



A STUDY ON AIRBORNE PARTICULATES
MATTER (PM₁₀ & PM_{2.5}) EXPOSURE ASSESSMENT
IN KL SENTRAL, KUALA LUMPUR, SYMPTOMS
ASSOCIATED WITH SICK BUILDING SYNDROME
(SBS) AND PERCEPTIONS ON INDOOR AIR
QUALITY (IAQ) AMONG THE BUILDING
OCCUPANTS

BY

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A dissertation submitted in fulfilment of the requirement
for the degree of Master in Science Building Services
Engineering (MSBSE)

Kulliyyah of Architecture and Environmental Design
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ABSTRACT

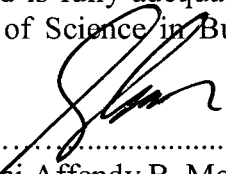
Indoor air pollution can be considered as a complex issue, much more than other environmental issues. Poor indoor air quality (IAQ) may affect human health either immediately or for a long term. This study aims to determine the level of IAQ and the effects of particles towards occupants of the office buildings. The objectives of study are (i) to measure the level of airborne particulates that contributes to the IAQ during working hours, (ii) to compare the level of airborne particulates with the existing guidelines and standards of IAQ in Malaysia and other Asian countries and (iii) to assess the symptoms associated with airborne particulates among the building occupants, which were achieved through primary data collection (case study or site survey, structured interview and questionnaire survey) and supported by literature reviews. The office buildings selected for the case study are SSM, KTMB and MRCB, KL Sentral. The results showed that the mass concentration level of airborne particulates within the areas has exceeded the allowable limit of $0.15\text{mg}/\text{m}^3$ by Indoor Air Quality (IAQ) Code of Practice, 2005 of the Department of Safety and Health (DOSH), Malaysia and $0.05\text{mg}/\text{m}^3$ by the Department of Environmental (DOE) (outdoor) of 8 hours continuous sampling. Based on the findings, the average percentage of respirable particulates from the total inhalable particulates at the lobby and office of MRCB (56%) was higher than the others. This is awful because respirable dust particulates are hazardous as they penetrate into human lungs and will cause severe health effects to the occupants of the building and the public in the long run. This is due to the nearby construction works and high numbers of particulates are generated from various types of vehicles for transportation surrounding KL Sentral. Therefore, the development of Standard for National Ambient Air Quality Guidelines on $\text{PM}_{2.5}$ as one of the crucial parameters is highly recommended.

ملخص البحث

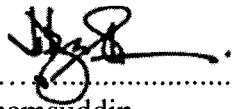
يُعتبر تلوث الهواء الداخلي قضيةً بيئيةً معقدةً، فالتلوث الضعيف يؤثر على صحة الإنسان تأثيراً مباشراً كان أو لأجلٍ طويل. ويهدف هذا البحث تحديد درجة جودة الهواء الداخلي (IAQ) وتأثير الغبار على الموظفين في بنين الأعمال. وأهداف البحث ثلاثة وهي أولاً تقييد درجات الغبار الجويّة التي تسهم إلى جودة الهواء الداخليّ في ساعات العمل، وثانياً مقارنة بين درجات الغبار الجويّة وخطوط جودة الهواء الداخليّ ومعايراتها الموجودة في ماليزيا وفي بلاد آسيا الأخرى، وثالثاً تحديد الأعراض الظاهرة من الغبار الجويّة على بنين الموظفين وهي كمايُحصل عليها من مجموعة البيانات الرئيسيّة (من دراسة الحالة، والاستعراضات في الأماكن المختارة، والمقابلة المنظّمة، والاستبيانات)، وهذه البيانات مؤيدة بالمراجعة الأدبيّة في هذا البحث. ومن بنين الأعمال المختارة هي إيس إيس إيم، كي تي إيم بي، إيم آر سي بي، وكي إيل سنترال. وتشير النتيجة بأن درجة التركيز الكبيرة للغبار الجويّة في تلك الأماكن تزداد فوق الحد المقبول وهو $0.15\text{mg}/\text{m}^3$ كما حدّته مدونة قواعد الممارسة لجودة الهواء الداخليّ (2005)، قسم السلامة والصحة بماليزيا، و $0.05\text{mg}/\text{m}^3$ كما حدّده قسم البيئة (الخارجي) وهو مأخوذ من العينة المتسلسلة في ثماني ساعات. وبناءً على هذه الاكتشافات، نجد أن الغبار الصالحة للتنفس بها في ردهة ومنصب إيم آر سي بي كانت أكثرها من الأماكن الأخرى وهي بمتوسط 56%. وهذا الأمر خطير جداً لأن هذه الغبار ستدخل صدور الناس وتسبب الأمراض الخطيرة خاصة للعاملين والأعوام الذين يسرون حول البنين وتأثيرها عليهم لأجلٍ طويل، وهذه القضية تحدث بسبب الإنشاءات وازدهار الحافلات العامة الواسع حول كي إيل سنترال. لذلك، ترى الباحثة أن يجب لنا تقييس الخط الخاص للجويّ على معامل $\text{PM}_{2.5}$ معاملاً ضرورياً.

APPROVAL PAGE

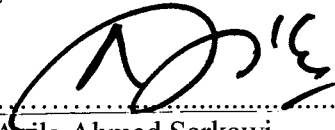
I certify that I have supervised and read this study and that in my opinion, it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Master of Science in Building Services Engineering (MSBSE).


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Shamzani Affendy B. Mohd. Din
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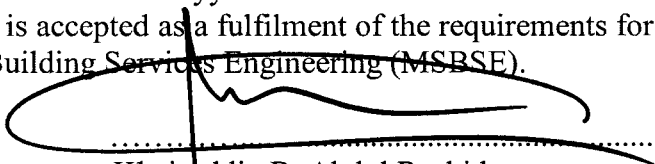
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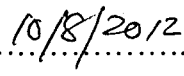

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DECLARATION

I hereby declare that this dissertation is the result of my own investigations, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degree at IIUM or other institutions.

Normadiyah Mohamed Aminuddin

Signature:

Date:

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

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AND PERCEPTIONS ON INDOOR AIR QUALITY (IAQ) AMONG THE
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.....
Date

DEDICATION

This work is dedicated to my lovely and supportive family members...

ACKNOWLEDGEMENTS

Ya Allah,

Without your guidance,

I am none but a forgotten human,

Who is never satisfied with what has been given.

Assalamualaikum...

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LIST OF SYMBOL

CH ₄	Methane
CO	Carbon Monoxide
CO ₂	Carbon Dioxide
N ₂	Nitrogen Gas
N ₂ O	Nitrous Oxide
NO ₂	Nitrogen Dioxide
NO ₃ ⁻	Nitrate
NH ₄ ⁺ / NH ₃	Ammonium
NMVOCs	Non-Methane Volatile Organic Compounds
O ₃	Ozone
Pb	Lead
SO ₂	Sulfur Dioxide
SO ₄	Sulfate
cm	centimeter
kg	kilogram
Lpm	Litre / minute
µm	micrometers
µg / m ³	micrometers per cubic meter
mg / m ³	milligrams per cubic meter
m ⁻² s ⁻¹	surface area per unit time
ppm	parts per million

LIST OF ABBREVIATION

API	Air Pollutant Index
BRI	Building –Related Illness
CAI	Clean Air Initiative
CFC	Chlorofluorocarbon
CVD	Cardio Vascular Diseases
DOE	Department of Environment
DOSH	Department of Occupational Safety and Health
DTCP	Department of Town and Country Planning
EPA	Environmental Protection Agency
ETS	Environmental Tobacco Smoke
EUAQS	European Union Air Quality Standards
HCHO	Formaldehyde
HVAC	Heating, Ventilation and Air Conditioning
IAP	Indoor Air Pollution
IAQ	Indoor Air Quality
IEE	Institute of Environment and Epidemiology Singapore
IIUM	International Islamic University Malaysia
ISO	International Standards Organisation
KAED	Kulliyyah of Architecture and Environmental Design
KTMB	Keretapi Tanah Melayu Berhad
KLIA	Kuala Lumpur International Airport
KL Sentral	Kuala Lumpur Sentral
MPI	Mass-psychogenic Illness
MPO	Myeloperoxidase
MRCB	Malaysian Resources Corporation Berhad
MyCoID	My Corporate Identity
NAAQS	National Ambient Air Quality Standards
NIOSH	National Institute of Safety and Health
NTD	Neurotoxic Disorder
OAR	Office of air and Radiation
PAI	Plasminogen Activator Inhibitor

LIST OF ABBREVIATION (CONT'D)

PM	Particulate Matter
PM ₁₀	Particulate Matter of Less Than 10 Microns in Size
PM _{2.5}	Particulate Matter of Less Than 2.5 Microns in Size
POPs	Persistent Organic Pollutants
PSNS	Parasympathetic Nervous System
ROC	Registrar of Companies
ROB	Registrar of Businesses
SBS	Sick Building Syndrome
SNS	Sympathetic Nervous System
SSM	<i>Suruhanjaya Syarikat Malaysia</i>
TSP	Total Suspended Particulates
UFP	Ultra-Fine Particulates
U.S EPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds
WBC	White Blood Cells
WHO	World Health Organization
WRI	Workplace – Related Illness