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論　文　要　旨
Thesis Abstract

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主論文題名　（Title）
CLIMATE-LED URBAN LANDSCAPE PLANNING: A SIMULATION DATA-DRIVEN ANALYTICS, DESIGN AND DECISION-MAKING PROCESS FOR IPOH, MALAYSIA

内容の要旨　（Abstract）
Designing urban landscapes for climate change adaptation and mitigation has been highly promoted in contemporary urban development. However, the knowledge gap between urban design and climatology have often put the agenda into an impasse in practice. This research, therefore, aimed to develop a climatology data-driven design framework for landscape planning and design. Four objectives were formulated based on the process of analysis, design, evaluation, and decision-making. The entire framework was laid on the basis of scenario modelling and simulations. There were nine chapters in this thesis. The Introduction first presented urban landscapes prospects in facilitating urban heat and climate change. Then it described current issues and problems of integrating climate considerations into urban landscape designs. These two parts helped to determine the research's goal and objectives, scope of study, study area, and thesis structure. Chapter 2 mainly reviewed outdoor thermal comfort, from the history and trend of thermal comfort studies to the thermal comfort implications between indoors and outdoors. It continued to review the parameters, indices, methods and tools used for thermal assessment, as well as past thermal studies in Malaysia. In Chapter 3, an assessment framework was developed to study outdoor thermal resilience and comfort. Taking a case study of Ipoh downtown, Malaysia, a model was built and simulated in ENVI-met and RayMan. This research integrated a GIS tool into the study of thermal-spatial relationships to gain more comprehensive insights as design guidelines. In Chapter 4, nine street greening prototypes were created and screened based on green coverage ratios. The selected prototypes were then replicated into a pilot model for simulation testing. Two scenarios were created accordingly: one focused on maximum greening, and the other considered heritage visibility in the downtown. The latter scenario was selected and applied to the full-scale model in Chapter 5 after being compared in thermal performance and design integrity. Chapter 5 was the resulting outcomes of previous chapters. Similarly, two scenarios were created and compared based on different design considerations in practice. The comparison supported that cooling magnitude was correlated with green and tree coverage ratio (GCR/TCR),

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enhancing greening significance in urban thermal improvement. Chapter 6 focused on sub-models thermal analysis at a micro-scale. In different zoning contexts, it is found that the urban microclimate and thermal comfort, and the greening effect of urban landscapes, were strongly associated with the nature of sites. This section showed that GCR / TCR was not always proportional to OACR (open area coverage ratio), but a high OACR could have adverse effects on urban thermal performance and reduced greening effectiveness. Also, ΔGCR (the degree of implementation) was correlated to Δ measured parameter indexes (the degree of improvement) in a non-proportional relationship, not the GCR/TCR. So, the highest GCR/TCR did not definitely lead to the greatest improvement. The same/similar GCR/TCR also did not have the same cooling effect. Chapter 7 mainly investigated whether the greening created at the buffer zone have thermal effects on the core study area. At last, the result showed that both buffer greening and core greening were necessary to achieve optimal thermal improvement. Chapter 8 was the final discussion on the so-called climate-led design, a new concept proposed mainly for landscape redevelopment. After discussing its ideas, framework, and approaches, this chapter also compared the concept to similar concepts used in existing urban design and planning. Finally, the Conclusion summarised all research significances and key lessons, study limitations, and suggestions for actual implementation and future studies. Overall, this research has demonstrated a complete design roadmap and quick-start guide on integrating thermal consideration into urban design and planning. Such an approach has four significances. First, it acts more precisely in capturing existing thermal conditions of a particular model, identifying site problems and problematic locations, and deriving specific insights to improve such a situation. Second, the integrated scenario modelling and simulation can better explore thermal effects in urban design, assist in testing hypothetical designs, and provide evidence-based explanations for any design decisions. Third, the loop evaluation is result-oriented, and this can minimize design failures in implementation. Lastly, the framework can be integrated with non-thermal objectives to enforce landscape positions in urban design. In conclusion, the climate-led approach is multi-dimensional, integrated and flexible in implementation. It is far-reaching, not only in urban thermal improvement but also in urban resilience and sustainability.

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