

Review

Thermal Behavior and Energy Efficiency of Modified Concretes in the Tropical Climate: A Systemic Review

Yeong Huei Lee ¹, Mugahed Amran ^{2,3,*} , Yee Yong Lee ⁴, Ahmad Beng Hong Kueh ⁴ , Siaw Fui Kiew ⁵ , Roman Fediuk ⁶ , Nikolai Vatin ⁷  and Yuriy Vasilev ⁷

- ¹ Department of Civil and Construction Engineering, Faculty of Engineering and Science, Curtin University, CDT 250, Miri 98009, Sarawak, Malaysia; yhlee@civil.my
- ² Department of Civil Engineering, College of Engineering, Prince Sattam Bin Abdulaziz University, Alkharj 11942, Saudi Arabia
- ³ Department of Civil Engineering, Faculty of Engineering and IT, Amran University, Amran 9677, Yemen
- ⁴ Department of Civil Engineering, Faculty of Engineering, Universiti Malaysia Sarawak, Kota Samarahan 94300, Sarawak, Malaysia; yylee@unimas.my (Y.Y.L.); kbahmad@unimas.my (A.B.H.K.)
- ⁵ Curtin Malaysia Research Institute, Sarawak Biovalley Pilot Plant, Curtin University, Sarawak Malaysia, CDT 250, Miri 98009, Sarawak, Malaysia; siaw.fui@curtin.edu.my
- ⁶ Polytechnic Institute, Far Eastern Federal University, 690922 Vladivostok, Russia; fedyuk.rs@dvfu.ru
- ⁷ Peter the Great St. Petersburg Polytechnic University, 195251 St. Petersburg, Russia; vatin@mail.ru (N.V.); yu.vasilev@madi.ru (Y.V.)
- * Correspondence: m.amran@psau.edu.sa or mugahed_amran@hotmail.com



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Abstract: Concrete remains the most utilised construction material for building envelopes, which regulate the indoor temperature to achieve human thermal comfort. Often, the energy consumption for building performance appraisal is related to the thermal behaviour of building materials as heating, ventilation, and air conditioning systems all variously contribute to human comfort. Following the development of concrete technology, many types of concrete have been invented to serve several purposes in the construction industry. To clearly understand the concrete type tailored for the specifics of a construction project, the local climate, concrete mechanical properties, and concrete thermal behaviours should be primarily identified to achieve energy efficiency, which also suits the sustainability of global materials. This paper, therefore, reviews the modified concrete thermal behaviours in the tropical climate for more systematic city planning in order to achieve better energy efficiency. Urban heat islands in the tropics and contributing factors, as well as heat transfer mechanisms, are first highlighted. The requirements of concrete thermal behaviour for building envelopes are then discussed through specific heat capacity, thermal conductivity, thermal diffusivity, time lag, and decrement factor in the context of applications and energy consumption in the tropical regions. With a case study, it is found that concrete thermal behaviours directly affect the energy consumption attributed mainly to the use of cooling systems in the tropics. The study can be a reference to mitigating the urban heat island phenomenon in the planning of urban development.

Keywords: thermal behaviour; tropic; energy efficiency; concrete



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1. Introduction

Population centralisation and increment customarily take place in urban and metropolitan areas in which impermeable construction materials surfaces, notably concrete, are gradually replacing natural green vegetation zones due to various financial opportunities and accelerated infrastructure development. Despite numerous evident revolutions in building technologies, concrete remains the primary material employed in a diversity of construction events. Hence, building and structural engineers expectedly need to acquire more knowledge on concrete than other building and construction materials. Concretes possess comparatively high specific heat that may contribute to extra energy consumption during the building performance stage. Their low albedo surfaces often result in secondary