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Opinion

Urban Structure Theory of Future Cities

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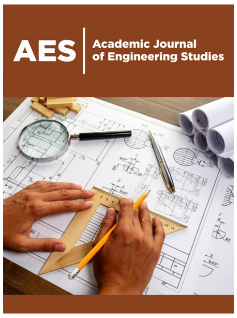

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Abstract

The practical implementation of natural ventilation in windproof structures is hindered due to the presence of air pollution and the high density of buildings. Also, the adoption of clean energy solutions like solar panels and photovoltaic water heaters to provide electricity and hot water faces numerous challenges in densely populated cities. The author suggests that future architecture will experience a significant transformation, incorporating advanced technologies and sustainable practices. This evolution will involve integrating solar panels and windcatchers throughout buildings, instead of just limiting them to the roof space and the emergence of new buildings for specific sustainable functions. As a result, buildings are expected to move away from traditional and symbolic designs and gradually adopt a more machine-like appearance.

Keywords: Future cities; Future urban structure; Urban structure theory

Introduction

In recent years, urban development has transformed high-density cities into concrete jungles, with tightly packed buildings and a surge in population. As a result, the provision of fresh air has become a crucial challenge [1,2]. While natural ventilation through windproof structures seems like an ideal solution, its practical implementation is hindered by the presence of air pollution and the high density of buildings.

In urban areas, emissions from vehicles, industrial activities, and other sources are prominent contributors to poor air quality. These pollutants include harmful particulate matter, Nitrogen Oxides, and volatile organic compounds, posing severe health risks to the occupants of buildings. Introducing natural ventilation may inadvertently allow these pollutants to infiltrate indoor spaces, jeopardizing the health and well-being of residents. Moreover, air pollution undermines the effectiveness of natural ventilation systems. Fine particulate matter blocks airflow, reducing the efficiency of air exchanges between the interior and the exterior. This obstructs the fresh air intake, limiting ventilation effectiveness and potentially pushing inhabitants towards relying on mechanical ventilation systems. Another significant challenge arises from the high density of buildings in urban areas. High-rise constructions and tightly packed structures limit the ability of natural ventilation to provide adequate airflow. Tall buildings block wind currents, impeding the circulation of fresh air and exacerbating the stagnation of pollutants. The lack of open spaces and limited availability of green areas diminish the potential for cross-ventilation and natural air movement. Consequently, natural ventilation becomes impractical as the congested nature of high-density cities hampers the effectiveness of windproof structures. Additionally, the close proximity of buildings obstructs the exposure of structures to wind channels. Without sufficient wind flow, the pressure differences needed for adequate ventilation are undermined. Therefore, natural ventilation systems struggle to maintain consistent and efficient airflow, further limiting their practicality in high-density urban environments.

While natural ventilation may prove challenging in high-density cities due to air pollution and building density, alternative approaches can be considered to enhance indoor air quality. Implementing advanced air filtration systems within buildings can effectively remove harmful pollutants and ensure a healthier indoor environment. Additionally, it will not be surprising to see huge buildings with the sole purpose of purifying and filtering the air in megacities.

Densely populated cities also face numerous challenges in adopting clean energy solutions [3], such as solar panels and photovoltaic water heaters, as a means to provide electricity and hot water respectively. Another significant obstacle is the high density of buildings, which limits the availability of space for the effective implementation of these technologies. In densely populated cities, sky-high buildings cast shadows, creating shaded areas that reduce the amount of direct sunlight available for solar panel installations. Effective generation of electricity from solar panels requires optimal exposure to sunlight, making it challenging to capture the necessary amount of solar energy when buildings obstruct a significant portion of the sunlight. This limited access to sunlight directly affects the performance and efficiency of solar panels, reducing their overall effectiveness.

The availability of space on rooftops poses a significant hurdle in densely populated cities. Urban areas tend to have congested buildings and limited open rooftops suitable for solar panel installations. The shared rooftops in multi-story buildings exacerbate the issue by making it difficult to achieve individual ownership for solar energy generation. Moreover, rooftop spaces are often allocated for other essential purposes, such as communication towers, HVAC equipment, or aesthetic considerations, further limiting the feasibility of installing solar panels. While the use of solar panels and photovoltaic water heaters offers great potential for sustainable energy generation and hot water supply, densely populated cities face practical challenges regarding their energy- and cost efficiency.

Vision

Architecture in the future is bound to undergo a significant transformation, incorporating advanced technologies and sustainable practices. According to the author, this evolution will see solar panels and windcatchers not limited to just the roof space but integrated throughout buildings. Consequently, buildings are projected to move away from formic and symbolic designs, gradually adopting a more machine-like appearance.

As the world increasingly emphasizes sustainable development, the integration of renewable energy sources into buildings becomes imperative. Solar panels integrated into windows, façades, and even building materials are becoming commonplace. Similarly, windcatchers are being designed to blend seamlessly into the architectural elements, including facades, rooftops, and vertical surfaces. By maximizing the utilization of renewable energy, buildings can become more self-sufficient and contribute significantly to reducing carbon footprints. The integration of solar panels and wind deflectors represents a broader shift in architectural philosophy, leading to a departure from formic and symbolic designs. Traditionally, buildings have often been constructed with a focus on aesthetics, symbolism, and architectural grandeur. However, the advent of sustainable technologies and the need for energy efficiency have prompted a reevaluation of these principles. Functional design, emphasizing the performance and purpose of a building, is gaining prominence. This shift necessitates a change in approach, where buildings prioritize practicality, eco-friendliness, and the well-being of occupants over ornamental elements. With a focus on functionality and sustainability, architecture and urban design of the future are projected to evolve into more machine-like structures. Just as machines are designed to efficiently perform specific tasks, future architecture aims to optimize energy capture and usage through these integrated systems. Buildings will be equipped with smart sensors, automated controls, and efficient energy structures, making them more self-sufficient, adaptable, and responsive to the environment.

The shift towards machine-like buildings presents several advantages. Firstly, the integration of sustainable technologies, such as solar panels and wind deflectors, allows buildings to harness renewable energy sources, reducing their reliance on conventional power grids. This leads to lower energy costs and reduced carbon emissions. Additionally, the emphasis on functional design promotes occupant comfort, well-being, and productivity. Machine-like buildings can also adapt to changing environmental conditions, ensuring energy efficiency and resilience. However, challenges are inherent in this evolution. The cost of integrating renewable energy systems into buildings may present financial barriers, especially in the initial stages. Furthermore, the aesthetics of machine-like architecture may not appeal to everyone, as it deviates from traditional design paradigms. Architects and designers must find innovative ways to strike a balance between functionality, sustainability, and aesthetics, ensuring acceptance and integration within society. This transition, away from formic and symbolic designs, focuses on the practical utilization of newly invented structures in the urban structure of megacities (e.g. Air filtering buildings). While challenges exist, the integration of advanced technologies and sustainable practices promises a more energy-efficient, responsive, and sustainable built environment.

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