



UNIVERSITI PUTRA MALAYSIA

***EFFECTS OF RADIANT COOLING ON THERMAL COMFORT IN
ENERGY COMMISSION BUILDING IN PUTRAJAYA, MALAYSIA***

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BY

SAAEED A. NEAMA AL-JAZAARI

**Thesis Submitted to the School of Graduate Studies, Universiti Putra
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Master of Science**

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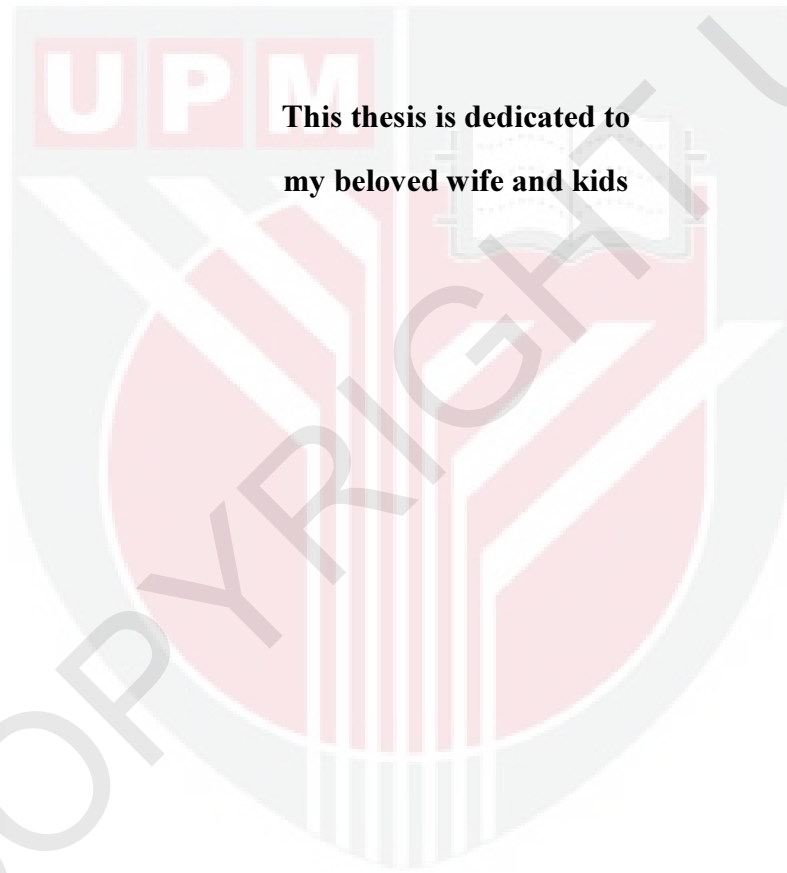
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DEDICATION

**This thesis is dedicated to
my beloved wife and kids**



Abstract of thesis presented to the Senate of Universiti Putra Malaysia
In fulfilment of the requirement for the degree of Master of Science

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This study presents the effects of radiant cooling on thermal comfort conditions in Energy Commission Building, Malaysia. Which is also known as The Diamond Building located in Putrajaya. It is equipped with radiant slab cooling. The main objective of this study was to determine the effects of radiant cooling on office workers' thermal comfort conditions. The survey procedure was adopted from the ASHRAE 55 and the ISO 7730 standards. Survey questionnaire were administrated to office workers in the second and sixth floors. The data were analyzed through comparison with ISO 7730's thermal environment evaluation requirements. In total, 132 data sets completed by 49 participants were collected. The data were collected continuously for four days (two days for each floor) during working hours. The survey data is comprised of two groups. The first group is the result of two online questionnaires, namely a background survey and a daily survey. The second group is comprised of three measurements namely the indoor climate, the radiant asymmetry, and the meteorology.

Findings of the thermal monitoring data suggests most of the thermal comfort conditions indices (excluding overall thermal comfort conditions) are within the recommended limits of the thermal comfort conditions standard of ISO 7730. However, the participants dissatisfied with the overall thermal environment. This dependent variable was compared with all of the independent variables in the background and daily surveys (personal variables, expectation, preferences, relative humidity, sweating, and head covering). The result was a high correlation with preferences for increased air speed ($p < .01$), additional fans ($p < .01$), and more fresh air ($p < .05$). Moreover, a high indoor relative humidity is recorded (due to not using dew sensor). A regression was found between sweating and comfort ($p < .01$). Another finding suggests that participants (males and females) who wore a head covering felt warmer than those who did not wear a head covering ($p < .01$). In conclusion, radiant cooling is not the main cause of thermal discomfort conditions in this building. However, the air supply, the relative humidity, the sweating, and head covering were the main cause of thermal discomfort conditions in this radiant cooling environment.

Absrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
Sebagai memenuhi keperluan untuk ijazah Master Sains

**KESAN PENYEJUKAN BERSERI PADA KESELESAAN HABA
DALAM BANGUNAN SURUHANJAYA TENAGA DI
PUTRAJAYA, MALAYSIA**

Oleh

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Kajian ini mengusulkan kesan penyejukan bahang haba terhadap keselesaan terma di Bangunan Suruhanjaya Tenaga yang juga dikenali sebagai "Diamond Building" yang terletak di Putrajaya. Bangunan ini dilengkapi dengan papak pendingin pancaran. Objektif utama kajian ini adalah untuk menentukan kesan pendinginan secara pancaran terhadap keselesaan terma. Prosedur kaji selidik telah diadaptasi daripada ASHRAE 55 dan standard ISO 7730. Borang survey telah diedarkan kepada pekerja yang bekerja di tingkat kedua dan keenam. Data dianalisis menerusi perbandingan dengan terma penilaian keperluan persekitaran (ISO 7730). Secara keseluruhan, 132 set data telah dikumpulkan menerusi 49 peserta. Data telah dikumpulkan secara berterusan selama empat hari pada waktu bekerja (dua hari untuk setiap tingkat bangunan). Kaji selidik ini terbahagi kepada dua kumpulan data. Kumpulan pertama adalah terdiri daripada eputusan bagi soal selidik diatas talian (kaji selidik latar belakang dan kaji selidik harian). Kumpulan kedua terdiri daripada tiga pengukuran (iklim tertutup, berseri asimetri, dan meteorologi).

Hasil daripada data pemantauan terma mencadangkan bahawa kebanyakan indeks keselesaan terma (tidak termasuk keselesaan haba keseluruhan) adalah dalam lingkungan had yang disyorkan mengikut standard keselesaan terma ISO 7730. Walau bagaimanapun, hasil dapatan mendapati kebanyakan subjek tidak berpuas hati dengan persekitaran haba secara keseluruhan. Didapati bahawa pembolehubah bersandar mempunyai hubungkait dengan kesemua pembolehubah bebas didalam kaji selidik latar belakang dan harian (iaitu pembolehubah peribadi, jangkaan, keutamaan, kelembapan relatif, udara, perpeluhan, dan tudung kepala). Kajian mendapati bahawa perkaitan yang tinggi dengan keutamaan bagi peningkatan kelajuan udara, kipas tambahan, udara lebih segar. Selain itu, kelembapan dalaman yang tinggi direkodkan (kerana tidak menggunakan sensor embun). Regresi a didapati antara berpeluh dan keselesaan. Dapatan menunjukkan bahawa peserta (lelaki dan perempuan) yang memakai tudung kepala berasa lebih panas daripada mereka yang tidak memakai kepala meliputi. Kesimpulannya, penyejukan berseri bukan punca utama keadaan ketidakselesaan terma dalam bangunan ini. Walau bagaimanapun, bekalan udara, kelembapan relatif, berpeluh, dan kepala

pegangan menjadi punca utama keadaan ketidakselesaian terma dalam persekitaran penyejukan ini berseri.



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