reducing energy usage and enhancing overall sustainability. By adopting a holistic approach that encompasses energy-efficient building design, renewable energy integration, smart technologies and sustainable urban planning, we can create more resilient, liveable and environmentally friendly communities for generations to come. ■

Andrew Tirta is the principal of VERITAS Indonesia