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Designed for both students and practicing professionals, it addresses critical issues of water quality, focusing on the illustration and application of both hydrologic and economic water management techniques. Stresses applications using worked examples, case studies and problems. Software is to assist in solving more complex problems and to apply demonstrated techniques. The software discussed in the book is available for download at <http://www.cee.ucf.edu/software/swm1993.zip>

In the developing countries, pollution through solid waste, sludge from water and wastewater treatment plants and pollution of natural water resources have become one of the grave issues. The root cause is population explosion, industrialization, urbanization and other anthropogenic activities. The increase rate of solid waste has become a major challenge for sustainable development of the environment. Poor management of solid waste and sludge from water and wastewater treatment plants may be the cause of health hazards and environmental problems. The book presents new methods and technologies to combat the aforementioned problems and focuses on the importance of using the recycled products. The technologies related to waste and sludge treatment are economical, eco-friendly and bring economic returns, and can be applied to most of the developing countries where waste treatment technologies, viz. composting, anaerobic digestion, recycling of plastic and agricultural waste in construction can be used. The aim of the book is to support everyone

who is involved in academics, teaching, research related to solid waste management and water and wastewater treatment study in the leading academic and research organizations globally. This book will be of prodigious value to upcoming researchers, scholars, scientists and professionals in Environmental Science and Engineering fields, and global and local authorities and policy makers responsible for the management of solid wastes and sludge. Globally, universities can develop new prospectuses on sustainable and eco-friendly waste and sludge management, which are relating to the book's theme. This book can also be of great source for designing and operation of waste reuse and recycling programmes.

Stormwater infiltration is the most complete approach to stormwater management. Only infiltration can simultaneously solve problems of water quality, flood control, streambank erosion, aquifer recharge, and maintenance of downstream base flows and wetland hydroperiods. Stormwater Infiltration is the first book to explain the principles of natural science on which infiltration is based, how to apply infiltration to any region of the country, and what kinds of results can be expected. It brings into one publication the complete range of necessary information on soils, vegetation, infiltration, hydrology, design criteria, site layout, construction process for surface and subsurface basins, porous paving materials, feasibility, maintenance, and performance. It draws more than half a century's actual experiences from all over the United States to place stormwater management in a context of environmental

balance and quality for human life.

This book gathers the latest research, innovations, and applications in the field of civil engineering, as presented by leading national and international academics, researchers, engineers, and postgraduate students at the AWAM International Conference on Civil Engineering 2019 (AICCE'19), held in Penang, Malaysia on August 21-22, 2019. The book covers highly diverse topics in the main fields of civil engineering, including structural and earthquake engineering, environmental engineering, geotechnical engineering, highway and transportation engineering, water resources engineering, and geomatic and construction management. In line with the conference theme, "Transforming the Nation for a Sustainable Tomorrow", which relates to the United Nations' 17 Global Goals for Sustainable Development, it highlights important elements in the planning and development stages to establish design standards beneficial to the environment and its surroundings. The contributions introduce numerous exciting ideas that spur novel research directions and foster multidisciplinary collaborations between various specialists in the field of civil engineering.

With superior fire resistance, strength, and a long service life, concrete is the most widely used construction material in the world. A sustainable material, concrete is also easily and affordably reused and rehabilitated. The first book to provide an overview of sustainability and concrete, *Green Building with Concrete: Sustainable Design and Construction* surveys the material's history in the green building movement and presents state-of-

the-art methodologies and best practices. From the manufacturing of cement to the rehabilitation of concrete, this comprehensive book explains how concrete can be used for sustainable design and construction. It offers insight into new technological and social developments guiding the introduction of green buildings and examines the attributes that concrete has to offer the green building movement. The text also highlights research on economic analysis—particularly life cycle costing—to provide a full picture of the economic benefits of concrete. Expert contributors from around the world offer diverse viewpoints on global sustainability. Topics covered include: Principles of sustainable design Benefits of concrete's thermal mass Mitigation of urban heat island effects Surface runoff and the application of pervious concrete for sidewalks and parking areas Reduction of construction waste Leadership in energy and environmental design (LEED) standards Emphasizing environmental impact and occupational and consumer health and safety, this book explains how to make the most of concrete in sustainable design. Written for university and concrete industry continuing education courses, it also serves as a reference for building owners and industry professionals who recognize the value of green building.

Pavements are the most ubiquitous of all man-made structures, and they have an enormous impact on environmental quality. They are responsible for hydrocarbon pollutants, excess runoff, groundwater decline and the resulting local water shortages, temperature increases in the urban "heat island," and for

the ability of trees to extend their roots in order to live. Porous pavements, despite their ability to mitigate these factors, remain the object of much skepticism and controversy. Written by a renowned expert with 25 years of experience in urban watershed management, *Porous Pavements* is the first comprehensive "encyclopedia" of porous pavement materials. The book begins with five chapters that lay a foundation for all porous pavement materials and applications, introducing the types of materials and arrangements, their roles in the urban environment, and the principles of pavement structure, hydrology, and rooting space. The following nine chapters outline the costs, maintenance requirements, advantages and disadvantages for different applications, installation methods, sources of standard specifications, and performance levels for each family of porous pavement materials. Relying on case studies and factual data from observed experience, and containing abundant references for further information, *Porous Pavements* gives responsible practitioners a complete toolbox from which to select the appropriate material for site-specific conditions, providing a "green" alternative to impervious pavements.

This book provides an updated state-of-the-art review on new developments in alkali-activation. The main binder of concrete, Portland cement, represents almost 80% of the total CO<sub>2</sub> emissions of concrete which are about 6 to 7% of the Planet's total CO<sub>2</sub> emissions. This is particularly serious in the current context of climate change and it could get even worse because the demand for Portland cement is expected to increase by

almost 200% by 2050 from 2010 levels, reaching 6000 million tons/year. Alkali-activated binders represent an alternative to Portland cement having higher durability and a lower CO<sub>2</sub> footprint. Reviews the chemistry, mix design, manufacture and properties of alkali-activated cement-based concrete binders Considers performance in adverse environmental conditions. Offers equal emphasis on the science behind the technology and its use in civil engineering.

Readers can now prepare for civil engineering challenges while gaining a broad overview of the materials they will use in their studies and careers with the unique content found in CIVIL ENGINEERING MATERIALS. This invaluable book covers traditional materials, such as concrete, steel, timber, and soils, and also explores non-traditional materials, such as synthetics and industrial-by products. Using numerous practical examples and straight-forward explanations, readers can gain a full understanding of the characteristics and behavior of various materials, how they interact, and how to best utilize and combine traditional and non-traditional materials. In addition to detailing the effective use of civil engineering materials, the book highlights issues related to sustainability to give readers a broader context of how materials are used in contemporary applications. Important Notice: Media content referenced within the product description or the product text may not be available in the ebook version.

Characteristics and Uses of Steel Slag in Building Construction focuses predominantly on the utilization of ferrous slag (blast furnace and steel slag) in building construction. This extensive literature review discusses the worldwide utilization of ferrous slag and applications in all sectors of civil engineering, including structural engineering,

road construction, and hydro-technical structures. It presents cutting-edge research on the characteristics and properties of ferrous slag, and its overall impact on the environment.

Comprehensively reviews the literature on the use of blast furnace and steel slag in civil engineering Examines the environmental impact of slag production and its effect on human health Presents cutting-edge research from worldwide studies on the use of blast furnace and steel slag

The Tenth International Conference on Ecosystems and Sustainable Development is the latest in a well established series that originated from the work of the late Nobel laureate, Ilya Prigogine, who challenged us to develop the science of "ecodynamics," integrating thermodynamics, ecology and economics. The papers presented at the conference, contained in this book, cover not only new research from all over the world related to ecological problems, but also new ideas and emerging concepts resulting from interdisciplinary efforts of scientists, engineers and economists. The included papers cover such topics as: Energy and the Environment; Environmental Indicators; Sustainable Development and Planning; Ecosystem Modelling; Natural Resources Management; Sustainable Development Studies; Waste Management; Soil Contamination and Recovery; Recovery of Damaged Areas; Protection and Mitigation; Sustainable Energy Systems; Economic and Benefit Analysis; Policies; Environmental Management; Climate Change and Adaptation; Forensic Analysis; Knowledge Dissemination; Social Responsibility; Environmental Monitoring and Assessment; Innovation in Environmental Management; Sustainable Indicators, Monitoring and Assessment; Natural Resources in Periurban Spaces; Territorial Risk Management.

Report on Pervious Concrete

"This report provides technical information on pervious

concrete's application, design methods, materials, properties, mixture proportioning, construction methods, testing, and inspection. The term 'pervious concrete' typically describes a near-zero-slump, open-graded material consisting of portland cement, coarse aggregate, little or no fine aggregate, admixtures, and water." [p. 1]

Mortar and concrete made with portland cement has been a popular construction material in the world for the past 170 years or more. However, cement mortar and concrete have some disadvantages such as delayed hardening, low tensile strength, large drying shrinkage and low chemical resistance. To reduce these disadvantages, polymers have been utilized as an additive. Polymer-modified or polymer cement mortar (PCM) and concrete (PCC) are the materials which are made by partially replacing the cement hydrate binders of conventional cement mortar or concrete, with polymers. This book deals with the principles of polymer modification for cement composites, the process technology, properties and applications of the polymer-modified mortar and concrete, and special polymer-modified systems such as M DF cement, antiwashout underwater concrete, polymer-ferrocement, and artificial I wood. The polymeric admixtures or cement modifiers include latexes or emulsions, redispersible polymer powders, water-soluble polymers, liquid resins and monomers. This book describes the current knowledge and information of polymer-modified mortars and concretes, and discusses or reviews the following items in detail: 1.

Principles of polymer modification for cement composites. 2. Process technology of polymer-modified mortars and concretes. 3. Properties of polymer-modified mortars and concretes. 4. Applications of polymer-modified mortars and concretes. 5. Special polymer-modified systems such as MDF cements, antiwashout underwater concretes, polymer-ferrocements, and artificial woods.



Durability and service life design of concrete constructions have considerable socio-economic and environmental consequences, in which the permeability of concrete to aggressive intruders plays a vital role. Concrete Permeability and Durability Performance provides deep insight into the permeability of concrete, moving from theory to practice, and presents over 20 real cases, such as Tokyo's Museum of Western Art, Port of Miami Tunnel and Hong Kong-Zhuhai-Macao sea-link, including field tests in the Antarctic and Atacama Desert. It stresses the importance of site testing for a realistic durability assessment and details the "Torrent Method" for non-destructive measurement of air-permeability. It also delivers answers for some vexing questions: Should the coefficient of permeability be expressed in  $m^2$  or  $m/s$ ? How to get a "mean" pore radius of concrete from gas-permeability tests? Why should permeability preferably be measured on site? How can service life of reinforced concrete structures be predicted by site testing of gas-permeability and cover thickness? Practitioners will find stimulating examples on how to predict the coming service life of new structures and the remaining life of existing structures, based on site testing of air-permeability and cover thickness. Researchers will value theoretical principles, testing methods, as well as how test results reflect the influence of concrete mix composition and processing.

**"THE MOST COMPREHENSIVE AND CURRENT GUIDE TO THE PROPERTIES, BEHAVIOR, AND TECHNOLOGY OF CONCRETET**This thoroughly updated edition contains new information on: Recently built construction projects worldwide Shrinkage-reducing admixtures Self-consolidatingconcrete, pervious concrete, internal curing, and other cutting-edge innovations Modeling of ice formation and alkali-

aggregate reaction in concrete Environmental impact of concrete Each chapter begins with a preview of the contents and ends with a self-test and a guide for further reading. More than 300 drawings and photographs illustrate the topics discussed in this definitive text on concrete. Comprehensive coverage includes:

Microstructure of concrete Strength Dimensional stability Durability Hydraulic cements Aggregates Admixtures Proportioning concrete mixtures Concrete at early age Nondestructive methods Progress in concrete technology Advances in concrete mechanics Global warming and concrete in the future "--

Addressing the interactions between the different design and construction variables and techniques this book illustrates best practices for constructing economical, long life concrete pavements. The book proceeds in much the same way as a pavement construction project. First, different alternatives for concrete pavement solutions are outlined. The desired performance and behaviour parameters are identified. Next, appropriate materials are outlined and the most suitable concrete proportions determined. The design can be completed, and then the necessary construction steps for translating the design into a durable facility are carried out. Although the focus reflects highways as the most common application, special features of airport, industrial, and light duty pavements are also addressed. Use is made of modeling and performance tools such as HIPERPAV and LTPP to illustrate behavior and performance, along with some case studies. As concrete pavements are more complex than they seem, and the costs of mistakes or of

over-design can be high, this is a valuable book for engineers in both the public and private sectors. The Utilization of Slag in Civil Infrastructure Construction strives to integrate the theory, research, and practice of slag utilization, including the production and processing of slags. The topics covered include: production and smelting processes for metals; chemical and physical properties of slags; pretreatment and post-treatment technology to enhance slag properties; potential environmental impact; mechanisms of potential expansion; special testing methods and characteristics; slag processing for aggregate and cementitious applications; suitability of slags for use in specific applications; overall properties of materials containing slags; and commercialization and economics. The focus of the book is on slag utilization technology, with a review of the basic properties and an exploration of how its use in the end product will be technically sound, environment-friendly, and economic. Covers the production, processing, and utilization of a broad range of ferrous, non-ferrous, and non-metallurgical slags Provides information on applicable methods for a particular slag and its utilization to reduce potential environmental impacts and promote natural resource sustainability Presents the overall technology of transferring a slag from the waste stream into a useful materials resource Provides a detailed review of the appropriate utilization of each slag from processing right through to aggregate and cementitious use requirements The subjects of the symposia are on composite materials with matrices behaving as brittle in normal or special

conditions. Brittle matrix composites are applied in various domains (civil engineering, mechanical equipment and machinery, vehicles, etc.) and in the last decades their importance is increasing together with their variety. Papers include: aggregate-binder composites (concretes, fibre concretes, rocks); sintered materials (ceramics); high strength composites with brittle matrices. In principle, the general problems of structures made of composite materials are not included in the papers. Various approaches to the material engineering problems are presented in the papers.

This volume highlights the latest advances, innovations, and applications in the field of asphalt pavement technology, as presented by leading international researchers and engineers at the 5th International Symposium on Asphalt Pavements & Environment (ISAP 2019 APE Symposium), held in Padua, Italy on September 11-13, 2019. It covers a diverse range of topics concerning materials and technologies for asphalt pavements, designed for sustainability and environmental compatibility: sustainable pavement materials, marginal materials for asphalt pavements, pavement structures, testing methods and performance, maintenance and management methods, urban heat island mitigation, energy harvesting, and Life Cycle Assessment. The contributions, which were selected by means of a rigorous international peer-review process, present a wealth of exciting ideas that will open novel research directions and foster multidisciplinary collaboration among different specialists.

This book gathers peer-reviewed contributions presented

at the 1st International Conference on Structural Engineering and Construction Management (SECON'20), held in Angamaly, Kerala, India, on 14-15 May 2020. The meeting served as a fertile platform for discussion, sharing sound knowledge and introducing novel ideas on issues related to sustainable construction and design for the future. The respective contributions address various aspects of numerical modeling and simulation in structural engineering, structural dynamics and earthquake engineering, advanced analysis and design of foundations, BIM, building energy management, and technical project management. Accordingly, the book offers a valuable, up-to-date tool and essential overview of the subject for scientists and practitioners alike, and will inspire further investigations and research.

Carbonation results when carbonate ions from dissolved carbon dioxide react with the Ca ions of the cement paste and precipitate calcium carbonate. By time all Ca-bearing cement hydrates will decompose and form calcite. The end product will apart from calcite be silica gels, metal hydroxides and clays. Carbon dioxide and water can be found in almost every environment and thus all concretes will be subjected to carbonation. The cement paste will in the course of time go back to the basic components in cement production. Therefore, the question is not if concrete and other cementitious products will carbonate, but how fast they will carbonate. In geological terms the cement paste turns into marly limestone and the concrete into marly agglomerate. Old Roman concrete structures are basically such a rock.

Carbonation is a process from the surface, i.e. the amount of carbonated material is related to exposure time and surface. Surfaces in direct contact with carbon dioxide and water will carbonate rapidly but a shell of already carbonated concrete will slow down the carbonation of the interior. Thus to be able to calculate the CO<sub>2</sub>-uptake we must know the transport mechanism of carbon dioxide and carbonate ions through the already altered product. The process of passing a shell of already carbonated concrete is complex. The speed of carbonation is apart from the amount of CO<sub>2</sub> in the environment also governed by the size and geometry of the porosity, the degree of water saturation, the type of cement/binder, the temperature, etc. Even concrete submerged in water or buried in soil will carbonate but at a slow speed due to biological degradation and the slowness of exchange reactions between water and the gases in the atmosphere. To be able to calculate CO<sub>2</sub> uptake one must consider the microclimate at individual concrete surfaces, concrete qualities and cement/binder types in a time frame. Thus approximations are needed. In the general case assuming a similar environment and concrete quality the carbonation rate slows down with the square root of time. By choosing the most common types of concrete structures, estimating the exposed surfaces in different environments and concrete qualities it is possible to get a good estimate of the rate of carbon dioxide uptake. As a consequence of the rapidly decreasing rate of carbonation one can assume that most of the carbonation of concrete structures takes place during the first 50 years and after demolition as

this will increase the surfaces dramatically. One must, however, also consider that the types of cement and quality of the concrete have changed and will change over time. Thus there will be a difference between how much is taken up today and how much that will be taken up in 50 years from now. Concrete is a fairly modern material and most concrete structures still remain but we can expect the amount of demolished concrete to increase in the future. A guess is that a 100-year perspective most concrete structures that exist today will probably be demolished and most of the carbonate rock calcinated during cement production will be back as a carbonate rock. To be able to calculate the carbonation rate some simplifications are needed. In this report concrete strength is used as a substitute for porosity and from literature data constants for different environmental classes are selected. The influence of different cements and additions is handled by correction factors.

Urban Drainage: a multilingual glossary provides d  
Geosynthetics in Civil and Environmental  
Engineering presents contributions from the 4th  
Asian Regional Conference on Geosynthetics held in  
Shanghai, China. The book covers a broad range of  
topics, such as: fundamental principles and  
properties of geosynthetics, testing and standards,  
reinforcement, soil improvement and ground  
improvement, filter and drainage, landfill  
engineering, geosystem, transport, geosynthetics-  
pile support system and geocell, hydraulic  
application, and ecological techniques. Special case

studies as well as selected government-sponsored projects such as the Three Gorges Dam, Qinghai-Tibet Railway, and Changi Land reclamation project are also discussed. The book will be an invaluable reference in this field.

This volume contains selected papers presented during the International Conference on Environmental Geotechnology, Recycled Waste Material and Sustainable Engineering (EGRWSE-2018). The multidisciplinary articles in this volume discuss environment-friendly technologies and the application of 'smart' solutions and initiatives to improve infrastructure and services, with a strong emphasis on sustainability and conservation of resources. This volume will be of interest to engineers, professionals, and researchers working on improving urban infrastructure and strengthen civic amenities in a sustainable manner.

This book presents the latest research advances and findings in the field of smart/multifunctional concretes, focusing on the principles, design and fabrication, test and characterization, performance and mechanism, and their applications in infrastructures. It also discusses future challenges in the development and application of smart/multifunctional concretes, providing useful theory, ideas and principles, as well as insights and practical guidance for developing sustainable infrastructures. It is a valuable resource for



researchers, scientists and engineers in the field of civil-engineering materials and infrastructures. Over the past few decades, the frequency and severity of natural and human-induced disasters have increased across Asia. These disasters lead to substantial loss of life, livelihoods and community assets, which not only threatens the pace of socio-economic development, but also undo hard-earned gains. Extreme events and disasters such as floods, droughts, heat, fire, cyclones and tidal surges are known to be exacerbated by environmental changes including climate change, land-use changes and natural resource degradation. Increasing climate variability and multi-dimensional vulnerabilities have severely affected the social, ecological and economic capacities of the people in the region who are, economically speaking, those with the least capacity to adapt. Climatic and other environmental hazards and anthropogenic risks, coupled with weak and wavering capacities, severely impact the ecosystems and Nature's Contributions to People (NCP) and, thereby, to human well-being. Long-term resilience building through disaster risk reduction and integrated adaptive climate planning, therefore, has become a key priority for scientists and policymakers alike. Nature-based Solutions (NbS) is a cost-effective approach that utilizes ecosystem and biodiversity services for disaster risk reduction and climate change adaptation, while also providing a

range of co-benefits like sustainable livelihoods and food, water and energy security. This book discusses the concept of Nature-based Solutions (NbS) – both as a science and as art – and elaborates on how it can be applied to develop healthy and resilient ecosystems locally, nationally, regionally and globally. The book covers illustrative methods and tools adopted for applying NbS in different countries. The authors discuss NbS applications and challenges, research trends and future insights that have wider regional and global relevance. The aspects covered include: landscape restoration, ecosystem-based adaptation, ecosystem-based disaster risk reduction, ecological restoration, ecosystem-based protected areas management, green infrastructure development, nature-friendly infrastructure development in various ecosystem types, agro-climatic zones and watersheds. The book offers insights into understanding the sustainable development goals (SDGs) at the grass roots level and can help indigenous and local communities harness ecosystem services to help achieve them. It offers a unique, essential resource for researchers, students, corporations, administrators and policymakers working in the fields of the environment, geography, development, policy planning, the natural sciences, life sciences, agriculture, health, climate change and disaster studies.

Advances in Construction and Demolition Waste Recycling: Management, Processing and Environmental Assessment is divided over three parts. Part One focuses on the management of construction and demolition waste, including estimation of quantities and the use of BIM and GIS tools. Part Two reviews the processing of recycled aggregates, along with the performance of concrete mixtures using different types of recycled aggregates. Part Three looks at the environmental assessment of non-hazardous waste. This book will be a standard reference for civil engineers, structural engineers, architects and academic researchers working in the field of construction and demolition waste. Summarizes key recent research in recycling and reusing concrete and demolition waste to reduce environmental impacts Considers techniques for managing construction and demolition waste, including waste management plans, ways of estimating levels of waste, and the types and optimal location of waste recycling plants Reviews key steps in handling construction and demolition waste

Volumen II de las ponencias presentadas en las Primeras Jornadas Internacionales de Estudiantes Investigadores, realizadas en el marco del "15o Congreso Internacional de Patologías y Recuperación de Estructuras", en la ciudad de Salta, Argentina, en el mes de noviembre de 2019. Incluye artículos cuyo desarrollo se sustenta en estudios y

descripciones de casos, relacionados con los temas tópicos del Congreso, tales como "Ensayos no destructivos y destructivos para evaluación de estructuras"; "Técnicas de rehabilitación y refuerzo de estructuras"; "Durabilidad y manifestaciones patológicas en la construcción"; "Materiales"; "Patrimonio histórico", entre otros.

This book collects selected full papers presented at the International Symposium on Energy Geotechnics 2018 (SEG-2018), held on 25th – 28th September 2018, at the Swiss Federal Institute of Technology in Lausanne (EPFL). It covers a wide range of topics in energy geotechnics, including energy geostructures, energy geostorage, thermo-hydro-chemo-mechanical behaviour of geomaterials, unconventional resources, hydraulic stimulation, induced seismicity, CO<sub>2</sub> geological storage, and nuclear waste disposal as well as topics such as tower and offshore foundations. The book is intended for postgraduate students, researchers and practitioners working on geomechanics and geotechnical engineering for energy-related applications.

The purpose of this manual is to provide clear and helpful information for maintaining gravel roads. Very little technical help is available to small agencies that are responsible for managing these roads. Gravel road maintenance has traditionally been "more of an art than a science" and very few formal standards exist. This manual contains guidelines to help answer the questions that arise concerning gravel road maintenance such as: What is enough surface crown? What is too much? What

causes corrugation? The information is as nontechnical as possible without sacrificing clear guidelines and instructions on how to do the job right.

Sponsored by the Low Impact Development Committee of the Urban Water Resources Research Council of the Environmental and Water Resources Institute of ASCE *Permeable Pavements* is a comprehensive resource for the proper design, construction, and maintenance of permeable pavement systems that provide a transportation surface and a best management practice for stormwater and urban runoff. A cornerstone for low impact development (LID) and sustainable site design, permeable pavements are considered a green infrastructure practice. They offer many environmental benefits, from reduced stormwater runoff and improved water quality to better site design and enhanced safety of paved surfaces. Commonly used for walkways, driveways, patios, and low-volume roadways as well as recreational areas, parking lots, and plazas, permeable pavements are appropriate for many different land uses, particularly in highly urbanized locations. This volume synthesizes today's knowledge of the technology, drawing from academia, industry, and the engineering and science communities. It presents an overview of typical permeable pavement systems and reviews the design considerations. Detailed design, construction, use, and performance information is provided for porous asphalt, pervious concrete, permeable interlocking concrete pavement, and grid pavements. Fact sheets and checklists help to successfully incorporate permeable pavement systems into design projects.

Additional chapters summarize emerging technologies, maintenance considerations, hydrologic design approaches, key components for specification writing, and key areas for additional research. Appendixes include a fact sheet clarifying information on common concerns, as well as data tables summarizing water quality treatment performance and costs. Permeable Pavements is an essential reference for engineers, planners, landscape architects, municipalities, transportation agencies, regulatory agencies, and property owners planning to implement this best management practice for stormwater and urban runoff. This second edition of Concrete Pavement Design, Construction, and Performance provides a solid foundation for pavement engineers seeking relevant and applicable design and construction instruction. It relies on general principles instead of specific ones, and incorporates illustrative case studies and prime design examples to highlight the material. It presents a thorough understanding of materials selection, mixture proportioning, design and detailing, drainage, construction techniques, and pavement performance. It also offers insight into the theoretical framework underlying commonly used design procedures as well as the limits of the applicability of the procedures. All chapters have been updated to reflect recent developments, including some alternative and emerging design technologies that improve sustainability. What's New in the Second Edition: The second edition of this book contains a new chapter on sustainability, and coverage of mechanistic-empirical design and pervious

concrete pavements. RCC pavements are now given a new chapter. The text also expands the industrial pavement design chapter. Outlines alternatives for concrete pavement solutions Identifies desired performance and behavior parameters Establishes appropriate materials and desired concrete proportions Presents steps for translating the design into a durable facility The book highlights significant innovations such as one is two-lift concrete pavements, precast concrete pavement systems, RCC pavement, interlocking concrete pavers, thin concrete pavement design, and pervious concrete. This text also addresses pavement management, maintenance, rehabilitation, and overlays.

**Author Biography:** Dr. Mohammad Abdul Mannan was born at a simple family of a small village, Aktarpur, Rangiarpota, Jibonnagar, Chuadanga, Bangladesh. He has obtained B.Sc. (Civil Engineering) degree with first class, MSc in Civil Engineering and PhD in Concrete technology. He has started carrier as lecturer at BIT Rajshahi (now RUET), Bangladesh followed by AJP consulting firm, then Universiti Malaysia Sabah (UMS) and is now a Professor of Department of Civil Engineering, Universiti Malaysia Sarawak, Malaysia. He is the inventor of few construction products. Based on 30 years of experience in teaching, professional practice and research, his vision is to be excellence in research on Innovative Construction Material and Structure.

**Book Description:** Due to a high demand in construction and furniture industries worldwide, natural resources such as stones and wood as non-renewable resources are being depleted. Thus, researchers are focusing on renewable

resources as alternative materials. As such, the utilisation of abundant solid wastes and byproducts, which are discharged from agriculture, industry and municipalities present an alternative to the conventional materials for the construction and furniture industries. These solid wastes and byproducts, when properly processed have shown to be effective and can readily meet design specifications. Agricultural solid wastes from oil palm distributors such as Oil Palm Shell (OPS) and Empty Fruit Bunch (EFB), which are abundant in agro-based countries, present an interesting alternative to the conventional aggregate in lightweight concrete and artificial plank production, respectively. At present, palm oil producing countries are Barkina Faso, Benin, Burundi, Cameroon, Central African Republic, Colombia, Costa Rica, Cte d'Ivoire, Democratic Republic of Congo, Ecuador, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea Bissau, Guinea, Honduras, India, Indonesia, Liberia, Malaysia, Mexico, Nigeria, Papua New Guinea, Peru, Republic of Congo, Senegal, Sierra Leone, Tanzania, Thailand, Togo, Uganda, Venezuela and others. In Malaysia, oil palm plantations cover over 5 million hectares, and annual production of OPS as solid waste from 450 oil palm mills is more than 6 million tons. This large amount of OPS as a renewable green aggregate can contribute to overcoming the over dependence on depletable resources for concrete production. The civil engineering projects are of a larger scale; they need sustainable materials in order to gain a greater momentum of growth. The major technical characteristics of OPS solid waste must be primarily



understood before each particular use. Therefore, there is a need to highlight the importance of OPS to be used in the construction industry.

Sustainable Buildings and Structures: Building a Sustainable Tomorrow collects the contributions presented at the 2nd International Conference on Sustainable Buildings and Structures (Suzhou, China, 25-27 October 2019). The papers aim at sharing the state-of-the-art on sustainable approaches to engineering design and construction, and cover a wide range of topics: Sustainable Construction Materials Sustainable Design in Built Environment Green and Low Carbon Buildings Smart Construction and Construction Management Sustainable Buildings and Structures: Building a Sustainable Tomorrow will be of interest to academics, professionals, industry representatives and local government officials involved in civil engineering, architecture, urban planning, structural engineering, construction management and other related fields.

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