

# Proceeding Book



## **GO GREEN2015** INTERNATIONAL POSTGRADUATE CONFERENCE ON GLOBAL GREEN ISSUES

*"Incorporating Green Approaches for Resilient Future"*

7 - 8 OCTOBER 2015 | Dewan Kuliah Al-Khawarizmi

Universiti Teknologi MARA, Cawangan Perak  
Kampus Seri Iskandar  
32610 Seri Iskandar  
Perak, Darul Ridzuan, MALAYSIA  
Website: [www.perak.uitm.edu.my/gogreen2015/](http://www.perak.uitm.edu.my/gogreen2015/)  
Email: [gogreen2015@perak.uitm.edu.my](mailto:gogreen2015@perak.uitm.edu.my)



UNIVERSITI  
TEKNOLOGI  
MARA



Fakulti Sarbina Perancangan Dan Ukur  
Faculty of Architecture, Planning And Surveying



9789675741357

INTERNATIONAL POSTGRADUATE CONFERENCE ON  
GLOBAL GREEN ISSUES

# GO GREEN2015

‘Incorporating Green Approaches for Resilient Future’

7-8 OCTOBER 2015  
Dewan Kuliah Al-Khawarizmi  
Universiti Teknologi MARA Cawangan Perak

ISBN 978 – 967 -5741-35-7  
eISBN 978 – 967 -5741-36-4

copyright  
Fakulti Senibina, Perancangan & Ukur,  
Universiti Teknologi MARA Cawangan Perak,  
2015

**ORGANISED BY**  
Fakulti Senibina, Perancangan & Ukur  
Universiti Teknologi MARA Cawangan Perak  
Kampus Seri Iskandar  
32610 Seri Iskandar,  
Perak Darul Ridzuan, MALAYSIA  
Tel: +605 374 2000  
Fax: +605 374 2244

# INDEX

		Page No.
<b>Keynote Paper</b>		
	<i>Ken Yeang Practice Report</i> <b>Key Yeang</b>	i
<b>SECTION I: GREEN DESIGN CONCEPT</b>		
<b>Paper ID</b>	<b>Title of the Paper and Authors</b>	
GR1001	<i>The Composition Of Usability Evaluation In Assessing Quality of the Display Case Lighting</i> <b>Siti Norsazlina Haron, Norashikin Abdul Karim, Afzanizam Muhammad, Anuar Talib , Md Yusof Hamid</b>	1
GR1002	<i>Usability Evaluation for Hospital Building Quality In-Use</i> <b>Siti Norsazlina Haron, Md Yusof Hamid , Yuhainis Abdul Talib</b>	7
GR1003	<i>The Green Adaptive Reuse of Historical Buildings</i> <b>Kartina Alauddin, Mohd Fisal Ishak, Noorzalifah Mohamed</b>	14
GR1004	<i>Industrial Building System; Does it good for sustainable building?</i> <b>S.Roshanfekar, N.M Tawil, N.A. Goh</b>	19
GR1011	<i>Book Transit Shelter : A Method in Developing a Zero-Waste Environment and Healthy Campus Community</i> <b>Muhammad Naim Mahyuddin, Hafizah Mohd Latif, Muhammad Redza Rosman, Nor Sahidah Samsudin, Rafizah Mohamed Nordin</b>	22
GR1015	<i>Green Concepts Through Shape-Grammar – The Language Of Intermediate Spaces In Traditional Malay Houses</i> <b>Suzana Said, M. Sabrizaa Abdul Rashid, Rosmawati Mohamed, Neta Suredah Baharum, Izatul Asyikin Nordin</b>	27
GR1017	<i>Characterization of Lime Plaster of Ipoh Royal Club for Conservation Purpose</i> <b>Farah Reeza Abdul Razak, Siti Norlizaiha Harun</b>	32
GR1018	<i>An Overview On The Typology Of Shophouses' Façade At The Heritage Area in Ipoh City</i> <b>Wan Nordiana Wan Ali, Nurul Huda Abdul Hadi, Noor Rizallinda Ishak</b>	38
GR1019	<i>Sustainability Of Building Elements In Bidayuh Traditional Longhouse Construction</i> <b>Janet Victoria, Siti Akhtar Mahayuddin, Wan Akmal Zahri Wan Zaharuddin, Siti Norlizaiha Harun, Balkhiz Ismail, Noorsaidi Mahat</b>	45

GR1021	<i>Ephemeral Architecture: In Between Permanence and Impermanence towards Sustainable Architecture.</i>	51
	<b>Sayed Muhammad Aiman Sayed Abul Khair, Ismail Samsuddin</b>	
GR1022	<i>In Search of Malay Landscape Design: Characteristic and Identification of Traditional Landscape at Sungai Perak</i>	58
	<b>Mohd Khazli Aswad Khalid, Mohd Sabrizaa Abd Rashid ,Ahmad Zamil Zakaria</b>	

## SECTION II: GREEN TECHNOLOGY

<b>Paper ID</b>	<b>Title of the Paper and Authors</b>	<b>Page No.</b>
GR2001	<i>New Environmentally Lightweight Building Materials from Hybrid Inorganic Polymer-Wood Particles</i>	66
	<b>Siti Noorbaini Sarmin</b>	
GR2004	<i>Hybrid Technology for the use of Solar Energy: The Challenge towards Green Energy</i>	72
	<b>S. I. Hossain, M. R. Al-Mamun, S. Sikdar, M. Al-Amin, S. C. Majumder, M. R. Hasan, M. Z. H. Khan</b>	
GR2006	<i>Waste Management Practices and Recycling Intention among Undergraduates Students in Higher Learning Institution</i>	79
	<b>Siti Fahazarina Hazudin, Anis Barieyah Mat Bahari, Alia Ezrie Ashiqin Jamaludin</b>	
GR2007	<i>Thioflavin Dye Degradation by Using Magnetic Nanoparticles Augmented Polyvinylidene Fluoride (PVDF) Microcapsules</i>	83
	<b>Mohamed Syazwan Osman, KaMan Kong, Boon Seng Ooi, Bassim H. Hameed, Jit Kang Lim</b>	
GR2013	<i>Concrete Compressive Strength Development when Polyethylene Terephthalate Partially Replaces Sand</i>	87
	<b>Muhammad Redza Rosman, Norishahaini Mohamed Ishak</b>	
GR2015	<i>Evaluation of Laser-Printed Paper Deinking Quality Facilitate By Lipase and Esterase Enzymes</i>	95
	<b>Nurul Shafika Azmi, Nik Raikhan Nik Him</b>	
GR2016	<i>Green Approach in Road Construction</i>	102
	<b>Suhaila Ali, Nurul Fatihah Yahaya , Norbaizura Abu Bakar, Mohd Hafiz Saberi, Norhafizah Yusop, Farhan Md Dahlan</b>	

GR2017	<i>Establishing a Strategic Framework of Green Procurement for the Malaysian Construction Industry</i> <b>MohdSallehuddin Mat Noor , Fadzil Hassan</b>	108
GR2019	<i>Environmental Psychology: An Analysis on Lighting Efficiency of the Architecture Studio in UiTM Perak</i> <b>Fazidah Hanim Husain, Zafuan Husri ,Farhah Amani</b>	113
GR2020	<i>Effect of Kenaf Fibre and Rice Husk Incorporation on Melt Flow and Mechanical Properties of Calcium Carbonate/Polypropylene Hybrid Composite</i> <b>Mohd Muizz Fahimi Mohamed, Rahmah Mohamed</b>	119
GR2027	<i>Surfacing Effects on Thermal Condition in Urban Open Space</i> <b>Liyana Ahmad Bazuli, Azhan Abdul Aziz</b>	124
GR2028	<i>Impact Of Urban Block Configuration And Direction On Urban Temperature Increase In Hot, Humid Regions</i> <b>Lin Yola, Ho Chin Siong</b>	131
GR2029	<i>Modular Construction System in Malaysia: Issues for Research in Sustaining an Affordable Home Projects</i> <b>Salmiah Aziz, Mohd Rofdzi Abdullah</b>	140
GR2030	<i>Review on Indoor Environment Quality Parameters Towards Healthier Green Buildings in Malaysia</i> <b>Fadhilah Che Aziz, Md Yusof Hamid</b>	153
GR2032	<i>Green Solar Dehydrator</i> <b>A. N. Alias, M. H. Khalid, N. F. M. Sahapini, Z. Mahfodz, F. Abdullah, R. Julius, M. A. Yahya, F. Fariesha</b>	161
GR2035	<i>Solar Energy: Dilemma and the Way Forward</i> <b>Norhafizah Yusop, Norbaizura Abu Bakar, Suhaila Ali, Mohd Hafiz Saberi, Mohamad Akmal Mohamad Najib, Noor Zawani Yusop</b>	166
GR2037	<i>An Overall Thermal Transfer Value (OTTV) – Based Approach in Analysing the Energy Efficiency of Buildings: A Review</i> <b>Afiqah Ahamad, Wan Abdullah Wan Alwi, Azman Zainoabidin</b>	172
GR2040	<i>Natural Fibre as Fibrous Reinforced in Polymer Modified Mortar: A Review</i> <b>Azamuddin Husin, Mahyuddin Ramli, Cheah Chee Ban</b>	177
GR2042	<i>Flame Retardancy Study Of Recycled Polymeric Foam Filled Composite Building Material.</i> <b>Syed Anas Syed Mustafa, Rahmah Mohamed, Lily Soraya Amerudin</b>	184

GR2044	<i>Improving Overall Thermal Transfer Value of Office Tower Building in Malaysia. Case Study : Ministry of Women Family and Community Development, Lot 4G11, Putrajaya</i> <b>Azman Zainoabidin, Amirul Amin Ismail</b>	191
GR2045	<i>Towards Green Roads in Malaysia: Review of Road Characteristics Effects On Road Surrounding Microclimates with Respect to Roadside Trees</i> <b>Nasibeh FaghihMirzaei, Sharifah Fairuz Syed Fadzil, Aldrin Abdullah, Nooriati Binti Taib, Reza Esmaeilifar</b>	200
GR2049	<i>Carbon Footprint Calculator for Children</i> <b>Romiza Md Nor, Haleeda Azwa Abdul Hadi</b>	208

### SECTION III: GREEN MANAGEMENT

<b>Paper ID</b>	<b>Title of the Paper and Authors</b>	<b>Page No.</b>
GR3001	<i>Project Manager Success Factors In Managing Green Buildings In Malaysia : Knowledge and Skills</i> <b>Asniza Hamimi Abdul Tharim, Aifa Syazwani Zainudin, Nur'Ain Ismail, Thuraiya Mohd, Noor Aileen Ibrahim</b>	213
GR3002	<i>Role of Real Estate Valuation Surveyors in the Malaysian National Taxation</i> <b>Mohd Hasrol Haffiz Aliasak , Mohd Farid Bin Sa'ad</b>	221
GR3003	<i>An Overview of the Challenges in Malaysian Green Construction</i> <b>Asniza Hamimi Abdul Tharim, Aifa Syazwani Zainudin, Noraidawati Jaffar</b>	228
GR3004	<i>Overview of Lean Issues in Managing the Green Construction Project</i> <b>Wan Nur Syazwani Wan Mohammad, Mohd Rofdzi Abdullah</b>	235
GR3005	<i>Identifying the Challenges in Obtaining Green Building Index (GBI) Certification In Construction Industry</i> <b>Izatul Farrita Mohd Kamar, Lilawati Ab Wahab, Nor Suzila Lop, Noor Aishah Mohammad Hamdan</b>	241
GR3006	<i>Stakeholder's Pressures on the Firm's Environmental Strategy in Malaysia</i> <b>Rohati Shafie, Loke Siew Phaik</b>	247
GR3007	<i>Key Success Factors of Green Building Implementation in Malaysia Construction Industry</i> <b>Nor Suzila Lop, Asmalia Che Ahmad, Nik Aqlima Diyana Nik Zulkipli</b>	254

GR3008	<i>The Effectiveness of the Implementation of QE/5S towards Quality Environment at Workplace</i> <b>Norhaslina Jumadi, Nurul Sahida Fauzi, Lizawati Abdullah, Wan Nur Syazwani Wan Mohammad, Johana Yusof</b>	363
GR3009	<i>Outsourcing Property Management Perspective: Universities in the District of Perak Tengah</i> <b>Nurul Sahida Fauzi, Noratikah Kamarudin, Siti Nadiah Mohd Ali, Nor Aini Salleh, Noraini Johari</b>	268
GR3010	<i>The Facilities Management Standard Service Category</i> <b>Zuraihana Ahmad Zawawi, Wan Samsul Zamani Wan Hamdan, Nur Azfahani Ahmad, Nurul Fadzila Zahari</b>	273
GR3011	<i>The Enhancement Criteria of Green Building Implementation For Property Development in Perak, Malaysia – Valuers’ Perspective</i> <b>Roshdi Sabu, Hayroman Ahmad, Lizawati Abdullah</b>	279
GR3014	<i>Preliminary Study on Waste Management for Implementation of Green Highway</i> <b>Asmalia Che Ahmad, Nur Illiana Husin, Abdul Muhaimin Ab Wahid, Syahrul Nizam Kamaruzzaman</b>	286
GR3016	<i>Critical Motivation Factors among Project Managers to Achieve Successful Project in Malaysian Construction Industry</i> <b>Farhan Md Dahlan, Muhammad Amirul Fahme Ahmad, Siti Nadiah Mohd Ali, Siti Sarah Mat Isa, Norbaizura Abu Bakar</b>	293
GR3018	<i>The Contractor’s Attributes For The Construction Project Success</i> <b>Mohd Hafiz Saberi, Norbaizura Abu Bakar, Norhafizah Yusop, Suhaila Ali, Mohd Fisal Ishak, Farhan Md Dahlan, Noraini Abdul Rani</b>	300
GR3020	<i>Review on Malaysia’s GreenRE in Comparison with Singapore’s GreenMark and UK’s BREEAM</i> <b>Halmi Zainol, Fadhilah Che Aziz, Suharto Teriman, Haryati Mohd Isa, Muhamad Asri Abdullah Kamar</b>	305
GR3021	<i>Risk Management Plan (RMP); Implementation and Challenges towards Sustainability and Green Concept for Public Projects in Terengganu</i> <b>Yuhainis Abdul Talib, Siti Nirwana Mat Usof, Kharizam Ismail</b>	311
GR3023	<i>Imperfection Of Tender Document: A Solution Towards Sustainable Construction Practice In Malaysia</i> <b>Mohd Esham Mamat, Shahela Mamter, Mohammad Sani Mat Hussein, Norazlin Mat Salleh</b>	318

GR3024	<i>Benefits of Green Building from Client's Perspective</i> <b>Norazlin Mat Salleh, Nik Noor Hazleeda Baharuddin, Shahela Mamter, Mohd Esham Mamat</b>	322
GR3025	<i>Green Material Procurement Implementation Towards The Green Buildings</i> <b>Shahela Mamter, Siti Rohayu Jusoh, Mohd Esham Mamat, Norazlin Mat Salleh</b>	328
GR3026	<i>A Review Of Ex-Mining Land Reclamation as Construction Project Activities: Focusing In City Of Ipoh</i> <b>Mohd Najib Abd Rashid, Hayroman Ahmad, Siti Jamiah Tun Jamil, Noor Azam Yahaya, Mohamad Hamdan Othman</b>	333
GR3027	<i>Repair and Maintenance Works For Low Cost Housing; Issues And Solution</i> <b>Yuhainis Abdul Talib, Amirul Helmi Abdul Malik , Siti Norsazlina Haron</b>	340
GR3028	<i>An Overview of Time and Cost in Arbitration for Construction Projects</i> <b>Azira Ibrahim, Zulhabri Ismail, Thuraiya Mohd, Ida Nianti Mohd Zin</b>	347

#### SECTION IV: GREEN CULTURE

<b>Paper ID</b>	<b>Title of the Paper and Authors</b>	<b>Page No.</b>
GR4002	<i>An Assessment of Carbon Footprint at UiTM Seri Iskandar Perak, Malaysia</i> <b>Nor Izana Mohd Shobri, Wan Noor Anira Wan Ali @ Yaacob, Norizan Mt Akhir, Siti Rasidah Md Sakip</b>	352
GR4005	<i>Eco-Friendly Food Packaging: Young Consumer 's Perception &amp; Practice</i> <b>Norsyamira Shahrin , Rabiatal Adawiyah Abd Rahman, Noorliza Zainol, Noor Saliza Salmi, Mohd Faisal Abdul Wahab</b>	357
GR4006	<i>Ethico-Legal Issues In The Medical Profession: A Case Study Of Nursing Profession In The World</i> <b>Lateef Wale Adeyemo, Syahirah Abdul Sukor, Amalina Ahmad Tajudin, Ali H Ali Beltamer</b>	364
GR4008	<i>Green Perception and Behavior among Students at UiTM Melaka</i> <b>Siti Norashikin Bashirun, Nurldayu Badrolhisham, Farah Shazlin Johari, Nurhafizah Mohd Zolkapli, Nor Maslia Rasli Samudin, NurFaithzah Jamian</b>	373



GR4009	<i>Geographical Information Systems (GIS) Approach For Mapping The Aboriginal Children Malnutrition Growth : A Case In Kemar, Perak</i> <b>Haslina Hashim, Izrahayu Che Hashim, Suzanah Abdullah, Fadhilah Md Isa, Noorfatekah Talib</b>	378
GR4010	<i>A Preliminary Study of Cinemagraph as A Tool In Enhancing Public Service Announcement (PSA) On Smoking Habit Issue</i> <b>Fahmi Samsudin, Rosita Mohd Tajuddin, Nik Ridzuan NikYusoff</b>	388
GR4011	<i>Green Branding: The Effect of Green Trust towards Brand Loyalty of the Five-Star Hotel Guest</i> <b>Muhd Nabil Hanif Hassim , Mohd Raziff Jamaluddin</b>	394
GR4014	<i>Students' Knowledge in the Waqf Land Concept</i> <b>Siti Nadiyah Mohd Ali, Rashidah Paujah Ismail , Abd. Halim Mohd Noor, Nurul Sahida Fauzi, Nor Nazihah bt Chuweni, Farhan Md Dahlan</b>	400
GR4016	<i>The Awareness of Generation 'Y' on Green Building Development in Malaysia</i> <b>Syarifah Nur Nazihah Syed Jamalulil, Haryati Mohd Isa, Nurul Huda Ahmad</b>	405

## SECTION V: GREEN ENVIRONMENT

<b>Paper ID</b>	<b>Title of the Paper and Authors</b>	<b>Page No.</b>
GR5001	<i>A Conceptual Study of Connectivity Elements Towards Successful Green Network</i> <b>Nor Hamizah Abdul Hamid, Muhamad Ezran Zainal Abdullah, Nik Hanita Nik Mohamad</b>	411
GR5006	<i>Sustainable Indicator for Feature Attributes Assessment of Urban Green Space</i> <b>Rabi'ah Ahmad , Abdul Nassir Matori</b>	417
GR5012	<i>Exploring the Relationship between Community Happiness and Environmental Setting</i> <b>Siti Rasidah Md Sakip, Khalilah Hassan, Azran Mansor</b>	425
GR5013	<i>The Potential of Lake in Generating the Urban Community Development. Case Study: Putrajaya Lake, Federal of Putrajaya.</i> <b>Wan Noor Anira Wan Ali @ Yaacob, Norhafizah Abdul Rahman, Marina Abdullah, Nor Izana Mohd Shobri</b>	433

GR5019	<i>Gis-Based Land Suitability Analysis Using AHP For Public Parks Planning In Kota Bharu, Kelantan</i> <b>Khalilah Hassan, Izrahayu Che Hashim, Siti Syamimi Omar</b>	439
GR5021	<i>Generating of Cotidal Dataset by Spatial Interpolation Techniques</i> <b>Khadijah Sahdan, Syed Ahmad Qusoiri Syed Abdul Karim, Othman Mohd Yusof</b>	446
GR5023	<i>Multiple Regeneration of Clinacanthusnutans Nodal Explants by using 6-Benzylaminopurine (BAP) Hormone</i> <b>Siti Zulaiha Ghazali, Saiyidah Nafisah Hashim</b>	451
GR5026	<i>Biodegradation of Petroleum Oil by using Isolated Penicillium sp.</i> <b>Nabilah Razak, Saiyidah Nafisah Hashim, Chia Chay Tay</b>	455
GR5030	<i>Students Awareness on Environmental Quality in Term of Daily Life Routine</i> <b>Noorlida Daud, Wan Noor Anira Wan Ali @ Yaacob, Anwar Fikri Abdullah</b>	460

## EDITORIAL BOARD

### Chief Editor

Dr. Atikah Fukaihah Amir

### Language Editors:

Jeyamahla Veeravagu

NoorAileen Ibrahim

Nur Fatima Wahida Mohd Nasir

Noraini Johari

Nurul Ain Hasni

Mohamad Syafiq Ya Shak

Wan Faridatul Akma Wan Mohd Rashdi

Zarlina Mohd Zamari

## BOARD OF REVIEWER

### Head:

Assoc. Prof. Dr. Mohd Sabrizaa Abd Rashid

### Research Area:

Green Design Concept	Assoc. Prof. Dr. Mohd Sabrizaa Abd Rashid
Green Technology	Dr. Azhan Abdul Aziz
Green Management	Dr. Ida Nianti Mohd Zain
	Dr. Sr. Hajah Nor Aini Salleh
Green Culture	Dr. Lilawati Ab Wahab
Green Environment	Dr. Suharto Teriman

### Reviewers:

Assoc. Prof. Dr. Ahmad Faisal Alias, UiTM Cawangan Perak  
Assoc. Prof. Dr. Halmi Zainol, UiTM Cawangan Perak  
Assoc. Prof. Dr. Ismail Samsuddin, UiTM Cawangan Perak  
Dr. Anis Sazira Bakri, UiTM Cawangan Shah Alam  
Dr. Asmat Ismail, UiTM Cawangan Perak  
Dr. Asmalia Che Ahmad, UiTM Cawangan Perak  
Dr. Hj Ashrof Zainuddin, UiTM Cawangan Perak  
Dr. Atikah Fukaihah Amir, UiTM Cawangan Perak  
Dr. Fadzil Mat Yassin, UiTM Cawangan Perak  
Dr. Haryati Mat Isa, UiTM Cawangan Perak  
Dr. Hayroman Ahmad, UiTM Cawangan Perak  
Dr. Kharizam Ismail, UiTM Cawangan Perak  
Dr. Kartina Alauddin, UiTM Cawangan Perak  
Dr. Kushairi Rashid, UiTM Cawangan Perak  
Dr. Mahanim Hanid, University of Malaya, Kuala Lumpur  
Dr. Muhamad Asri Abdullah Kamar, UiTM Cawangan Perak  
Dr. Mohd Fadzil Abdul Rashid, UiTM Cawangan Perak  
Dr. Mohd Hasrol Haffiz Aliasak, UiTM Cawangan Perak  
Dr. Mohamad Mohd Derus, UiTM Cawangan Perak  
Dr. Norhasandi Mat, UiTM Cawangan Perak  
Dr. Norhafizah Abdul Rahman, UiTM Cawangan Perak  
Dr. Nooriha Mansoor, UiTM Cawangan Perak  
Dr. Sallehan Ismail, UiTM Cawangan Perak  
Dr. Suzana Said, UiTM Cawangan Perak  
Dr. Siti Rasidah Md Sakip, UiTM Cawangan Perak  
Dr. Thuraiya Mohd, UiTM Cawangan Perak  
Dr. Yuhainis Abdul Talib, UiTM Cawangan Perak

# Natural Fiber as a Fibrous Reinforced in Polymer Modified Mortar: A Review

Azamuddin Husin<sup>1</sup>, Mahyuddin Ramli<sup>2</sup>, CheahChee Ban<sup>2</sup>

<sup>1</sup>Department of Building, Faculty of Architecture, Planning and Surveying, UniversitiTeknologi MARA (Perak), Malaysia,

<sup>2</sup>Building Technology Programme, School of Housing, Building and Planning ,Universiti Sains Malaysia, Email: azamu696@perak.uitm.edu.my

---

## Abstract

The disadvantages of cement based material are due to its brittleness, thus perform low tensile strength and poor fracture toughness. This poor performance can be improved by using fiber as reinforcement. Fiber such as carbon fiber, glass fiber is widely used to enhance the properties of the cement-based material, especially in the form of thin sheet/plates. While global scenario has intensively moved towards green buildings, it is possible to use our local resources. It is to innovate local green building materials such as using natural fiber from agricultural waste such as oil palm fiber, coir fiber, kenaf and wood fiber. Therefore, this paper highlights the review of the literature regarding the use of natural fiber in polymer-modified mortar.

*Keywords:* Natural fibre, fibre reinforced, polymer modified mortar.

---

## 1.0 Introduction

Concrete possesses high compressive strength but also have low tensile strength. This brittle material has to be reinforced with steel reinforcement system to gain good compressive and tensile strength with appropriate post crack deformation due to strain softening. These advantages, however, lack of resistance towards penetration of water and other aggressive elements due to its high permeability characteristic that lead to carbonation and chloride attacks resulting to corrosion of the steel rebar. Gjorv's (as cited in Pacheco-Torgal&Jalali, 2011) reported that serious deterioration occurs to almost 25% of bridges built after 1970 in Norway. Meanwhile Ferreira's estimated that 40% of 600,000 bridges were affected due to corrosion in U.S.

The aspect of high-cost maintenance due to this deterioration should be improvised by adopting materials that provide durability and performance of the material used. Meanwhile, the current global scenario in construction has intensively moved towards green buildings approach such as adopting various aspects of materials recycling, reused and energy conservation. Thus, it is possible to use our local resources to innovate local green building materials such as using natural fiber from oil palm fiber, coir fiber, pineapple leaf, kenaf and wood fiber as the reinforcement. By adopting these natural fibers, it is possible to enhance brittle materials such as OPC structure but with fewer problems of deterioration.

This abundant source of natural fiber has not been fully utilized and most likely will be left untreated and rotten with some of the fiber will later pollute the environment as well. Various researches have been undertaken to understand and utilized natural fiber in the form of composite materials. However, the development of natural fiber reinforced in the cement based composite are limited due to incompatibility under cementitious environments such as high permeability and lack of resistance to crack growth.

ACI Committee 544 (2002) concluded that fibers can swell in the presence of moisture and resulted to some deficiencies in their durability aspects. Previous studies have also shown that most of composite system has similar problems that related to cracks propagation due to the deterioration of the fiber in alkalinity of cement environment. Several researchers had used matrix modification approaches such as reduce the alkalinity of the cement matrix, modification of natural fiber surface using chemical and also involving process technique.

While OPC have common issues of permeability, modifications of the cement properties have significant potential to enhance the matrix by using filler additives and cement replacement methods. Polymer modified cement in concrete and mortar has been intensively adopted to enhance durability and strength. Applying natural fiber in polymer modified matrix may lead to the opportunity of reducing similar problems of corrosion and offer surface coating to fiber.

## 2.0 Fiber characteristic and properties

Fiber can be classified into two parts of organic fiber. There is a natural fiber that consists of a vegetable origin and animal origin. The other type of organic fiber is man-made fibers. Man-made fibers consist of the natural polymer and synthetic group. The classification of fiber is shown in Figure 1.

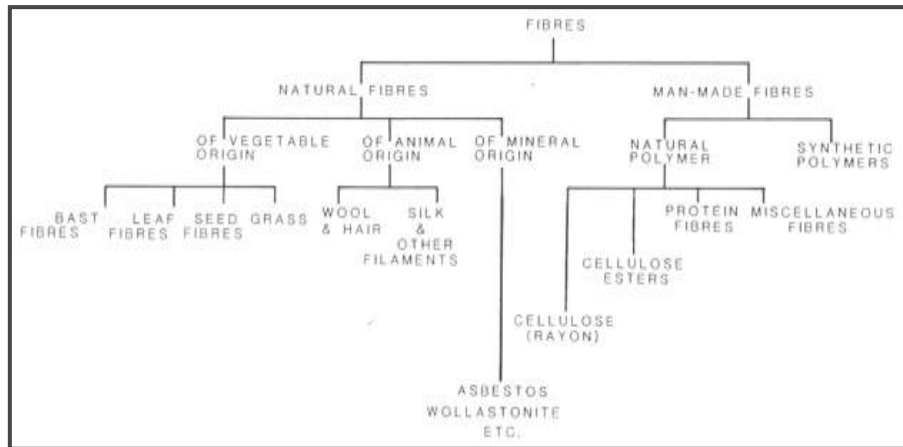


Figure 1: Classification of fiber(Z.Fordos, 1988)

Table.1: Properties of vegetable fibers(Savastano, Warden, & Coutts, 2000).

Properties	Specific gravity [Kg/m <sup>3</sup> ]	Water absorption [%]	Tensile strength [MPa]	Modulus of elasticity [GPa]
Sisal	1370	110	347-378	15.2
Coconut	1177	93.8	95-118	2.8
Bamboo	1158	145	73-505	10-40
Hemp	1500	85-105	900	34
Caesarweed	1409	182	300-500	10-40
Banana	1031	407	384	20-51
Prassava palm	1054	34-108	143	5.6
Date palm [7]	1300-1450	60-84	70-170	2.5-4

The variation of fiber properties has encouraged over fiber pre-treatment. Pre-treatment of the fiber changes the composition and effect to the properties of the fibers. Other related treatment includes reducing the alkalinity of the cement matrix and also by acquiring technical process.

## 3.0 Natural Fiber as Reinforcement in Cement Composites

The advancement of natural fibers reinforced in cement-based composite has gained attention since scientist knows that asbestos composite causes the health hazard. The attention to replacing asbestos has led to numerous studies on natural fibers composite. However, with vast technology, high-performance man-made materials such as carbon fiber composite and other synthetic fibers composites has gained popularity. However, due to economic reason, most of the man-made fiber are not cost viable anymore for the industries. For the last decade, there has been a positive interest again in natural fibers due to its potential advantages of renewable resources as well of its offerings towards weight saving and lower raw material price. As an example, there have been numerous investigations on fiber treatment to improve their low strength and durability as similar to glass fiber properties.

Among the advantages that the fibrous cement exhibits are such as its ductility, flexural capacity and crack resistance. It also performed toughness strength as compared to non-fiber reinforced cement-based materials. The major advantage of fiber reinforcement is the behavior to resist post cracking in brittle material such as the cement and mortar. The cracking strain of the matrix does not change where the fiber has successful bridges across the crack.

The attention to produce a systematic and durable construction material has been taken into various researches on the natural fiber mechanical properties and physical performance. Fibers from coconut husk, sisal, sugar cane

bagasse, bamboo, jute, wood, akwara, elephant grass, water-reed, plantain and musamba were introduced in the cementitious matrix. Their mechanical properties adaptation was also investigated (M. Ramli&Dawood, 2010).

The achievement in fibrous cement composites is quite remarkable whereby their application in housing can only be seen in the exterior application such as the siding and roofing. Previously most of the available products are non-structural building materials. With the natural fiber substituting the typical steel reinforcement, it can achieve a desirable tensile rupture and stress strength. The behavior of natural fiber in cement composite materials shows that it could act as a primary reinforcement to increase the strength and toughness. It also acts as secondary products in controlling cracks induced by temperature and humidity (Golbabaie, 2006).

### **3.1. Natural Fiber Reinforced Composite.**

Investigation of natural fiber reinforced cement composites has been done by numerous researches involving most of the common natural fibers as mention before. The physical and mechanical of the fibers may sometimes appear differently in which is strongly influenced by their growing environment. Some of the properties of particular fiber may have huge difference even though the diameter is approximately the same, but the magnitude of tensile strength is different. Other examples such as the density of different fiber may show a different value, and this variation of properties may not be considered to be used as construction materials (Majid, 2009).

There are several factors affecting the properties of natural fiber reinforced cement composite such as fiber type, fiber geometry, fiber form, fiber surface, matrix properties, mix design, mixing method, placing method, casting method and last but not least is the curing method. According to Aziz, Paramasivam, & Lee (1981), all the factors are almost equally important. As an example, the optimum fiber length and volume concentration for coconut fiber are at 38mm and 4% respectively but for jute fibers are at 25mm and 3% respectively.

### **3.2. Properties of Fresh Natural Fiber Reinforced Composite.**

An investigation by Toledo et al., (2005) to evaluate shrinkage and creep behaviour of vegetable fiber reinforced composite using sisal and coconut fiber was conducted to establish the influence of the fibers on the free and restrained plastic shrinkage, early drying shrinkage cracking, crack self-healing and long-term drying shrinkage of mortar matrices. In this study specimen were subjected to a wind speed test of 0.4–0.5m/s at 40°C temperature for up to 280min. Drying shrinkage tests were carried out at room temperature with about 41% relative humidity for 320 days. The influence of curing method, mix proportions and a partial replacement of ordinary Portland cement (OPC) by ground granulated blast-furnace slag and silica fume on the drying shrinkage of vegetable fiber reinforced composite (VFRC) was also investigated. This investigation established findings that concluded the benefits of fibers incorporation. Free plastic shrinkage is significantly reduced by the inclusion of 0.2% volume fraction of 25mm short sisal fibers in cement mortar. An addition of 0.2% volume fraction of 25mm sisal and coconut fibers delays the initial cracking for restrained plastic shrinkage and effectively controls crack development at the early age of composite. The presence of sisal and coconut fibers promotes an effective self-healing of plastic cracking after 40 days at 100% relative humidity. The drying shrinkage is increased by up to 27% when up to 3% volume fraction of sisal or coconut fibers is present.

Fibers incorporation in matrix usually tends to stiffen the matrix, harsh when static but still manage to be vibrated. The stiffening effect will eventually disappear under vibration respond and with proper FRC design mix may intend to be handled the same way as plain concrete in terms of mobility and ability to flow. In measuring static condition such as slump test, it is seen to be inappropriate to use this method as it can show misleading result as in the fact that concrete can be workable when vibrated. It is suggested that dynamic approach are to be used when conducting workability for fresh FRC. As such, VeBe, flow table and time flow through inverted slump cone are more compatible to measure FRC workability (Bentur, 1990).

Researchers in this particular area usually measure the workability and flowability of the composite. In cement based composite such as concrete, it was reported that the inclusion of oil palm trunk fiber in fresh concrete had significantly changed the flowability behavior. It was found that the workability decrease due to the addition of fiber which resulted in the increase in surface area. The test was conducted using three methods comprises of slump test, compacting factor and Vebe. For slump test, it was found that the slump shows loss of about 73% from 130mm to 30mm (100mm loss) with fiber inclusion at 3%. However, there was no significant slump loss when the fiber content is at 1 to 2%. This result shows that the moisture content of the mixture has decreased which resulted in the fiber stiffened the mixture and stabilized the cohesiveness but apparently reduce the workability. The compacting factor of fresh concrete shows a value of 0.83 with the inclusion of 1% and reduces to 0.7 and 0.65 respectively with the inclusion of 2% and 3%. Neville (1995) suggested that value of 0.85 and lower has a low

workability. Result from VB test shows with 3% and 2% fiber inclusion in concrete; it has higher time to spread compared to that with 1% and without fiber. According to Naik, (2004) concrete with 3% and 2 % fiber has good workability with references to ASTM C995, which recommended that the time of flow of fiber reinforced concrete is 8-15 sec.

Incorporation of cellulose pulp in cement matrix exhibits a low workability and increase the void content of the composites. The volume fraction of 10% and higher has discouraged mixing ability where it found that the fibers tend to cluster together resulting in inhomogeneity of the board and reduction in strength. Additional of water ratio was required to avoid fiber lump and for most cases an optimal ratio of water to solids should be 10:1 or 20:1 (Z.Fordos, 1988). This is also been reported by ACI Committee 544, (2002) which explained the reduction of workability due to the increased surface area and water absorption of the fiber.

### **3.3. The Properties of Hardened Natural Fiber Reinforced Cement-Based Composite.**

According to Z. Fordos (1988), for natural fiber, reinforced composite, low fiber contents (<3% by mass) gives almost the same strain capacity as unreinforced cement pastes or mortars in its dry state, during matrix cracks. At higher fiber contents (>3% by weight), the strain capacity and bending strength of the composites shows increase strength in the dry or semi-wet state. Fibers inclusion in the matrix can act as crack arrester and can absorb a significant amount of energy if the considerable proportion of the fibers is pulled out from the matrix in its semi or wet state. The ultimate strength of the composite is much dependable on the fiber type, length and volume fraction of fibers and fiber distribution and also the matrix properties. Other factors that remain important are the type of pulp and also pulp process.

The efficiency stress transfer of fiber reinforcement in composite depends on several important aspects in hardened natural fiber composite. It depends on the relative fiber-matrix stiffness, fiber-matrix interfacial bond and strain compatibility. Higher elastic modulus of fiber compare to the matrix will result in the effectiveness of fiber in restraining pre-cracking of the composite. It is quite impossible to achieve due to its minimum modular ratio ( $\epsilon_{\text{fiber}}/\epsilon_{\text{matrix}}$ ). Due to low modulus and high elongation characteristics, strength improvement is less important to be achieved but it is capable of absorbing large strain energy and explosion as compared to other high modulus rigid fibers. (S.S. Rehsi, 1988 cited Krishnamoorthy, S. and Ramaswamy, H.S. 1982).

The strength of the interfacial bond between the matrix and the fiber determines the effectiveness of stress transfer from the matrix to the fibers when the matrix tends to crack. A strong bond is essential for the improved tensile strength of the composite. It is a common observation that, at the point of failure in a fiber reinforced concrete, fibers invariably are pulled out but do not fail in tension. This result shows that it is the interfacial bond strength that is the limiting factor rather than the high tensile strength of the fiber. In post cracking stage, natural fibers with relatively low tensile strength perform equally well provided that the interfacial bond is adequate.

Udoeyo, F. F. &Adetifa, A. (2012) reported an investigation towards the flexural and toughness characteristic of Kenaf fiber-reinforced mortar composites. The dimension of the mortar sheet was 650mm x 450mm x 8mm. The content of fiber inclusion are from 0.5%, 1.0% and 1.5% with four length ranges of 20mm, 30mm, 40mm and 50mm were considered in the experimental program. The mixing method applies the following procedure; by mixing the sand and cement thoroughly until homogeneity then the required amount of fiber are mixed until reaches uniformity. The water are added later until it achieved a workable paste condition. In this investigation, the characteristic of kenaf fiber in the cement mortar composites on bending capacity shows decreased strength result with fiber volume increment. However, it also shows that with higher fiber content the flexural toughness and impact resistance significantly improved. The result shows that at fiber volume of 0.5% and 20mm fiber length gives the maximum bending capacity.

### **4.0 Polymer Modifiers in Concrete and Mortar**

Polymer modified concrete (PMC)/mortar (PMM) using latex has been in use since the 1950s. PMC is a Portland cement concretes with polymer modifier such as acrylic or styrene-butadiene latex (SBR), polyvinyl acetate and ethylene vinyl acetate (Fowler, 1999).

Japan has been in developing polymer modified mortar for almost 50 years and has contributed to vast multifunction and sustainable, popular construction materials application as compared to conventional cement mortar and concrete. The polymer modified mortar and concrete use polymeric admixtures. In 1960's this material has played major parts in Japan construction industry. Polymer modified mortar being applied as repair and finish works and polymer modified concrete established on limited application only (Bhutta&Ohama, 2010).

In polymer modified cement mortar, the inclusion of polymer into cement system was found to develop a unique interpenetrating network structure between the cement paste and aggregate. The process is governed by the hydration of cement and the formation of the polymer film in the binder. The long-term durability of polymer modified cement concrete/mortar (PMM) has been significantly effects by several factors. It depends on the degree of the microstructural integration of the polymer phase and the cement binder. Styrene-butadiene rubber (SBR) is among the common polymer used as PMM in the form of latex.

A work on PCC microstructure adopting water soluble polymer conducted by Knapen& Van Gemert (2009) was reviewed. The result demonstrated that polymer tend to retard the flocculation of cement particles and minimize the formation of a water-rich layer on the aggregate surfaces. It found that the unhydrated cement particles are distributed uniformly in the matrix without noticeable depletion near the aggregate surface and, as a result, reduced the ITZ that establish more cohesive microstructure and reduction of microcracks.

According to Ohama et al. (1991), total pore volume tends to decrease with an increase in polymer/cement ratio and the decrease in water/cement ratio. Furthermore, SBR latex has the ability of bonding agents and may enhance the interfacial bonding between the fiber and cement matrix. Incorporating SBR latex may also reduce and even replace the need of superplasticiser (SP) for the flowability of the paste. The inclusion of SBR latex can increase the workability of fresh mortar as effectively done by adding superplasticizer into the cement paste. However, with fiber inclusion into the matrix and with the respect to gain high-performance mortar the requirement of water has to be practically less but at the same time possessed good workability. Therefore, to achieve high-performance mortar, the water content is vital and must be optimum at lower content. With the addition of SBR, it is, therefore, can reduce or replace the SP but still achieve good workability and high strength.

The polymer can also enhance the workability of the paste due to fiber inclusion because of the ball bearing effects from the polymer molecules. It is also observed that high water content is potential for greater volumetric shrinkage than a stiffer mixture with low water content. Therefore, polymer content such as SBR may eliminate the need to add extra water while mixing to have an adequate plastic form of a paste (Pelisser et al., 2010).

#### **4.1 Natural Fibrous system in Polymer Modified Cement Binder.**

The characteristic of the matrix plays an important role of adhesion between the fiber and matrix due to the development of the interfacial transition zone (ITZ) between both surfaces. These adhesions of fiber to the matrix are highly dependent on the density between the fibers and cement matrix gaps. Therefore, the interfacial transition zone contributes to porosity, cracks development and also the content of calcium hydroxide crystal which affects the bond between the fiber and matrix. Several authors had also concluded that 200µm thickness of ITZ at 180 days. (Savastano et al, 2005).

As for fiber composite such as cement composite, a stronger interface does not necessarily produce stronger composite and may result into brittle and flaw-sensitive composite material. The effect of the transition zone in fiber composite was discussed by several researchers in the relation of the fiber to matrix bonding. As vegetable fibers are a concern, it is prone to absorb as high as 80% of water that inhibits the narrow region between the fiber and matrix. This reaction cause's high porosity in this transition zone with thickness varies from 50 and 100µm. Alternatively, in cement composite, low porosity and portlandite (calcium hydroxide crystal) concentration in transition zone will positively improve the fiber-matrix bonding. Thus increase the elastic tensile strength and could also reduce ductility (Savastano&Agopyan, 1999). Therefore, the integration of polymer modifiers in cement could enhance a unique bonding of fiber and the matrix.

Investigation on the crack behavior characteristic such as linear elastic fracture mechanics and elastic-plastic fracture mechanics are often incorrectly assumed particularly in particle filled polymer composites, cement concrete and mortar with the inclusion of synthetic fibers as the reinforcement. On the other hand, natural fiber gives some interesting value concerning of its mechanical properties. Therefore improvement of the mechanical behavior of polymer concrete led to the study of chopped coconut, sugar cane bagasse and banana fibers as reinforcement in the matrix. This investigation feature fracture toughness and fracture energy by using the two parameter fracture model (TPFM). These models proposed the critical stress intensity factor,  $K_{Ic}$ , and the critical crack tip opening displacement CTODC by performing three points bending test. Fracture toughness, fracture energy absorbed and flexural strength were determined in comparison to unreinforced polymer concrete. Chopped Coconut fiber and sugarcane bagasse fiber increase the fracture toughness at 15.7% with coconut reinforcement and 17.8% increment for sugar cane bagasse reinforcement. The fracture energy of 100.8% increment is obtained when coconut fiber is used as reinforcement. A 15.9% and 41.1% increment is observed for sugar cane bagasse and banana pseudostem fiber, with respect to unreinforced polymer concrete. The result also successfully



established that coconut fiber reinforcement display an increment flexural properties in polymer concrete when compared to glass and carbon fiber from their previous investigation (Reis, 2006).

Ghazali et al., (2008) conducted a research using electron beam irradiation doses to study the interaction of the microstructure chains of blended cement with polymer emulsion SBR latex. In the research, polymer emulsion acts as the binder of the cement paste with the sugar cane bagasse fiber. The composite samples were hot pressed and tested for the mechanical strength and fracture surface morphology. Samples that exhibit the highest tensile strength result were selected to be irradiated in air at ambient temperature. The results show that SBR latex at 6% exhibit the highest tensile strength and with exposure to the irradiation at 30kGy also increase the strength value. Both parameters of SBR latex and irradiation doses resulted in increments of mechanical strength but decreased when higher percentages of SBR latex and irradiation doses were incorporated.

The observation concluded that the water loss through evaporation and absorption of polymer latex in a substance resulting the suspended resin or polymer particles to crowd together. It is due to the higher magnitude of capillary forces that significantly overcome the forces of repulsive forces of the water- air interfaces between the polymer particles. These create an increase in the concentration of the material soluble in the water phase.

## 5.0 Conclusion

From the literature review, natural fibers as reinforcement in Polymer Modified Mortar, in general, have the potential of other Natural Fiber Reinforced Composites. There is great potential in using these materials since polymer modified mortar/concrete has unique properties of durability and ability to close the gap of the disadvantages of natural fiber in the OPC environment. In the context of Malaysia, the information and technical aspects of the potential of Natural Fiber in Polymer Modified Mortar/Concrete are still lacks and therefore progressive effort need to be taken as part of the green material approach.

## 6.0 References

- ACI Committee 544. (2002). State-of-the-Art Report on Fiber Reinforced Concrete Reported by ACI Committee 544. *ACI Structural Journal*, 96(Reapproved).
- Aziz, M. A., Paramasivam, P., & Lee, S. L. (1981).Prospects for natural fiber reinforced concretes in construction.*International Journal of Cement Composites and Lightweight Concrete*, 3(2), 123-132.
- Bentur, A. M., Sidney. (1990). *Fiber Reinforced Cementitious Composites*. England: Elsevier Science Publisher Ltd.
- Bhutta, M. A. R., &Ohama, Y. (2010).Recent Status of Research and Development of Concrete-Polymer Composites in Japan.*Concrete Research Letters*, 1(4), 125-130.
- Ferreira RM. Service-life design of concrete structures in marine environments: a probabilistic based approach. VDM Verlag Dr. Mülle
- Fowler, D. W. (1999). Polymers in concrete: a vision for the 21st century. *Cement and Concrete Composites*, 21, 449-452.
- Gjorv O. Steel corrosion in concrete structures exposed to Norwegian marine environment. ACI Concrete International 1994:35–9
- Ghazali, M. J., Azhari, C. H., Abdullah, S., Omar, M. Z., & Materials, A. S. (2008). Characterisation of Natural Fibers ( Sugarcane Bagasse ) in Cement Composites, *II*, 3–5
- Golbabaie, M. (2006). Applications of Biocomposites in Building Industry: University of Guelph, Department of Plant Agriculture URL: [http://www.uoguelph.ca/plant/courses/plnt-6250/pdf/M\\_Golbabaie.pdf](http://www.uoguelph.ca/plant/courses/plnt-6250/pdf/M_Golbabaie.pdf).
- Knapen, E., & Van Gemert, D. (2009). Cement hydration and microstructure formation in the presence of water-soluble polymers. *Cement and Concrete Research*, 39(1), 6–13. doi:10.1016/j.cemconres.2008.10.003
- Pacheco-Torgal, F., & Jalali, S. (2011). Cementitious building materials reinforced with vegetable fibers: A review. *Construction and Building Materials*, 25(2), 575–581. doi:10.1016/j.conbuildmat.2010.07.024
- Pelisser, F., Neto, A. B. d. S. S., Rovere, H. L. L., & Pinto, R. C. d. A. (2010). Effect of the addition of synthetic fibers to concrete thin slabs on plastic shrinkage cracking.*Construction and Building Materials*, 24(11), 2171-2176
- Ramli, M., &Dawood, E. T. (2010).Effects of Palm Fiber on the Mechanical Properties of Lightweight Concrete Crushed Brick.*Am. J. Engg. & Applied Sci*, 3(2), 489-493.
- Reis, J. M. L. (2006). Fracture and flexural characterization of natural fiber-reinforced polymer concrete. *Construction and Building Materials*, 20(9), 673–678. doi:10.1016/j.conbuildmat.2005.02.008
- Rehsi, S.S. 1988, Use of natural fiber concrete in India. In: Natural fiber reinforced cement and concrete, ed. By R.N. Swamy. Glasgow & London, Blackie & Son Ltd. Pp.243-255

- Majid, A. (2009). Natural Fibers as Construction Materials.
- Ohama, Y., Demura, K., Kobayashi, K., Satoh, Y., & Morikawa, M. (1991). Pore size distribution and oxygen diffusion resistance of polymer-modified mortars. *Cement and Concrete Research*, 21(2), 309-315.
- Savastano, H., Warden, P. G., & Coutts, R. S. P. (2000). Brazilian waste fibers as reinforcement for cement-based composites. *Cement and Concrete Composites*, 22(5), 379-384.
- Savastano H, Warden P, Coutts R. Microstructure and mechanical properties of waste fibre–cement composites. *Constr Build Mater* 2005;27:583–92.
- Toledo Filho, R. D., Ghavami, K., Sanjuán, M. a., & England, G. L. (2005). Free, restrained and drying shrinkage of cement mortar composites reinforced with vegetable fibers. *Cement and Concrete Composites*, 27(5), 537–546. doi:10.1016/j.cemconcomp.2004.09.005
- Udoeyo, F. F., & Adetifa, A. (2012). Characteristics of kenaf fiber-reinforced mortar composites. *International Journal of Research and Reviews in Applied Sciences*, Vol 12(Issue 1), 18-26
- Z.Fordos. (1988). Natural or Modified Cellulose Fibers as Reinforcement. In R. N. Swamy (Ed.), *Natural Fiber Reinforced Cement and Concrete* (first ed., Vol. 5, pp. 173-206). Glasgow and London: Blackie.