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Review of adaptive thermal comfort models in built environmental regulatory documents

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Abstract: In recent years, adaptive thermal comfort models have been integrated into several building design and operations regulatory documents. Although the theoretical background of the adaptive thermal comfort models is quite mature, still some ambiguities exist for their application. The objective of this study is to identify the main sources of uncertainty around application of adaptive models and to analyze quantitatively the difference between the adaptive comfort models proposed by the regulatory documents when applied across a spectrum of different climate zones. This paper analyzes the adaptive models in ASHRAE Standard 55, the European EN 15251 (and its revision prEN 16798), the Dutch ISSO 74 and the Chinese GB/T 50785. For each regulatory document, the major variations or sources of uncertainty are investigated: for ASHRAE 55, the length of the calculation period of the prevailing mean of outdoor temperature, and for EN 15251, prEN 16798, and GB/T 50785, the exponential decay weighting factors used in the calculation of the running mean outdoor temperature.

This study shows that, although these regulatory documents have promoted the uptake of adaptive comfort models by practitioners and designers, uncertainties surrounding their application obstruct full exploitation. In response, this paper offers a fine-tuning of some of the adaptive comfort models. However, the issue of adaptive models' applicability in hybrid ventilation or mixed-mode buildings is still to be resolved, as is a rational basis for identifying the operational mode of such buildings when the adaptive models can be applied, because of their intermittent compliance during transition seasons and also extreme weather events.

Keywords: Thermal comfort, Adaptive thermal comfort models, Built environmental regulatory documents, ANSI/ASHRAE 55, EN 15251, prEN 16798-1, ISSO 74, GB/T 50785.

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