



SESSION ABSTRACTS*

Full-Depth Reclamation Using a Cement Slurry Spreader – Attached to a Ready Mixed Concrete Truck

Gregory Halstead, Portland Cement Association

The full-depth reclamation (FDR) process, using Portland cement as a stabilizer, has been growing in use as an alternate to reconstructing failed flexible pavements throughout the western United States. This presentation will document numerous FDR with cement projects in the Salt Lake City area, and present the highlights of studies conducted by BYU. This presentation will also highlight the development of a cement slurry spreader (patent pending) which simplifies the FDR process, and allows the cement slurry to be delivered in a standard ready mixed concrete truck.

Sustainability and Concrete Pavements for Real Engineers

Peter Taylor, Ph.D., P.E.

Practicing Engineers are under increasing pressure from pavement owners to become “sustainable”. This paper provides practical guidance that includes definitions of the terminology, what can be done to make things better, where to get help to quantify improvements, and what factors to consider through the design, construction and maintenance process. The paper also introduces a short publication that has recently been completed and discusses the work underway in preparation a full “Manual of Practice” that will be functionally complete by the time of the conference. Topics include the 7 basic principles behind real sustainability and how they can be applied in everyday practice.

Evaluation of Assessment of Concrete Produced by Utilizing Treated Wastewater

Naser Alenezi

The present use of desalinated water – a subsidized commodity in Kuwait, for the preparation of concrete, indirectly imposes a heavy burden of cost on the government. There may also be shortages of water for domestic consumption in the future. Tertiary wastewater effluent from wastewater plants may be a suitable substitute for pipe-bore water. The project proposal envisaged establishment of means to use tertiary-treated wastewater as a full or partial substitute for desalinated water in concrete preparation. For this purpose, a thorough quality analysis of wastewater is to be made taking into consideration the criteria and requirements of the standard specifications for the use of water in concrete. This progress report contains the steps carried out and the results to date.

Challenges and Opportunities with using Recycled Materials in Ready Mixed Concrete

Colin Lobo, Ph.D., P.E., National Ready Mixed Concrete Association

The NRMCA sustainability initiatives establish an ambitious goal of increasing the recycled content in ready mixed concrete by 200% by 2020. The ready mixed concrete industry currently incorporates a considerable quantity of recycled material in its product but the volume percentage is rather small in comparison to competing building materials. This presentation will discuss some of the challenges and opportunities, relative to industry codes and standards, on increasing the recycled quantity in a unit volume of ready mixed concrete. Opportunities to increase the volume fraction of the recycled aggregates and mixing water and the potential impact and limitations on product performance and quality will be discussed. To achieve the stated goal, recycled content in all ingredient materials in concrete should be quantified. Incentives for achieving these goals should also be identified.

Construction and Demolition Waste used as Recycled Aggregates in Concrete: Solutions for Increasing the Marketability of Recycled Aggregate Concrete

Brett Tempest, University of North Carolina Charlotte

The use of crushed construction and demolition waste as a recycled aggregate in the production of new concrete has been successfully demonstrated by researchers as well as by practitioners in the field. However, the acceptance and utilization of recycled aggregate concrete (RAC) has not become widespread. In expanding urban areas, the intensive construction of new infrastructure, as well as rehabilitation and retrofitting of existing infrastructure, opens many potential markets for RAC produced in various grades. The goal of this study was to show that use of recycled aggregates in concrete is both economically viable and technically feasible.

Innovative Sustainable Pavement Solutions

Fares Abbo

Because natural resources used in pavement construction and rehabilitation are being rapidly depleted, decision makers are now looking for alternative paving products and construction methods that provide long service life while conserving materials and energy. Although most of the attention for sustainable development has been focused on materials and efficiency of buildings, attention is now also focused on paving materials and performance. This presentation will focus on sustainability contributions of various paving products including conventional concrete, pervious concrete, concrete overlays, roller-concrete concrete and composite pavements. Case studies will be presented to demonstrate how these products may be leveraged to conserve natural resources; reduce use of energy to mine, process, and transport new materials; provide longer pavement service life; increase recycling; maintain quality of natural water; and reduce cost of construction and maintenance.

The Influence of City Street Pavement Types on Fuel Consumption and Emissions

Siamak Ardekani, University of Texas at Arlington

Significant differences in fuel consumption and emissions rates have been observed on rigid versus flexible pavement surfaces under urban driving conditions. Fuel consumption measurements were made by driving an instrumented van over two new pavement sections, a flexible and a rigid section of two parallel city streets. The two sections were both tangent sections with identical gradients and similar roughness. All other factors that could influence fuel consumption were either controlled or kept the same during the test runs. The differences in fuel consumption rates were determined to be statistically significant at 10% level of significance for both dry and wet pavement conditions. Over the design life of a typical pavement, these differences could result in substantial differences in the total energy consumption and carbon footprints and should be considered in life cycle cost analyses of alternative designs.

Latest Strategic Advances in Green Concrete Pavement Technologies

Dan Huffman, National Ready Mixed Concrete Association

An UPDATE of the most strategic elements of the 2008 Concrete Technology Forum presentation entitled "Best Strategic Advances in Pervious Concrete Technology" this presentation will focus on the NEW advances in the strategic utilization of pervious concrete, it will also include an overview of the strategic influences upon the greater utilization of conventional concrete pavements relating to environmental and sustainability dynamics.

The Development of a Geopolymer 'Roadmap' Towards Making Geopolymer Concrete an Engineered Material

E. Ivan Diaz, Louisiana Tech University

The variability of fly ash as source material for geopolymer was investigated and statistically assessed. The results of elemental chemical analyses, X-ray diffraction (XRD) and particle size distribution (PSD) of twenty-five (25) fly ash samples are presented and used as variables for the assessment.

The Virtual Cement and Concrete Testing Laboratory: Performance Prediction and Sustainability

Jeffrey Bullard, Inorganic Materials Group

To use concrete effectively and economically, it should be optimized to meet desired performance criteria such as strength, stiffness, chemical resistance – or sustainability. A quantified service life are important factors that help determine sustainability, but there are also factors like use of alternative materials, non-

optimal materials, and recycled concrete. A NIST-led consortium of leading cement and concrete companies and associations is developing the Virtual Cement and Concrete Testing Laboratory (VCCTL), which is a performance prediction software package designed to act like a physical testing laboratory. The VCCTL vision is to computer-design concrete just like structural engineers computer-design structures.

Impacts of Green Cement Mandates

Richard Szecsy

In the last three years, multiple municipalities have chosen to pursue construction options that mandate the use of “green cement.” This “green cement” is largely (and somewhat loosely) defined by either the CO₂ or NO_x emissions per ton of clinker or ton of actual cement. The city of Dallas, Texas was the first to adopt a change to its City specifications for the requirement to use “green cement”. Their decision was based on air quality emissions attributable to cement production, not based on the actual production of concrete with those cements. Several other municipalities have followed suit by issuing city ordinances or revisions to design standards that mandate the use of a “green cement.” This paper will explore the impact of these decisions from a legal, economic, and environmental aspect. The City of Dallas specifications will be featured as an actual example.

High Performance Building Requirements for Sustainability

Stephen Szoke, Portland Cement Association

The Portland Cement Association (PCA) has developed a sample ordinance that amends and appends the International Code Council International Building Code to address high performance buildings. Key to the ordinance is the inclusion of guidelines for building structures that are more durable—resistant to fire, wind storms, flood, seismic events, hail impact, and other potential disasters. The use of these provisions results in code requirements that will provide jurisdictions with more durable, more energy efficient, safer, and more disaster resistant building while reducing the negative environmental impacts of building design and construction.

An Investigation of Nano Silica in the Cement Hydration Process

Jon Belkowitz, Lafarge North America

With the advent of nano technology, materials have been developed that can be applied to high performance concrete mix designs contributing to a more durable product that can outlast standard concrete. In this paper, relationships have been developed to distinguish the benefits when using different sizes of nano silica in cement paste. An extensive regime of experimental analysis was carried out to determine the effect of nano silica.

An Environmental Concrete for the Lehigh Cement Plant in Leeds, Alabama

Gary Knight, Heidelberg Technology Center

Lehigh Hanson, Leeds Alabama, cement plant decision to construct a new three chamber 20,000 MT silo, 240 feet tall with an 80ft diameter along with automatic truck loading. The thought of using C1157 and C989 SLAG Cement and being green, was far from anyone’s mind. To give the new silo the greenest foot print and the longest possible life cycle. The concrete proposed for the silo was 60% C1157 performance based cement with 10% interground limestone and the addition of 40% Slag with a low water cement ratio. A hundred year durable concrete can be expected with this combination of cementitious materials. The C1157 from Leeds is a Type HE, MS (High Early, Moderate Sulfate) cement. All this was proposed to the slip form contractor who had no familiarity with doing a complicated slip form with this combination of cementitious materials.

Equivalent Performance with Half the Clinker Content using PLC and SCM

Michael D.A. Thomas, FACI, University of New Brunswick

In response to growing pressures to reduce the clinker content in cement, the Canadian Standards Association (CSA A3001-08) introduced a new classification of cement in 2008, Portland Limestone Cement (PLC) containing up to 15% limestone. This paper presents data from laboratory and field studies on the properties of concrete produced with portland limestone cement (PLC) and moderate to high levels of supplementary cementing materials (SCM).

The Recycling and Reuse of Concrete

Harve Stoeck, Lafarge North America

This presentation will deal with the efforts that Lafarge North America has in the recycling and reuse of concrete and concrete related materials. It will delve into our relationship with the WBCSD and the “cement sustainability initiative” and how this has influenced Lafarge’s thinking and approach on this topic. The presentation will cover Lafarge’s experiences gleaned from its sustainability initiatives and its target setting exercises. From a practical point of view, the presentation will be discuss what Lafarge is currently doing but moreover will give the audience some insight into an innovative pilot program for recycling of left over concrete using a crib system.

Ultra High Strength Concrete Using Local Materials

Srinivas Allena, New Mexico State University

This paper presents the development of ultra high strength concrete (UHSC) using local materials. Because materials used in UHSC are often shipped long distances, the cost of these materials is often driven up. Additionally, strict requirements on the chemistry of the cement and silica fume increase the cost of commercially available, prepackaged UHSC products. The present work focused on developing UHSC mixture proportions using local materials so that UHSC may be made more affordable to a wider variety of applications. Producing this innovative material with local materials reduces the cost of the material, improves sustainability, and produces similar mechanical performance.

Insulating Light-Weight Cementitious Materials

Neal S. Berke, Grace Construction Products

In this paper, recent advances to produce lighter cementitious materials with substantially higher strength, and lower thermal conductivity (k) or higher resistance to heat flow (R) than conventional materials at the same density are presented. These light-weight materials can be pumped or poured into place. They can be used to reduce the heating and air conditioning loads of residential and commercial buildings without the use of manufactured lightweight aggregates, can provide insulation to embedded pipes. The material is green to produce in using substantially less cement per unit volume, and can incorporate recycled materials. The lighter weight reduces transportation costs.

Decreasing the Clinker Component in Cementing Materials: Performance of Portland-Limestone Cements in Concrete in combination with Supplementary Cementing Materials

R. Doug Hooton, University of Toronto

Portland-limestone cements have been used in Europe for decades and now meet EN 197 CEMIIA-L (6-20% limestone) or CEM IIB-L(21-35% limestone). In Canada, portland-limestone cements (PLC) with up to 15% interground limestone were included in CSA A3001 in 2008, and adopted in the CSA A23.1 concrete standard in 2009 (except for sulfate exposures until further data is collected). In CSA A3001, these cements have attained the same setting time and strength development performance as Portland cements. One of the initial concerns was that concrete producers would not be able to use normal levels of fly ash or slag in combination with portland-limestone cements. However, this concern appears to be unfounded and certainly with slag, PLC mixtures can actually develop better early strengths and lower permeabilities than when used with portland cements. This contribution will provide data on the impact of PLC on both the physical and durability properties of concrete made with and without slag.

Optimization of the Use of Rice Husk Ash and Other Comparable Supplementary Cementitious Materials in Cementitious Mortars

K.V. Harish, Clemson University

Rice husk ash is a sustainable supplementary cementing material that has a significantly lower carbon foot-print than comparable cementitious materials. However, its use in concrete has been limited. Among the principal reasons for the lack of widespread use of RHA in concrete is the difficulty in producing high quality RHA that is low in its unburnt carbon content and crystalline silica. Recent innovations in developing a low-carbon RHA have opened potential opportunities to embark on use of RHA as a commercial pozzolan in concrete industry. This paper presents findings from investigations conducted on RHA and other comparable reactive pozzolans such as silica fume, metakaolin and a commercial alumino-silicate glass (VCAS) to optimize their dosage level in cementitious mortars.

Multi-Parameter Study of Sulfate Attack in Blended Cement Materials

Aboozar Bonakdar, Arizona State University

In this presentation, parameters affecting the sulfate resistance of concrete are reviewed and the modifications to conventional expansion tests are discussed. The role of fly ash chemical composition on the level of damage is presented using experimental and analytical data at macro and micro scales. The results indicate that the sulfate resistance of cementitious materials is significantly influenced by the chemical composition and the transport properties of the system which can be improved by appropriate fly ash substitution. It is also demonstrated that the study of these mechanisms can be expedited using modified size specimens.

A New Approach to Managing Biodiversity/Ecosystem Services as part of RMX Companies' Sustainability Programs

Harve Stoeck, Lafarge North America

This paper will address the importance of a biodiversity/ecosystem services element in a ready mix concrete company's sustainability program. The key sections of the paper include: the designation of 2010 as the United Nation's Year of Biodiversity; the World Business Council for Sustainable Developments Focus and Ecosystem Services Program; Lafarge North America Inc's Sustainability Ambitions for Biodiversity and Community Outreach; ready mix concrete companies' use of the Wildlife Habitat Council's (WHC) programs to address biodiversity and community outreach elements of their sustainability programs; a simplified and cost effective WHC program to address RMX site specific biodiversity/wildlife habitat opportunities; set forth the process for identifying site specific wildlife habitat opportunities and cost effectively implementing them, and seeking certification of these RMX sites; set forth a WHC education program for reaching out to neighborhood schools and other stakeholders in the local community; and formalizing a WHC-NRMCA Memorandum of Understanding to help foster implementation of the WHC programs at NRMCA member companies' sites.

Effect of Order Placement on Energy Efficiency in Ready-Mixed Concrete Plants in Japan

Satoshi Fujimoto, Hiroshima University

Electric energy consumption in ready-mixed concrete plants is not distinctively big for each plant, but not negligible as a whole for their huge production amount. Therefore it is important to seek effective and acceptable ways to improve energy efficiency in concrete production process. In this paper, characteristics of energy consumption are analyzed through direct measurements of electric systems in ready-mixed concrete plants. Production and procurement data are also collected to investigate the effect of shipping/procurement timing and the types of concrete on the efficiency of electric systems. Microscopic dynamism of energy consumption is investigated to find out the ways of improving energy efficiency.

The NRMCA Sustainable Concrete Plant Guidelines: The Next Step Towards Industry Sustainability

Lionel Lemay, P.E., S.E., LEED AP, CAE, National Ready Mixed Concrete Association

The National Ready Mixed Concrete Association has set aggressive targets for reducing the concrete industry's environmental footprint. One key program to help achieve these targets is the NRMCA Sustainable Concrete Plant Guidelines. Within the Guidelines are five main categories that match the life cycle phases of concrete construction: Material Acquisition, Production, Construction, Product Use, and Reuse/Recycling. And within each category the Guidelines provide credits for meeting several different objectives including: lowering embodied energy, lowering CO₂ emissions, lowering potable water use, lowering waste created, increasing recycled content, and improving social equity. A CO₂ and energy footprint calculator is included with the Guidelines. The Guidelines discuss how to accurately measure progress towards achieving specific credits and strategies for improving the sustainability footprint. This presentation will outline the NRMCA Sustainability Initiatives and provide detail on the NRMCA Sustainable Concrete Plant Guidelines. Discussion of how these tools will be used to shape the future of concrete production will be presented.

Measuring Stormwater Quality Improvement through Pervious Concrete Paving

Michael Hein, Auburn University

Increased infiltration from pervious concrete (PC) is generally regarded as a benefit, as it mimics natural systems that sustain groundwater and stream base flows. However, less is known about the ability of PC pavements to remove pollutants associated with parking lot runoff. This presentation will review the design and installation of a field study aimed at measuring the improvement in quality of stormwater leached through a PC paving system compared with runoff from conventional impervious paving.

Pervious Concrete Filtration for Economic Removal of Metals from Various Waste Streams

Greg Majersky, Liquid Asset Development

Pervious concrete has grown in popularity as an alternative infrastructure medium to enhance the quality of surface water in developed geographical areas. Previous studies have shown that pervious concrete structures and the subgrade layer that supports them are effective at significantly reducing the concentrations of common pollutants such as soap, motor oil, brake fluid, brake dust, and roof shingle particles from rain water and snow melt. Studies thus far have shown enough promise to encourage growing use of pervious concrete in infrastructure categories such as storm channels, sidewalks and parking lots. This paper examines the use of pervious concrete to remove metals and neutralize pH from a synthetic solution simulating acid mine drainage (AMD). In addition, destructive testing of cores taken from pre-filtration and post filtration filters were used to evaluate the potential lifespan of a pervious concrete filter when exposed to the prolonged flow of polluted water.

Sediment Capture in Pervious Concrete Pavement Systems: Effects on Hydrological Performance and Suspended Solids Discharge

Luis A. Mata, Lawrence Technological University

A properly designed Pervious Concrete Pavement System (PCPS) can provide important flood control benefits by capturing and infiltrating some or all of the runoff generated on a site in a design storm. A PCPS can also provide important water quality benefits by capturing sediment in that runoff, therefore significantly reducing the quantity of suspended solids discharged into receiving waters. The need for a rational method to evaluate sedimentation effects in a PCPS prompted a study and the findings are the basis for a guide which is intended to provide engineers and other design professionals and environmental scientists, and permit-granting agencies with a methodology based on recognized principles and established data, to evaluate the likely long-term hydrologic performance of a PCPS exposed to sediments in various site specific applications. The methods described in this presentation also provide a rational estimate of the amount of total suspended solids (TSS) captured by the PCPS.

Advances in Chemical Admixture Technology and their Impact on Sustainable Concrete Construction

Mark A. Bury, BASF

Chemical admixtures have been used for decades to counteract the challenges of the natural environment on production, placement, finishing, curing, and performance of concrete. By preventing the effects of freezing on concrete, novel accelerating admixtures allow concrete to be placed in extremely cold temperatures reducing energy during construction. Likewise, anti-washout admixtures use robust chemistry to resist washout of cement and other fines in underwater concrete placement helping to protect aquatic life and achieve the desired strength. Today, as the industry calls for improved environmental sustainability of concrete, new admixture chemistries are being developed to address this emerging demand. This presentation will discuss the various ways in which new advances in admixture technology are able to further maximize concrete performance, service life and resource efficiency, while minimizing the ecological impact of concrete production. Test data and case study examples will illustrate how the right admixture selection and combinations, tailored for the specific concrete mixture, can help producers, contractors and engineers achieve environmentally preferable and cost-effective concrete.

Impact of Chemical Admixtures to Modify the Rheological Behavior of Cementitious Systems Containing Manufactured Aggregates

Ara Jeknavorian & Eric Koehler, Grace Construction Products

The use of local materials is an important part of sustainability for the concrete industry. The declining availability of aggregate resources in many areas has the potential to result in the use of alternative

aggregates of lower quality, which can result in higher cementitious materials contents, or the use of aggregates shipped from greater distance. In some markets, manufactured sands are taking the place of natural sands, which can adversely impact the rheology of cementitious mixtures. The use of certain chemical admixtures has been found to often minimize the need to increase cement and water contents in order to overcome the loss of workability that can accompany aggregate sources which feature flat, elongated, angular, and rough particles. In this study, a wide range of natural and manufactured sands, characterized for gradation, mineralogy, shape, texture, and cleanliness were evaluated for their effect on mortar rheology with polycarboxylate (PCP) and viscosity modifying type chemical (VMA) admixtures.

Optimizing Concrete's Sustainability Through the use of Lightweight Aggregate

John Reis, Expanded Shale, Clay and Slate Institute

Lightweight aggregate plays a vital role in today's move toward a sustainable environment. Discover how lightweight concrete provide value in sustainable construction and hear how new insights and practices can extend the service life of concrete pavements and bridges, and lower the overall carbon foot print of a structure. Learn the latest on suspended floor drying rates and how the use of lightweight aggregate contributes to LEED, improves the energy performance of building, enhances green roofs and how Lightweight aggregate fines qualify as a recycled material. The use of lightweight aggregate provides strategies to improve concrete performance, reduce life-cycle costs and reduce environmental impacts of production, transport and construction.

Laboratory Evaluation of Abrasion Resistance of Latex-Modified Pervious Concrete

Baoshan Huang, Ph.D., P.E., University of Tennessee

Pervious Portland cement concrete has been increasingly used to reduce the amount of runoff water and improve the water quality near pavements and parking lots. However, due to the relatively low strength and abrasion resistance associated with high porosity, pervious concrete cannot be routinely used as load-bearing pavement surface without further treatments. The application of pervious concrete is limited to squares, footpaths, parking lots, and paths in parks. This presentation reports on the findings from a laboratory study in which the abrasion resistance of pervious concrete was improved with the addition of low dosage of polymer. The polymer and the cement hydration products commingle and create two interpenetrating matrices, resulting in improved material properties.

Pervious Concrete Specifications: Technology, Testing, and Trends

Matthew Offenberg, Grace Construction Products

As the technology behind pervious concrete rapidly grows and changes, specifications are quickly adapting to keep up with this dynamic landscape. The art of mixture proportioning is maturing, leading designers to be more advanced in their specifications. Test methods are being incorporated into projects, allowing the community to see what works and what needs refinement. And, designers are finding new and innovative ways to integrate pervious concrete into their projects. This presentation will discuss the state of the technology, and examine specific projects where these trends lead to success or failure of pervious concrete.

Integrating Structural and Hydrologic Design Considerations in Permeable Pavement

David R. Smith, Interlocking Concrete Pavement Institute

This paper explains and compares published structural and hydrological design methodologies for permeable interlocking concrete pavement, pervious concrete and porous asphalt. The paper further demonstrates how hydrological and structural designs are integrated. State of the art software design tools are explained for permeable interlocking concrete pavement for use by design professionals and stormwater agencies. These include hydrological models combined with the empirical structural design approach in the AASHTO 1993 Guide for Design of Pavement Structures. The paper demonstrates the need for data to accomplish mechanistic design to support such programs as the Green Highway Partnership, as well as efforts by state and local agencies to implement permeable pavements as the norm for selected applications.

LCA of Cement-Based, Polymer-Based, and Natural Stone Architectural Finish Materials

Russell Gentry, Georgia Institute of Technology

Solid-surface materials used as countertops, flooring, and wall tiles can be made from natural stone (typically granite), cement-based composites, and polymer-based composites. This paper reviews the environmental impact of these materials, compared on a functionally-equivalent basis, using the Life Cycle Assessment (LCA) methodology. For granite materials, the effects of material source (U.S., Europe, South America) are included in the LCA. For cement-based composites, the effect of product depth and reinforcement are considered, as it is difficult to achieve the 30 mm depth common to other systems, with cement-based composites. Practical application of the methodology, in the context of an architectural practice in the Southeastern United States (as a location for product end use) is considered and the tools used for this product-based LCA are reviewed as part of the presentation.

The New Indianapolis Airport Parking Garage - Sustainable Concrete to Produce a 70-year Design Life

Tony Kojundic, Silica Fume Association

The Indianapolis Airport planners wanted a parking structure that would contribute to the LEED certification of the new midfield terminal, and incorporated supplementary cementitious materials (SCMs) to replace a portion of Portland cement and the corresponding CO₂ impact from its production. A high-performance concrete (HPC) mixture used in previous parking projects was selected as a starting point. The Life-365, service life and life cycle model was used to estimate the projected service life. The contractor then modified the mixture to enable post-tensioning in 1d and flying the forms to fast-track construction over the 16-month period. The parking garage designers also incorporated the HPC strength in the building design. This presentation will describe how the owner, designer, and contractor benefited from using HPC on this 'under-budget' parking project, the LEED credits received, and the software tools used by the planners and contractor.

The Use of LCA in LEED 2009

Erin Ashley, Ph.D., LEED AP, National Ready Mixed Concrete Association

In the first ever version of LEED to utilize Life Cycle Assessment (LCA), LEED 2009 has implemented a pilot credit (as of November 2009) which provides up to 5 points and an additional 2 LCA innovation points for the analysis of structure and envelope assemblies with the use of LCA. This presentation will review this new and unique credit within the LEED 2009 system and will introduce the "USGBC Credit Calculator" used to perform the LCA analysis. A review of the background literature and a discussion on concrete's performance in this calculator will be provided.

Characterizing the Impact of Concrete in an Overall Building Framework: The Promise of Whole-Building LCA

Surabhi Joshi, Georgia Tech

As the construction industry places an increased emphasis on sustainability, building practitioners seek more comprehensive methods to evaluate and reduce the industry's environmental impacts. Life Cycle Assessment (LCA) has emerged as one of the most capable tools to aid in this evaluation. New LCA methods and tools allow the assessment of whole-building impacts during its life-cycle, allowing us to quantify the role that cement and concrete play in these impacts. This research reviews case-studies of use of whole-building LCA in practice in the US and the state of the tools used to complete whole-building LCA. The review shows that there are significant obstacles in the integration of LCA in design practice. Nevertheless, improvements in the tools and integration with technologies like Building Information Modeling (BIM) and Energy Modeling are making LCA more feasible.

Sensitivity Analysis in the Life Cycle Assessment (LCA) of Concrete and Asphalt Pavements

Alex Loijos, Massachusetts Institute of Technology

The goal of the present LCA study is to provide a comparison between one square meter (the functional unit) of the two most common broad categories of pavements: concrete and asphalt, in a robust manner that considers scenarios of using recycled material inputs, varying traffic loads, and varying climatic conditions, and further, considers different common pavement subtypes appropriate for a variety of engineering design decisions. The goal is also to employ the most recent and thorough data for the subtypes chosen for analysis and the materials, energy, and emissions life cycle inventory data. The

study will provide a critical overview of the LCA methodology as applied to paving and the sensitivity of the results to the initial assumptions will be demonstrated for a variety of scenarios.

Development of Sustainable and Multi-Functional Inorganic Polymer Coating Material for Restoration and Protection of Constructed Concrete Infrastructure as well as New Structures

Felix Achille, Green World Crete Inc.

The innovation of the proposed study is the development of a new multi-functional sustainable aluminosilicate-based cementitious inorganic polymer coating material derived from post-industrial waste products such as fly ash and slag and natural sources such as volcanic ash, kaolinite clay using different inorganic and organic activators. The performance of the new inorganic polymer multi-functional coating, that can be applied using any of the usual coatings application routes, will be evaluated for exposure to different environmental conditions. The experimental results from macro-level physical tests will be correlated with those from micro-level infrared spectroscopy, IR, for various mixtures of activators and green cementitious materials. The performance of the multi-functional material will be evaluated under a range of harsh environmental conditions for a variety of purposes, specifically as a protective coating for concrete, coating for rebar, and as a repair material.

Recycling Carbon Dioxide into Concrete – A Feasibility Study

Yixin Shao, McGill University

Concrete has long been known to possess the ability to absorb atmospheric carbon dioxide. This capacity can be utilized in the early stages of concrete production to consume carbon dioxide in a beneficial manner. For applications without reinforcing steel, the carbonated concrete can perform better in terms of strength and durability. The feasibility of recycling carbon dioxide into the curing process of concrete was investigated. The CO₂ uptake capacities of four commonly used cement based building products: masonry block, paving stone, cement board and fiberboard, were evaluated. The proposed process offers a feasible method of safe and permanent sequestration of carbon dioxide in manufactured concrete products. With low energy consumption and high gain in performance, carbonation curing technology offers a promising tool for the cement and concrete industry to directly reduce its carbon footprint.

Carbon Efficient Construction - Why Carbon Accounting is Key to the Next Generation of the Built Environment

Phil Williams, P.E., LEED AP

This paper reviews the strategic importance of using carbon modeling to create more sustainable buildings. It covers Webcor's multi-year journey from measuring direct emissions to making carbon assessment an integral part of every project, and how that journey has evolved to a long-term strategy for continuous improvement and innovation. It also provides an overview of the science required to make estimates of the carbon impact of all material components and the approach that iterates repeatedly to refine those numbers down to the specific supplier level including structural, envelope, interior and MEPS building elements.

* Subject to change.

