

# **TUGAS AKHIR**

## **THE USE OF GREEN BUILDING MATERIALS IN THE CONSTRUCTION INDUSTRY**



**DISUSUN OLEH :**

**ESAM SHARYAN MUTHANNA AL-HELALI**  
**NIM : 03118103**

**Under the Guidance of**  
**Dr. Ir. H. SRI WIWOHO MUDJANARKO S.T., M.T., IPM.**

**CIVIL ENGINEERING STUDY PROGRAM**  
**FACULTY OF ENGINEERING**  
**NAROTAMA UNIVERSITY SURABAYA**  
**2022**

# **TUGAS AKHIR**

## **THE USE OF GREEN BUILDING MATERIALS IN THE CONSTRUCTION INDUSTRY**



**Disusun Oleh :**

**PRO PATRIA**

**ESAM SHARYAN MUTHANNA AL-HELALI**

**NIM : 03118103**

**Under the Guidance of**

**Dr. Ir. H. SRI WIWOHO MUDJANARKO S.T., M.T., IPM.**

**CIVIL ENGINEERING STUDY PROGRAM**

**FACULTY OF ENGINEERING**

**NAROTAMA UNIVERSITY SURABAYA**

**2022**

**PENELITIAN/RISET**

# **TUGAS AKHIR**

## **THE USE OF GREEN BUILDING MATERIALS IN THE CONSTRUCTION INDUSTRY**

**Disusun Oleh :**

**NAMA : ESAM SHARYAN MUTHANNA AL-HELALI  
NIM : 03118103**

**Diajukan guna memenuhi persyaratan  
untuk memperoleh gelar Sarjana Teknik (S.T) pada Program  
Studi Teknik Sipil  
Fakultas Teknik  
Universitas Narotama Surabaya.**

**Surabaya, 23 Agustus 2022**

**TUGAS AKHIR**

**Mengetahui  
Dosen Pembimbing,**

**Dr. Ir. H. SRI WIWOHO MUDJANARKO S.T., M.T., IPM.  
NIDN : 03040106**

**PENELITIAN/RISET**

## TUGAS AKHIR

### THE USE OF GREEN BUILDING MATERIALS IN THE CONSTRUCTION INDUSTRY

Disusun Oleh :

NAMA : ESAM SHARYAN MUTHANNA AL-HELALI

NIM : 03118103

Penelitian ini telah memenuhi persyaratan dan disetujui untuk di ujikan.

Surabaya, 23 Agustus 2022

Menyetujui,

Dosen Pembimbing I,

Dosen Pembimbing II,

PRO PATRIA

Dr. Ir. H. SRI WIWOHO MUDJANARKO S.T., M.T., IPM.  
NIDN : 03040106

Rizal Bahaswan S.T., MSC  
NIDN : 03041903

PENELITIAN/RISET INI  
TELAH DIUJIKAN DAN DIPERTAHANKAN DIHADAPAN TIM PENGUJI

Tim penguji terdiri :  
1. Ketua Penguji

Dr. Ir. Adi Prawito, MM., MT  
NIDN .0706056601

Mengesahkan,  
Ketua Program Studi Teknik Sipil,

Dr. Ir. Adi Prawito, MM., MT  
NIDN .0706056601

2. Sekretaris

Hendri Sulowijaya S.T., MT  
NIDN .0703120205

3. Anggota

  
**PRO PATRIA**

Dr. Ir. H. Dik Wicaksono MUDJAHARNO S.T.,  
MT., MT.  
NIDN .00000100

Fakultas Teknik dan Ilmu komputer



Dr. Ir. H. Dik Wicaksono MUDJAHARNO S.T., MT  
NIDN .0710097402



## SURAT PERNYATAAN

Yang bertanda tangan dibawah ini, Saya :

Nama : ESAM SHARYAN MUTHANNA AL-HELALI

NIM : 03118103

JUDUL PENELITIAN : THE USE OF GREEN BUILDING MATERIALS IN THE  
CONSTRUCTION INDUSTRY

Dengan ini saya menyatakan bahwa dalam Penelitian ini tidak terdapat karya yang pernah diajukan untuk memperoleh gelar kesarjanaan disuatu Perguruan Tinggi, dan sepanjang pengetahuan saya juga tidak terdapat Karya/Pendapat yang pernah ditulis oleh orang lain, kecuali yang secara tertulis diacu dalam naskah ini dan disebutkan dalam Daftar Acuan/Daftar Pustaka.

Apabila ditemukan suatu Jiplakan/Plagiat maka saya bersedia menerima akibat berupa sanksi Akademis dan sanksi lain yang diberikan oleh yang berwenang sesuai ketentuan peraturan dan perundang-undangan yang berlaku.

Surabaya, 23 Agustus 2022



Nama : ESAM SHARYAN MUTHANNA AL-HELALI

NIM : 03118103

## ACKNOWLEDGEMENT

Here, I wish to express my gratitude and grateful appreciations to my dedicated supervisor of this research, Dr. Dr. Ir. H. SRI WIWOHO MUDJANARKO S.T., M.T., IPM ..and DR. Rizal Bahaswan S.T., MSC

Many thanks for Them invaluable guidance, encouragement, advise, motivation and assistance throughout the research. Without them continued support and heedful advices, this report would not be successfully accomplished.



# **THE USE OF GREEN BUILDING MATERIALS IN THE CONSTRUCTION INDUSTRY**

## **ABSTRACT**

The adverse impacts to the environment from the construction industry had lead to a growing realisation that there is a need for a more sustainable and responsible approach to the current practices. This growing attention pushes the government and professional bodies in Malaysia to be more proactive in alleviating this problem without restraining the need for development. But, have these borne fruits? Creating sustainable construction depends on the knowledge and involvement of all people involved in the industry. So, what is the level of understanding of this concept and application? This report aims to explore the issues of green building materials in the construction industry in Malaysia. Through intensive literature study, it has brought better understanding on the definition and purpose of using green building materials. In addition, this research includes the construction process work for green building materials, risk management for green building materials, design and construction relationships and environmental assessment of materials. This research also recommends some green building materials to be used in the construction industry in Malaysia. Data of this research were collected through questionnaire survey and interview with appropriate professionals. Recommendation will be proposed in order for the construction industry to move towards sustainability. In conclusion, it is necessary to raise the awareness of sustainable development and educate the organisations and public in order to create avenues for further action towards continual performance improvement.



## TABLE OF CONTENTS

<b>DECLARATION</b>	
<b>ACKNOWLEDGEMENTS.....</b>	<b>ii</b>
<b>ABSTRACT.....</b>	<b>iii</b>
<b>TABLE OF CONTENTS.....</b>	<b>iv</b>
<b>LIST OF TABLES .....</b>	<b>vii</b>
<b>LIST OF FIGURES .....</b>	<b>viii</b>
<b>LIST OF SYMBOLS / ABBREVIATIONS .....</b>	
<b>LIST OF APPENDICES .....</b>	<b>xii</b>
<b>CHAPTER</b>	
<b>INTRODUCTION .....</b>	<b>1</b>
1.1 Introduction .....	1
1.2 Sustainability in Construction .....	2
1.3 Sustainable Construction in Malaysia .....	6
1.4 Problems Statement.....	8
1.5 Rationale of Research.....	9
1.6 Aim and Objectives .....	10
1.6.1 Aim of Research.....	10
1.6.2 Objectives of Research.....	10
1.7 Scope and Limitation of Research .....	10
1.8 Chapter Outline .....	11
<b>II LITERATURE REVIEW .....</b>	<b>13</b>
2.1 What Are Green Building Materials .....	13
2.2 Why Use Green Building Materials .....	14
2.3 The Construction Processes .....	15
2.4	
2.5 V	
2.3.1 The Bidding Phase .....	16
2.3.2 The Construction Phase .....	17
2.3.3 The Construction Phase as the Successful End to	

the Project .....	19
Risk Management for Green Building Materials .....	19
Design and Construction Relationships .....	20
2.5.1 The Building Owner .....	20
2.5.2 The Building Official .....	21
2.5.3 The Design Professional .....	22
2.5.4 The Construction Manager .....	23
2.5.5 The Contractor .....	23
2.5.6 The Subcontractor .....	24
2.5.7 The Design Team .....	25
2.6 Environmental Materials Assessment .....	26
2.7 Green Building Materials .....	30
RESEARCH METHODOLOGY .....	49
3.1 Introduction .....	49
3.2 Research Strategy .....	49
3.2.1 Interview .....	49
3.2.2 Questionnaire .....	50
3.2.3 Primary Data .....	51
3.2.4 Secondary Data .....	51
3.3 Research Design .....	52
3.3.1	
Introduction .....	53
3.3.2 Preliminary Stage .....	53
3.3.3 Second Stage — Collecting Data .....	54
3.3.4 Third Stage — Analyse, commentary and summarise the data .....	55
3.3.5 Final Stage — Research's findings write-up .....	55
3.4 Questionnaire Design and Structures .....	55
3.4.1 The descriptive statistic method .....	55
3.4.2 By using formula .....	56
IV DATA ANALYSIS AND DISCUSSION .....	57
4.1 Survey Questionnaire .....	57

4.1.1 Introduction .....	57
4.1.2 Result of Research Analysis.....	57
4.1.2.1 Section A: Respondents Background	58
4.1.2.2 Section B: Issue related sustainable construction and green building materials .....	60
4.1.3 Conclusion.....	82
4.1.3.1 Section A: Respondents background	82
4.1.3.2 Section B: Green Building Materials issues	83
4.2 Interview .....	87
4.2.1 Introduction .....	87
4.2.2 Summary of Interview .....	88
4.2.2.1 Architect.....	88
4.2.2.2 Engineer.....	92
4.2.3 Conclusion.....	96
V CONCLUSION AND RECOMMENDATION.....	98
4.3 Introduction .....	98
4.4 Research Contribution to the construction Industry.....	98
4.5 Difficulties and Barriers Faced .....	99
4.6 Recommendations for Continuation Research.....	99
4.7 Conclusion for Overall Research Result .....	103
REFERENCES .....	104

## LIST OF TABLES

### TABLE TITLE PAGE

4.1 Factors Hindered People from Regularly Incorporating Sustainable Strategies into Their Work	63
4.2 Ranking of Green Building Materials .....	70
4.3 The Important Criteria under Resources Assessment .....	72
4.4 The Important Criteria under Green Building Index (GB I)	76
4.5 Media to Enhance the Awareness Level of Green Building Materials .....	79
4.6 Background of Interviewees.....	88
4.7 Green Building Index Classification .....	95

## LIST OF FIGURES

### FIGURE

#### 1.1 TITLE

Fibreglass impact resistance compared to other  
window materials (adapted from Das Gandhi et. al.,

PAGE

2006) ..... 3

1.2 The diagram of sustainability in construction ..... 5

#### 2.1 Environmental

Material

Assessment

Matrix ..... 30

(compare similar product categories) ..... 30

2.2 Prima Cellulose Fibre Cement Boards ..... 31

2.3 Autoclaved Aerated Concrete (AAC) Blocks ..... 33

2.4 Ceiling Queen Energy Board ..... 35

2.5 Exxomas Biobrick ..... 37

2.6 3M Window Film ..... 39

2.7 JOTUN Jotashield Extreme ..... 41

2.8 Clean Colorbond Steel ..... 43

2.9 Sika Sarnafil PVC Membranes ..... 45

2.10 Legacy Coolroof & System ..... 47

3.1 Flowchart of Research Methodology ..... 52

4.1 Nature of Business of Respondents Company ..... 58

4.2 Respondents Working Experience ..... 59

4.3 Level of Understanding on Sustainability Concept ..... 60

4.4 Level ..... of

Understanding ..... of

the Concept ..... of

Sustainable Construction ..... 61

4.5	Level of Implementation of Sustainable Practices .....	62
4.6	Factors Hindered People from Regularly Incorporating Sustainable Strategies into Their Work	64
4.7	Concept of Green Building Materials .....	65
4.8	Green Building Materials Important Nowadays? .....	66
4.9	Perception Pertaining to Green Building Materials.....	67
4.10	Why Green Alternative Better Than Conventional Materials and Methods .....	69
4.11	Ranking of Green Building Materials .....	71
4.12	The Important Criteria under Resources Assessment .....	73
4.13	Awareness on Green Building Index (GBI) .....	75
4.14	The Important Criteria under Green Building Index (GBI)	76
4.15	Stakeholder Responsible to Decide on the Use of Green Building Materials .....	78
4.16	Media to Enhance the Awareness Level of Green Building Materials .....	80
4.17	Prospect of Implementing Sustainable Practices in 5 Years	81



## LIST OF SYMBOLS / ABBREVIATIONS

percentage

IEQ Indoor Environment Quality

IAQ Indoor Air Quality

VOCs Volatile Organic Compounds

CFCs Chlorofluorocarbons

MSDs Material Safety Data Sheets

AAC Autoclaved Aerated Concrete

NRNC Non-Residential New Construction

NREB Non-Residential Existing Building

RNC Residential New Construction

CO<sub>2</sub> Carbon dioxide

CO Carbon monoxide

ROHs Restriction of Hazardous Substances UV

Ultra violet

BMTBase Metal Thickness

GBI Green Building Index

UBBL Uniform Building by Laws

ASHRAE

American Society of Heating, Refrigerating and Air -Conditioning  
Engineers

QLASSIC

Quality Assessment System in Construction IBS

Industrialize Building System

CVA Completion & Verification Assessment

APEO Association of Professional Engineers of Ontario

LEED Leadership in energy and Environmental Design

CVA Completion & Verification Assessment

DA Design Assessment

GBI Green Building Index

GBIAP GBI Accreditation Panel

MGBC Malaysia Green Building Confederation

IBS Industrialised Building System

GPMGreen Pages Malaysia

FiT Feed-in Tariff

NABERS

National Australian Built Environment Rating System



## LIST OF APPENDICES APPENDIX

### TITLE PAGE

A	Statement of Learning in the Course of the Project .....	106
B	Project Definition Document.....	107
C	Record of Supervision or Meeting .....	108
D	Sample of Survey Questionnaires.....	109
E	Sample of Interview Questions .....	110
F	Sample Returned Questionnaires.....	111
G	Green Building Index (GBI) Assessment Criteria for Residential New Construction (RNC) .....	112
H	Manual for Industrialised Building System (IBS) Content Scoring System (IBS SCORE) .....	113
I	Analysis Techniques .....	114



