

R & D of Current Environmental Technologies in Thailand

-An Engineering Study of Comfort Environmental in the Office Buildings-

Tawee Vechaphutti, P.E.

Member ASHRAE

ABSTRACT

This research is an engineering study of comfort environment in office buildings to determine the effect of illumination, acoustics and thermal environmental on Thai subjects using data obtain from office works.

1. INTRODUCTION

Most of the subjects work in the offices about 8 to 10 hours a day, so the comfort environment play a major role in efficient performance of all subjects. The parameters shall be considered as followings.

- a. Thermal Comfort (Temperature, Humidity)
- b. Illumination (Lighting)
- c. Acoustics (Sound)

The above parameters shall be impact to the working conditioned of the subjects in the offices. In this investigation using the 8 offices and no. of subjects 240 persons conduction the research for a period of 6 months.

2. PARAMETERS CONSIDERATION

2.1 Sensory Perception

Human Response shall be depends on a intensity input (\varnothing_i), feedback function (\varnothing_f), and psyche function (φ), so the relation of a human response function (\varnothing_0) as following.

$$\varnothing_0 = f(\varnothing_i, \varnothing_f, \varphi)$$

2.2 Comfort Conditions of Human Mind

The impact of environment will crested a stress and strain to the human. The comfort condition shall be balanced by the equilibrium of psychological and physiological, so the relation of following.

$$\begin{aligned} X(t)_{\text{phy}} &= X(t)_{\text{psy}} \\ \text{When } X(t)_{\text{phy}} &= \text{physiological strain} \\ X(t)_{\text{psy}} &= \text{psychological stress} \end{aligned}$$

2.3 Variables of Comfort Environment

2.3.1 Thermal Comfort

From a study of Prof. P.O. Fanger, the most important variable which influence the condition of thermal comfort are

- Air temperature
- Mean Radiant Temperature
- Relative Air Velocity
- Activity Level (heat production in the body)
- Thermal resistance of the clothing (clo-value)

- Water Vapor Pressure in ambient air

2.3.2 Illumination

The lighting comfort for the workers in the offices depend on the following .

- Level of direct light (Illumination) from the light source.
- Coefficient of reflectance of floor wall and ceiling.
- Visibility
- Age
- Sex.

2.3.3 Acoustics

The variable that effect the human comfort for acoustics as following

- Background noise
- Level of Intermittent Noise
- Sensory of hearing
- Age
- Sex

3. EXPERIMENTAL METHODS

3.1 In conducting an investigation of as comfort environment, eight companies in Bangkok were selected. Subjects are men and women with activities as working in offices, Data collection was obtained from a questionnaire given to each subject asking them to vote and “tick mark” as the following details.

- Sex, age, weight and height
- Activity of subjects
- Clothing of subject
- Voting scale of Thermal Sensational, Illumination (Lighting), and Acoustics (noise)
- Physical condition of subjects (body temp), visibility and hearing)
- Educational Level

3.2 A group of testing subjects were inspected a visibility (by using an equipment with light source and a Landolt ring), hearing efficiency (by using tape recorder with noise source and earphone), and thermal comfort (by using Thermal comfort meter) respectively.

3.3 Subject data

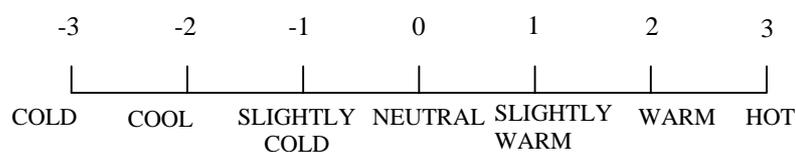
- Sex : men 118 persons, women 98 person
- Age : between 20 to 60 year divided into the following group

20-30	years	75.9 %
31-40	years	20.9 %
41-50	years	3.2 %
51-60	years	0.5 %
- Education

Lower than Backhelor degree	45.4 %
Bachelor degree	53.7 %
Higher than Bachetor degree	0.9 %
- Average weight of subjects 56.5 kilograms
- Average height of subjects 164.6 centimeters.

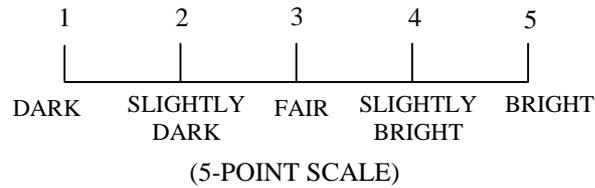
3.4 Voting Scales

- Thermal Comfort

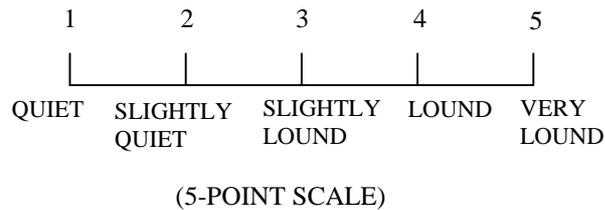


(7-point ASHRAE scale)

b. Illumination (lighting)



c. Acoustics (Noise)



5. RESULTS

Form the analysis the results as the following

<u>Age (year)</u>	<u>Illumination (Lux)</u>	<u>Noise (dbA)</u>	<u>Comfort Temps (°C)</u>
20-30	320-440	50-58	23.9
31-41	460-600	49-55	23.9
41-50	610-730	47-53	23.9
51-60	780-900	45-57	23.9

6. CONCLUSIONS

This research will be the guidelines for researches in Thailand to conduct more investigation in a study of comfort environment in various type of buildings. The results of investigation shall be benefit for a building system design of all designers.

REFERENCES

- Fanger P.O., Thermal Comfort, McGraw-Hill Book Company, U.S.A 1972.
ASHRAE. Fundamental Handbook 1981. Atlanta, U.S.A.
Thermal Environment Conditions for Human Occupancy, ANSI/ASHRAE 55-1981, U.S.A.
Vechphutti T., Wongtraru P. "A Study of Thermal Comfort in Thailand", EIT proceeding, annual meeting, 1992.
Croome D.J., International series in heating ventilation and refrigeration volume 11. Noise, building and pepople, First edition , pergamon press, 1977.
Kanf man T.E., Lighting handbook. The standard lighting guide. Fourth edition. New York: Illuminating engineering society (IES), 1966
ASHRAE IAQ,89 The human equation health and comfort 1989
Fred N., Kerlinger and J.Elazar, Pedhazur Multiple regression in behavioral research. New York: Holt, inaheart and Winston, 1973.

Tawee Vechaphutti is Associate Professor of Mechanical Engineering Department, Faculty of Engineering, Chulalongkorn University, Bangkok, 10330, Thailand.
Director of Building Technology and Environment Research Laboratory (BTERL)
BOG.ASHRAE THAILAND CHAPTER,(2000-2001)
Fellow of Professional Engineer (P.E.,) Council of Engineering, Bangkok 10310, Thailand.