Performance Index of Satisfaction for Adaptable Housing: A Sustainable Design Framework for Low-Carbon Residential Development in Brunei Darussalam

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Abstract

The building sector contributes significantly to global greenhouse gas (GHG) emissions through material extraction, construction activities, operational energy use, renovation, and demolition. One practical strategy for reducing the environmental footprint of residential buildings is to enhance their adaptability, enabling housing to respond to changing social, demographic, and technological needs without requiring major reconstruction. Adaptable housing extends building service life, reduces construction waste, minimises resource consumption, and supports the transition towards a circular and low-carbon built environment.

This study presents the findings of the Performance Index of Satisfaction for Adaptable Housing in Brunei Darussalam, an internal research project conducted by Universiti Teknologi Brunei. The research investigates how adaptable housing principles can improve residential sustainability while supporting national housing development. The study integrates theoretical analysis, empirical investigation, participant observation, comparative case studies, and user satisfaction surveys to evaluate the adaptability of residential buildings. Local observations were undertaken at the RPN Rimba National Housing Scheme in Brunei Darussalam, while an international comparative study was conducted at the internationally recognised NEXT21 experimental housing project in Osaka, Japan. These case studies provided valuable insights into long-term housing adaptability, flexibility, user participation, and sustainable housing design.

The research evaluates housing adaptability using four principal dimensions: spatial organisation, structural systems, technological flexibility, and user satisfaction. The findings indicate that residential buildings designed with flexible planning, modular structural systems, and provision for future expansion can accommodate changing household requirements more effectively while reducing premature renovation and redevelopment. Such design strategies improve the long-term utilisation of housing stock, enhance occupant satisfaction, optimise resource efficiency, and decrease the embodied carbon associated with repeated construction interventions. The study further demonstrates that adaptability should be recognised as an essential component of sustainable housing policy rather than merely an architectural design preference.

The research proposes a sustainable housing framework that integrates adaptable architectural design with housing policy recommendations suitable for Brunei Darussalam and other rapidly developing countries. By extending the lifespan of residential buildings and reducing lifecycle environmental impacts, adaptable housing contributes directly to climate change mitigation, resource conservation, and sustainable urban development. The study supports the objectives of low-carbon development and demonstrates how adaptable housing can contribute to achieving national climate commitments and the United Nations Sustainable Development Goals. This work provides practical evidence that flexibility in housing design should be considered an important strategy for reducing GHG emissions and improving the resilience of future residential environments.

References/ Publications

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Access to relevant information

If any.