THERMAL COMFORT IN TROPICAL AND HUMIDE CLIMATE: COASTAL STRIP OF BENIN

Aurélien OLISSAN
Université de Liège, équipe BEMS (Building Energy Monitoring & Simulation), 185 Av. de Longwy, 6700, Arlon, Belgique
olissanaurelien@yahoo.fr,

Clément KOUCHADE,
Laboratoire de Physique du Rayonnement de l'Université d'Abomey Calavi, 01 BP 4521 Cotonou, Benin
ckouchade@yahoo.fr,

Philippe ANDRE
Université de Liège, équipe BEMS (Building Energy Monitoring & Simulation), 185 Av. de Longwy, 6700, Arlon, Belgique
p.andre@ulg.ac.be,

Cossi Norbert AWANOU
Laboratoire de Physique du Rayonnement de l'Université d'Abomey Calavi, 01 BP 4521 Cotonou, Benin
cawanou@yahoo.fr,

Abstract: The thermal comfort in buildings is often defined using the theory of heat exchange between the human body and its environment. Using measurements made at the University of ABOMEY CALAVI in Benin, the Predicted Mean Vote (PMV) model developed by FANGER has been used to characterize the thermal comfort in Benin's tropical humid climate (coastal strip). A discrepancy has been found between the actual mean and the predicted thermal sensation. This paper proposes an adaptation of this PMV-PPD model to the climatic conditions and to those who live in this region. This error seems to be related to the thermo-physiological shades, especially to the black skin ethnic shades. Therefore, Beninese people may be less sensitive to high temperature than relative humidity and would accept more easily high temperatures than low temperatures. Using the systemic approach, we have shown the complementarity between the rational analytical FANGER's method and the adaptive one. This confirms the hypothesis that FANGER's method would be sufficient to describe thermal comfort in indoor air-conditioned environments, only if the discrepancy has been corrected. The adaptive GRIFFITH'S models with coefficients 0.33; 0.4; 0.5; 0.6 and 5 and that of HUMPHREYS have been tested in this region. The most suitable is the GRIFFITH'S coefficient 5 model. The acceptable comfort range by 90% is between 27.47°C and 30°C and the ideal adaptive comfort temperature would be 28.74°C. However, the 0.5 value as expectancy factor does not seem to be applicable in this region. A comfort zone included in one defined by GIVONI for hot and humid climates have been located in the psychometric chart and meets the usual observations in that region.

Keywords: Thermal comfort, index PMV, tropical and humide climate, actual thermal sensation

Nomenclature

PMV= Predicted mean vote
M= metabolic rate per unit body area W/m^2 (1met=58.15W/m$_2$)
I_{cl}=Clothing insulation (clo 1 clo=0.155m^{2}K/W)
v= air velocity m/s
t_r= mean radiant temperature (°C)
h_c=convection heat transfert coeffi-