Schedule: General Session G01.1 – May 20, 8:00-10:00
Presenter: Craddock, Frank
Title: The Strategic Opportunities of Sustainable Development
Author(s): Frank Craddock
Abstract: Sustainable development and the green building movement are beginning to shape the way we build. The concrete industry can play a major role in sustainable development. This presentation will outline the strategic opportunities of promoting green building and how the concrete industry can take a lead role in moving towards sustainable construction practices.
Presentation Length: 30 minutes

Schedule: General Session G01.2 – May 20, 8:00-10:00
Presenter: Horst, Scot
Title: A Utopian Vision of Concrete
Author(s): Scot Horst
Abstract: Utopia is not a place that exists. And yet establishing a vision of what a perfect would looks like can provide direction and innovation that we might not create if we only see our situation from our current perspective. Through the lens of sustainability this talk will review where the concrete industry is today and will take individual components of the industry in order to project possible scenarios for where the industry might be in the future and what it might specifically look like in a perfectly utopian world.
Presentation Length: 45 minutes

Schedule: General Session G01.3 – May 20, 8:00-10:00
Presenter: Deane, Michael
Title: A Contractors View of Sustainable Development
Author(s): Michael Deane
Abstract: This presentation will present the experiences of Turner Construction on green building projects. It will provide ideas for improving the construction process to minimize environmental impact. Case studies will be provided.
Presentation Length: 45 minutes

Schedule: General Session G02.1 – May 22, 10:30-12:00
Presenter: Li, Victor
Title: Bendable Concrete for Sustainable Infrastructure
Author(s): Victor Li
Abstract: Research on greening concrete with recycled material, concrete material durability, concrete structural durability and infrastructure sustainability have been growing over time. In most circumstances, these four areas of research are conducted in separate research communities. In this presentation, a new research paradigm is proposed which logically connects these areas of inquiries on a coherent platform. Specifically, an ultra ductile fiber reinforced cement based composite material is used to illustrate strategies for material greening, while simultaneously enhancing crack control and service life extensions in structures. Life cycle assessment results of a bridge deck using such a material confirm that significant savings in primary energy, and reductions in global warming potential and solid waste production can be achieved.
Presentation Length: 40 minutes

Schedule: General Session G02.2 – May 22, 10:30-12:00
Presenter: Roumain, Jean-Claude
Title: Sustainability through People, Process and Product Innovation
Author(s): Jean-Claude Roumain
Abstract: This presentation will demonstrate how the concrete industry must achieve sustainability through people, process and product innovation. Technology can play a crucial role in the efficient use of our natural resources and the effective substitution of byproducts or waste from other industries. We must educate architects, engineers, contractors and specifiers about the value and benefits of cement and concrete, and the new performance standards that can help minimize environmental impact. We must continually improve the delivery, quality, ease of placement of concrete. We must continually improve the product and its application to meet the ever increasing expectations of our customers. As an industry we have a responsibility to keep in balance the two most important needs of society: building an infrastructure to support our desired standard of living, while insuring the protection of our environment, and the efficient use of our natural resources.
Presentation Length: 40 minutes

Schedule: Technical Session T01.1 - May 20, 10:30-12:00
Presenter: Lemay, Lionel
Title: Concrete and Climate Change
Author(s): Lionel Lemay
Abstract: Sustainable development, green building, and in particular climate change, are now a fact of life. Corporations in every industry are increasingly being shaped by their customers' demand to be more environmentally responsible. Government regulations to limit environmental impact of manufacturing will continue to place pressure on corporations to improve environmental performance. Environmental performance, including the reduction green house gas emissions, will be increasingly monitored and regulated. In the near future, individual companies will compete on lowest environmental impact and most likely on carbon foot print. Companies who ignore these challenges (or opportunities) will lose. Those not able to adapt to these changes simply will not survive. This presentation will outline the current state of concrete as it relates to climate change and in particular carbon dioxide emissions.
Presentation Length: 30 minutes

Schedule: Technical Session T01.2 - May 20, 10:30-12:00
Presenter: Cooper Carter, Kristin
Title: The Industry's Role in Ensuring and Promoting Sustainable Development
Author(s): Kristin Cooper Carter
Abstract: As part of a coordinated global effort, the cement industry is enhancing sustainability by improving how cement is made and how cement and concrete are used. By improving energy efficiency and reducing emissions, and the use of virgin material in manufacturing, the industry can minimize any negative environmental impacts. Meanwhile, the industry is advancing the use of concrete and other cement products to create energy efficient buildings and pavements. The positive effects of reducing energy use in the general population can dramatically outweigh the diminishing impact of the cement manufacturing process. These efforts and opportunities must be actively promoted to ensure the selection of concrete as a green building product. The cement and concrete industries, together with a network of academic institutions, are increasingly engaged in educational and promotional activities to spread the word that concrete is an important building block of a sustainable future.
Presentation Length: 30 minutes

Schedule: Technical Session T01.3 - May 20, 10:30-12:00
Presenter: Ashley, Erin
Title: Comparison of Green Building Rating Systems
Author(s): Erin Ashley
Abstract: The green building movement continues to gain momentum as developers, government agencies, and designers build structures to minimize environmental impact. To take full advantage of this movement and be a participant in the process, the ready mixed concrete industry must have a detailed understanding of the design concepts and guidelines detailed in the current green building rating systems. This presentation will attempt to provide a comparison and overview of several popular green building rating systems such as: Leadership in Environmental Energy and Design (LEED), Green Globes, National Association of Homebuilders National Green Building Standard, and Environmental Protection Agency Energy Star Program.
Presentation Length: 30 minutes

Schedule: Technical Session T02.1 - May 20, 10:30-12:00
Presenter: Palmer, William
Title: The Many Uses of Recycled Concrete
Author(s): William Palmer Jr. and Paul Newman
Abstract: Concrete is the penultimate material for recycling, sine every part can be reused in a myriad of ways, from road base to high quality fill to landfill cap. And, with the right base concrete, recycled concrete makes an outstanding aggregate for making new concrete. At the now-closed Stapleton airport in Denver, concrete made with aggregate of recycled concrete was used to build new homes and businesses in areas that once were runways. This talk will cover that project and other recent recycling efforts.
Presentation Length: 30 minutes

Schedule: Technical Session T02.2 - May 20, 10:30-12:00

Presenter: Givan, Rick

Title: Techniques of Recycling Demolished Concrete and Asphalt into Specification Aggregates for Re-use

Author(s): Rick Givan

Abstract: This presentation will explain the types of aggregate products that can be produced from concrete rubble and their reuse applications. Product specifications standards and the production process will also be discussed, as well as the types of equipment that is used to recycle the concrete into specification aggregates. Urban quarry concept as well as urban aggregate resources, and focuses on three case studies: the recycling of Stapleton International Airport in Denver, Colorado; the recycling of the El Toro Marine Air Base in Irvine, California; and recycling on a Colorado DOT project along I-70 will be presented. Environmental and sustainability benefits of recycling concrete will be outlined.

Presentation Length: 30 minutes

Schedule: Technical Session T02.3 - May 20, 10:30-12:00

Presenter: Razaqpur, Ghani

Title: The Key to the Design and Production of High Quality Structural-Grade Recycled Aggregate Concrete

Author(s): G. Fathifazl, A.G. Razaqpur, O.B. Isgor, A. Abbas, B. Fournier and S. Foo

Abstract: In this presentation, the fallacy that concrete, be it plain or reinforced, made with coarse recycled concrete aggregate (RCA) has inherently inferior short- and long-term properties, is demonstrated. This has been achieved by examining the fundamental principles that govern the mechanical and physical properties of composite materials and structures. The outcome of that examination is a novel mix proportioning method for concrete made with coarse recycled concrete aggregate, in which RCA is treated as a two-phase material comprising mortar and natural aggregate (NA); and the residual mortar in RCA is considered as part of the total mortar (fresh plus residual mortar) in the mix. It is demonstrated by testing an extensive number of specimens that the proposed method would result in the production of high quality structural-grade concrete, with predictable fresh and hardened properties (i.e., slump, fresh and hardened density, elastic modulus, compressive strength, stress-strain relationship, creep and shrinkage) comparable to similar concrete made with fresh natural aggregates.

Presentation Length: 30 minutes

Schedule: Technical Session T03.1 - May 20, 1:30-3:00

Presenter: Ashley, Erin

Title: Environmental Life Cycle Assessment

Author(s): Erin Ashley

Abstract: Environmental life cycle assessment (LCA) is the investigation and valuation of the environmental impacts of a given product, process or service. The term 'life cycle' refers to the “cradle to cradle” assessment including all phases of a products existence including raw material extraction, manufacture, assembly, distribution, use and disposal/recycle/re-use including all intervening transportation steps. This presentation will provide a brief overview of the concept of LCA and its potential future use in evaluating construction products and projects.

Presentation Length: 30 minutes

Schedule: Technical Session T03.2 - May 20, 1:30-3:00

Presenter: Nielsen, Claus V.

Title: Carbon Footprint of Concrete Buildings Seen in the Life Cycle Perspective

Author(s): Claus Nielsen

Abstract: The primary environmental indicator is CO2 footprint when concrete is assessed due to its impact on the global climate change. However, even though concrete is known to have a relatively high CO2 emission during production it is of paramount importance to include the service life of buildings as well as the secondary life after demolition and recycling. The presentation will demonstrate these issues through examples where the benefits of heavy building materials are illustrated. The high thermal inertia of concrete is used to improve the energy performance of buildings with improved thermal comfort as a result. After demolition concrete is typically crushed into smaller fractions, which may be utilized as fill material in road construction or in back-fill applications. The exposure to atmospheric air means that the concrete rubble absorbs CO2 during the carbonation process. This is a process that actually improves the carbon footprint of concrete over a certain period of time.

Presentation Length: 30 minutes

Schedule: Technical Session T03.3 - May 20, 1:30-3:00

Presenter: Marceau, Medgar

Title: A Comparative Life Cycle Assessment of Three Types of Residential Construction

Author(s): Medgar Marceau and Martha VanGeem

Abstract: This presentation will discuss the results of a life cycle assessment (LCA) comparing the environmental impacts of three types of single-family houses: wood, concrete masonry, and insulating concrete forms (ICF). The LCA shows that the most significant environmental impacts in single-family housing are from the production and household use of electricity and natural gas. The LCA was carried out in accordance with the international standard ISO 14044. The LCA includes the energy, materials, and emissions from material extraction, manufacturing and construction along with occupancy, including heating and cooling energy use and maintenance over a 100-year life.

Presentation Length: 30 minutes

Schedule: Technical Session T04.1 - May 20, 1:30-3:00

Presenter: Cooper Carter, Kristin

Title: Making Sustainability Work for You: How your Company can Benefit from This Movement

Author(s): Kristin Cooper Carter, Kim Wier and California State University Chico students

Abstract: Graduate and undergraduate students participated in a campus wide sustainability audit on the California State University, Chico campus. They conducted the information gathering, data collection and writing of a report that was presented to campus administrators. This report resulted in significant changes to the way the university conducts its day-to-day business. The findings of this study highlighted several ways for the campus to save money and become more earth-friendly. This process has since become a model for the City of Chico. The City has recently hired our university to conduct a carbon footprint assessment of their activities. The City is motivated to identify where their main carbon issues reside. The concrete and cement industries are under tremendous strain to reduce their emissions. Is it possible to create partnerships to address these issues in a win-win manner?

Presentation Length: 30 minutes

Schedule: Technical Session T04.2 - May 20, 1:30-3:00

Presenter: Wang, Kejin

Title: Utilizing Deconstructed Masonry Materials as Recycled Aggregate in Concrete

Author(s): Kejin Wang, Jiong Hu and James Gaunt

Abstract: A study has been conducted to establish a rational method for proportioning concrete containing aggregate recycled from deconstructed old masonry buildings. Four different types of masonry materials (concrete blocks and clay bricks) and two different kinds of cement (portland cement and calcium sulfoaluminate cement) were selected for this study. The basic properties, such as specific gravity, absorption, and gradation, of the crushed masonry materials were evaluated. Three different water-to-cement ratios and three aggregate-to-cement ratios were considered to produce concrete mixtures with three different levels of workability. Compressive strength of all concrete mixes was tested at 3, 7, and 28 days. Although having lower than the strength of concretes made with natural aggregate, the strength of concrete containing deconstructed masonry materials as aggregate is sufficient for being used in local street, parking lot, foundation, and sometime in highway pavement construction.

Presentation Length: 30 minutes

Schedule: Technical Session T04.3 - May 20, 1:30-3:00

Presenter: Neithalath, Narayanan

Title: Durability Characteristics of Concretes Containing Fine Glass Powder

Author(s): Nathan Schwarz and Narayanan Neithalath

Abstract: This study aims at evaluating the durability characteristics of concretes made with fine glass powder as a cement replacement material and compares its properties to Class F fly ash modified concretes. One set of concretes with glass powder and fly ash replacing 10% of cement by mass was proportioned with a water-to-cementing materials ratio (w/cm) of 0.40, while in the other set, the w/cm was adjusted to produce concretes having the same workability as the control mixture. The durability characteristics evaluated were the rapid chloride permeability (ASTM C 1202), moisture transport characteristics, and alkali-silica reactivity (ASTM C 1260). It was observed that, at all ages studied, the chloride penetration values of the glass powder modified mixtures were lower than that of the control mixture, and were comparable to those of fly ash modified concretes. Since the glass powder has high alkali content, the potential of increased expansion due to alkali-silica reaction was studied.

Presentation Length: 30 minutes

Schedule: Technical Session T05.1 - May 20, 3:30-5:00

Presenter: Pool, Vance

Title: Reducing the Effect of Heat Islands Utilizing Concrete

Author(s): Vance Pool

Abstract: This presentation will provide an introduction to the concept of the urban heat island effect. It will provide background information on NASA research on heat islands. The presentation will explain how concrete can be used to minimize urban heat islands including parking areas, streets, and building cladding. Green roofs will also be discussed.

Presentation Length: 30 minutes

Schedule: Technical Session T05.2 - May 20, 3:30-5:00

Presenter: Marceau, Medgar

Title: Solar Reflectance of Concretes for LEED® Sustainable Sites Credit: Heat Island Effect

Author(s): Medgar Marceau and Martha VanGeem

Abstract: Portland cement concrete can reduce heat islands and minimize the impact buildings have on the environment. A recent study shows that concretes typically used in the US have a solar reflectance index (SRI) that meets the criteria of the LEED® Sustainable Sites Credit for reducing heat islands. This presentation will describe the results from measuring the solar reflectance of 45 concretes that represent the range of concrete and concrete constituents typically used in exterior flat work in the U.S. The concrete constituents consist of six portland cements, six fly ashes, three slag cements, four fine aggregates, and two coarse aggregates. While all materials were tested, more concrete mixes were made with the darker material combinations, that is, those most likely to fail the LEED® criteria. Test specimens were proportioned, mixed, fabricated, and finished like typical exterior flatwork. Replacement levels of 25% for fly ash and 45% for slag cement were chosen because they are commonly used substitution levels for portland cement.

Presentation Length: 30 minutes

Schedule: Technical Session T05.3 - May 20, 3:30-5:00

Presenter: Haselbach, Liv

Title: Preliminary Field Testing: Urban Heat Island Impacts and Pervious Concrete

Author(s): Liv Haselbach and Allen Gaither

Abstract: The urban heat island (UHI) effect is a phenomenon where the air temperature surrounding an urban, or metropolitan area, is significantly higher than surrounding areas. Pervious concrete may help reduce the local effects of UHI in several ways, two of which are studied here. First, pervious concrete has a relatively light color with a higher solar reflectance, or albedo, than darker pavements such as asphalt, although it may have a darker color or higher albedo due to the uneven surface and mix characteristics than other concretes. Secondly, the open pore structure means pervious concrete may be less efficient at storing and transferring heat than other typical paving materials. This research focuses on initial investigations into the albedo and thermal conductivity properties of pervious concrete relative to standard concrete and asphalt pavement.

Presentation Length: 30 minutes

Schedule: Technical Session T06.1 - May 20, 3:30-5:00

Presenter: Lobo, Colin

Title: Reuse of Plastic Returned Concrete and Wash Water

Author(s): Colin Lobo

Abstract: The common practice in the industry is to order excess concrete to account for contingencies. Additionally there are rejected loads. The average returned concrete amounts to 2-10% at ready mixed concrete plants. Truck wash-out results in 50-200 gallons of water per truck. This presentation will discuss the options for reusing plastic returned concrete, what the specifications permit and provide some research results on the impacts of concrete properties when reusing plastic returned concrete and wash water in new batches of concrete. The impacts, challenges and benefits to sustainable concrete production and construction will be outlined.

Presentation Length: 30 minutes

Schedule: Technical Session T06.2 - May 20, 3:30-5:00

Presenter: Obla, Karthik

Title: Crushed Returned Concrete as Aggregates for New Concrete

Author(s): Karthik Obla

Abstract: Every year, it is estimated that 2-10% (average of 5%) of the estimated 455 million cubic yards of ready mixed concrete produced in the U.S. (est. 2006) is returned to the concrete plant. A research project was undertaken by the NRMCA Research Laboratory to study the use of crushed returned concrete, referred as crushed concrete aggregate (CCA), as a portion of the aggregate component in new concrete. Demolishing old concrete structures, crushing the concrete and using the crushed materials as aggregates is not new and has been researched to some extent. This material is generally referred as recycled concrete aggregates (RCA). However, RCA is different from CCA as construction debris tends to have a high level of contamination (rebar, oils, deicing salts, and other building components). CCA on the other hand is prepared from concrete that has never been in service and thus likely to contain much lower levels of contamination. This presentation summarizes the key findings from the 20 month study.

Presentation Length: 30 minutes

Schedule: Technical Session T06.3 - May 20, 3:30-5:00

Presenter: Kim, Haejin

Title: Internal Curing with Crushed Returned Concrete Aggregates for High Performance Concrete

Author(s): Haejin Kim and Dale Bentz

Abstract: High performance concrete (HPC) requires a low water-to-cementitious materials mass ratio (w/cm), often with the inclusion of supplemental cementitious materials such as silica fume in the mixture, thus necessitating the use of a superplasticizer. Because of the low w/cm and rapid reaction at early ages, proper curing from the earliest time possible is very essential in HPC. Internal curing has been developed and demonstrated to substantially reduce autogenous shrinkage and minimize early-age cracking of HPC. In 1991, Philleo suggested this new concept of "water-entrained" concrete with the addition of saturated lightweight fine aggregates (LWAS) as a remedy to provide an internal source of water to offset the chemical shrinkage that occurs during hydration of the paste. However, the use of LWAS may not be cost effective which brings attention to exploring crushed returned concrete aggregate (CCA) as a cost effective internal curing material. In this investigation, CCAs in the low (1000 psi), medium (3000 psi) and high strength (5000 psi) range were prepared for evaluation as internal curing agents.

Presentation Length: 30 minutes

Schedule: Technical Session T07.1 - May 21, 8:00-10:00

Presenter: Huffman, Dan

Title: Best Strategic Advances In Pervious Concrete Technology

Author(s): Dan Huffman

Abstract: This presentation seeks to generate increased understanding and enthusiasm for pervious concrete by advising on progress taking place by various organizations and individuals connected to noteworthy projects and strategies moving the technology forward. The projects to be presented are either completed or in the pipeline and in one very special case, located outside the U.S. Utilization of pervious concrete on LEED® projects will be a special focus. A brief overview of user motivations will be presented as well as some insight into the specific needs for supportive research and documentation necessary for expanded promotion. Available industry resources for general informational and promotional purposes will also be presented. A state of the art report on where the industry is with this technology on a mostly strategic basis and incorporating technological advances as well because of their effect on over-all strategic positioning.

Presentation Length: 60 minutes

Schedule: Technical Session T07.2 - May 21, 8:00-10:00

Presenter: Buffenbarger, Julie

Title: Pervious Concrete Pavement Hydrological Design Considerations and Methods

Author(s): Julie Buffenbarger

Abstract: Urbanization significantly alters the hydrology of a watershed as residential and commercial development leads to an increase in impervious surfaces. By utilizing site design techniques that incorporate on-site storage and infiltration and reductions in the amount of directly connected impervious surfaces, the amount of runoff generated from a site can be significantly reduced. Pervious concrete pavement, an EPA best management practice (BMP) for the management of stormwater and prevention of pollution from stormwater runoff, allows storm water to filter through, and into the underlying soils or recharge beds that act as retention areas. The open cell structure filters pollutants from untreated runoff discharging into storm sewers, rivers, and streams. The design robustness of pervious concrete systems is dependent upon properly engineered hydrological design parameters, including the amount of rainfall expected, pavement characteristics and underlying soil properties. Proper design of these parameters will be discussed.

Presentation Length: 30 minutes

Schedule: Technical Session T07.3 - May 21, 8:00-10:00
Presenter: Marks, Andrew
Title: Design of Pervious Portland Cement Concrete Pavement – How Important Is Strength?
Author(s): Andrew Marks
Abstract: This presentation examines the relative importance of quantifying compressive and flexural strengths in the construction and structural design of pervious pavements. The hypothesis put forward is that conservative design procedure is cost effective and reliable without strength data as a control or acceptance parameter, and advocates use of ACI 522 specification.
Presentation Length: 30 minutes

Schedule: Technical Session T08.1 - May 21, 8:00-10:00
Presenter: MacDonald, Kevin
Title: High Performance/High Pozzolan Concrete in Practice
Author(s): Kevin MacDonald
Abstract: The use of recycled materials in concrete is often seen as a compromise between a reduction in newly manufactured materials and the quality of the concrete. This view is often mistaken. Concrete can be made with large quantities of recycled materials and have performance which exceed that of concretes made with virgin materials. The paper will discuss high performance concrete in Minnesota which contains significant replacement levels of recycled materials. The focus will be on concrete in production, not only laboratory programs. Problems and solutions arising from practical applications will be discussed for concretes used in bridges, tunnels, parking structures and high-rise, fast-track construction.
Presentation Length: 30 minutes

Schedule: Technical Session T08.2 - May 21, 8:00-10:00
Presenter: Shilstone, Jay
Title: Traditional Concrete Design Impediments to Sustainable Concrete
Author(s): James Shilstone, Jr.
Abstract: The concrete industry has traditionally been slow to change, both on the design side and the construction side. Tried and true methods are passed from one project to the next, sometimes with little understanding of the true needs of the new project with respect to the capabilities of the old process. Traditional design criteria, such as minimum cement contents, maximum slumps, maximum w/c and the inclusion of non-essential air entrainment requirements increase the demand for cement and impact the carbon footprint of the completed structure. Concrete performance can be achieved in many ways. Various methods of achieving concrete performance characteristics are discussed in this presentation.
Presentation Length: 30 minutes

Schedule: Technical Session T08.3 - May 21, 8:00-10:00
Presenter: Hansen, Marion
Title: Development of High Volume Fly Ash Concrete
Author(s): Marion Hansen, Brian Phillips, David Tullis, Andy Baker, and Munkhzul Distabazar
Abstract: This project developed high volume fly ash concrete (HVFAC) containing 50% fly ash by weight of the cementitious material. Phase I included an extensive investigation into the chemical durability problems of alkali-silica reactivity (ASR) and sulfate attack using Ben French fly ash (BFFA) mortar. Replacing up to 40% cement with BFFA produced mortar with acceptable ASR and sulfate resistance when tested per ASTM C 1260 and 1012. Phase II of the project tested concrete containing BFFA for strength development and time of set. This research showed that acceptable concrete could be made with BFFA up to the 25% replacement level. Phase III included tests on HVFAC using the BFFA for strength development and time of set. It showed that acceptable concrete could be made with BFFA in the 30-60% replacement range. Phase IV of the project performed a rigorous examination of both mortar and concrete at the 50% replacement level.
Presentation Length: 30 minutes

Schedule: Technical Session T08.4 - May 21, 8:00-10:00

Presenter: Bühler, Eckart

Title: High Percentage Recovered Mineral Component [Silica Fume] in Cement and Concrete for Extreme Concrete Exposure and Exceptional Concrete Durability Applications

Author(s): Eckart Bühler

Abstract: EPA has designated silica fume, a very fine dust-like material generated during alloyed metal production, as a recovered mineral component (RMC) that functions as a concrete additive to increase strength and durability. Silica fume has been widely utilized in the U.S. for the past quarter century in the ready mixed concrete industry. It is now universally known for its contributions to high performance concrete (HPC), primarily for applications of high strength-, high modulus of elasticity-concrete as well as providing low permeability concrete characteristics offsetting the accelerating properties of chloride-induced corrosion. This presentation will focus on the lesser known benefits of silica fume utilized at high addition rates from 15-25% (by the weight of cement) for applications in the heavy industrial sector. Abrasion, impact and chemical resistance are some of the durability issues addressed.

Presentation Length: 30 minutes

Schedule: Technical Session T09.1 - May 21, 10:30-12:00

Presenter: Offenberg, Matthew

Title: Development of a Test Method for Assessing the Surface Durability of Pervious Concrete

Author(s): Matt Offenberg and Michael Davy

Abstract: One of the key concerns with pervious concrete is the material's surface durability, specifically resistance to raveling. This study took lab cast cylinders and compared the raveling resistance of pervious concrete mixtures using different aggregates, varying cement contents, and basic chemical admixtures. The results will provide the industry with beginning correlations between basic mix ingredients, and the surface durability of a finished pervious concrete pavement.

Presentation Length: 30 minutes

Schedule: Technical Session T09.2 - May 21, 10:30-12:00

Presenter: Schaefer, Vernon

Title: A Retrospective Look at the Field Performance of Iowa's First Pervious Concrete Sections as of Spring 2008

Author(s): Vern Schaefer, John Kevern and Kejin Wang

Abstract: Starting in 2004, the Iowa Concrete Paving Association (ICPA) and the Iowa Ready Mixed Concrete Association (IRMCA) sponsored research at Iowa State University (ISU) to determine if pervious concrete could be made to withstand the climate in the Northern U.S. During the first laboratory phase, freeze-thaw durable mixture designs were developed using aggregate types and gradations readily obtainable to the IRMCA members. The ISU mixture designs were then used in test pours and commercial placements across the state. This presentation describes the performance of the first five significant pervious concrete placements in Iowa including a total of 14 different mixture designs. The initial laboratory determined properties are presented including freeze-thaw durability testing. During the spring of 2008 the field performance of each of the sites was measured by a condition survey and field permeability compared with the original values. The results show that all sections are performing well with no observable freeze-thaw deterioration of the concrete paste.

Presentation Length: 30 minutes

Schedule: Technical Session T09.3 - May 21, 10:30-12:00

Presenter: Kevern, John

Title: A Synthesis of Pervious Concrete Freeze-Thaw Testing Results

Author(s): John Kevern, Kejin Wang and Vern Schaefer

Abstract: Since late 2004, Iowa State University has been investigating all aspects of pervious concrete, but none so much as freeze-thaw durability. This presentation is a synthesis of the to-date freeze-thaw results covering many aspects of pervious concrete. Durability was improved by optimizing the ratio of cement to aggregate for particular aggregate gradations and including additional fine aggregate and fibers. Impacts from water-to-cement ratio on workability, compaction, and durability are also provided. The aggregate impact on pervious concrete durability was investigated using 17 different aggregates from around the U.S. and Canada. The effects of many popular paste-modifying admixtures, including latex-based workability aids on mixture properties and freeze-thaw performance are presented. The effects on freeze-thaw behavior of various SCMs including slag, fly ash, and silica fume were also investigated. The conclusions include optimized aggregate gradation limits and suggestions on maximizing durability using fine aggregate, admixtures.

Presentation Length: 30 minutes

Schedule: Technical Session T10.1 - May 21, 10:30-12:00

Presenter: Cost, Van (Tim)

Title: High Limestone Cements for Performance as Well as Sustainability

Author(s): Tim Cost

Abstract: High limestone content cements have been common in Europe and other parts of the world for a number of years. U.S. specifications have only recently allowed up to 5% limestone content in most cements, though 3.5-4.0% is a more practical maximum target under these specs that are also governed by LOI and insoluble limits. Higher limestone content is possible under ASTM C 1157, a performance cement specification, however. When limestone content is essentially doubled from these common limits, to around 8-10%, there are obvious benefits in associated CO2 emissions, energy usage, and other clinker factor-related facets of sustainability. Such cements can be produced and used today wherever C 1157 is accepted for use in concrete. This presentation will present experiences and test data with high limestone C 1157 cement from several plants and will discuss related benefits of such cements.

Presentation Length: 30 minutes

Schedule: Technical Session T10.2 - May 21, 10:30-12:00

Presenter: Williams, Brooke

Title: Green Cement – Achieving Durable Concrete with Environmentally Friendly Cements

Author(s): Brooke Williams

Abstract: This presentation will showcase a variety of ASTM C 595 and C 1157 cements in real world ready mixed concrete applications across the U.S., highlighting the environmental and performance benefits of these concrete mixes. Examples of cements that may be combined with other supplementary cementitious materials at the ready mix plant will also be included. Environmental benefits, as part of the LEED® program will be shown with an example project using the LEED® calculator from the Holcim Envirocore website. In addition, environmental benefits not currently addressed in LEED® for cement will be discussed such as clinker factor reduction, efficient thermal energy use, use of alternative fuels, raw materials and how these relate to concrete performance.

Presentation Length: 30 minutes

Schedule: Technical Session T10.3 - May 21, 10:30-12:00

Presenter: Bucher, Brooks

Title: Preliminary Comments on Shrinkage and Shrinkage Cracking Behavior from Cement Systems that Contain Limestone

Author(s): Brooks Bucher, Aleksandra Radlinska and Jason Weiss

Abstract: The use of limestone fillers is one way to improve the sustainability of construction. While, the environmental benefits of limestone addition are well known, the influence of these materials on shrinkage and the potential for cracking has been questioned. In this paper, the authors evaluate three cements including a reference cement and two cements containing limestone (5% and 10% by replacement) from the time of casting until 28 days. Total deformation is assessed from the time of casting using a combination of the corrugated tube protocol and the ASTM C157 technique. Further, the restrained ring test (ASTM C 1581) is used to quantify the development of residual stresses and the potential for cracking in these systems. The results indicate that the limestone cements exhibit similar or less shrinkage than the plain case when the shrinkage is measured properly.

Presentation Length: 30 minutes

Schedule: Technical Session T11.1 - May 21 1:30-3:00

Presenter: Mata, Luis

Title: Sedimentation Effects on Pervious Concrete

Author(s): Luis Mata and Michael Leming

Abstract: The sedimentation rates of two pervious concrete mixtures were examined with three different soil types: sand, silty sand, and silt. Total and effective porosities were obtained using differential masses in air and water and based on ASTM D 7063-05 using an Instrotek Corelok system. Two cylinders and two beam specimens were used for each pervious concrete mixture in combination with each sediment type. The specimens were exposed to sediments mixed in water to simulate runoff with heavy soil sediments. Falling head permeability tests were performed in the specimens before and after the exposure, and after washing-off the sediments with pressurized water. The effects on clogging and permeability recovering rates were obtained for each specimen and sediment type. Other tests included flexural strength, compressive strength and splitting tensile strength.

Presentation Length: 30 minutes

Schedule: Technical Session T11.2 - May 21 1:30-3:00

Presenter: Neithalath, Narayanan

Title: Modeling the Retention of Oil in Enhanced Porosity Concretes

Author(s): Bhavin Bhayani, Omkar Deo, Thomas Holsen and Narayanan Neithalath

Abstract: Groundwater contamination from vehicular oil spills due to stormwater runoff is a major concern in highly impervious areas. This presentation examines the potential of enhanced porosity concrete (EPC) in retaining spilled oil in its pore structure. In this study EPC mixtures with porosities varying between 13-35% were examined. Known quantities of oil were introduced in different EPC specimens and rain events of different magnitudes were simulated. Oil recovered in the water that drained through the sample was quantified using a partition gravimetric method. The influence of material properties of EPC such as porosity and pore sizes, and varying environmental conditions such as rainfall intensities and rates of oil and water addition on the quantities of oil retained by the system was quantified. Using a simple geometric model for the pore system in EPC, the material parameters relevant for transport and retention are quantified. The experimental results are used to build and validate the model.

Presentation Length: 30 minutes

Schedule: Technical Session T11.3 - May 21, 1:30-3:00

Presenter: Obla, Karthik

Title: ASTM C 09.49 Subcommittee Activity on Test Methods for Pervious Concrete

Author(s): Karthik Obla

Abstract: This presentation will update the audience on the latest activities of the ASTM C 09.49 Pervious Concrete Subcommittee as related to test methods standardization.

Presentation Length: 30 minutes

Schedule: Technical Session T12.1 - May 21, 1:30-3:00

Presenter: Goss, David

Title: Future Challenges and Possible Responses to Fly Ash Supplies Impacted by Regulatory Initiatives

Author(s): David Goss

Abstract: Electric utility compliance with air emission regulations could have an adverse impact on the use of fly ash in concrete in the U.S. in the next decade. Changes in fuel types or sources, the addition of scrubbers and mercury removal technologies will challenge the quantity or supply of ASTM C618 compliant fly ash. This presentation will discuss the potential impacts of these regulation and possible opportunities to overcome these challenges.

Presentation Length: 30 minutes

Schedule: Technical Session T12.2 - May 21, 1:30-3:00

Presenter: Gasiorowski, Stephen

Title: Beneficiation and Utilization of Coal Combustion Fly Ash: A Major Success in Reducing Solid Waste and Increasing Supplies of Construction Materials While Reducing Green House Gas Emissions

Author(s): Stephen Gasiorowski

Abstract: Over 70 million tons of fly ash are generated by coal-fired power plants annually in the U.S., most of which is disposed of in land fills. Only approximately 12 million tons of fly ash is used to replace portland cement in the production of concrete annually. The amount of fly ash used in concrete production is limited to material meeting chemical and physical specifications to assure strength and durability properties of the concrete. Separation Technologies LLC (ST) has developed and implemented innovative, patented processes to reduce unburned carbon and detrimental ammonia levels in coal fly ash for use in concrete production.

Presentation Length: 30 minutes

Schedule: Technical Session T12.3 - May 21, 1:30-3:00

Presenter: Collins, Russell

Title: Generation of Marketable Carbon Offsets via use of Alternative Cementitious Materials in Concrete

Author(s): Russell Collins

Abstract: The manufacture of portland cement is second only to the generation of electrical power in its creation of carbon dioxide gas. For every ton of cement produced, a ton of CO_2 is released. It therefore follows that for every ton of cement replaced by a recycled material (i.e. fly ash, ground, granulated blast furnace slag, etc.) an offset of one ton CO_2 is created. These may be sold on the open market, creating a potential for millions of dollars of new revenue that can then be reinvested into the industry for further emission reduction.

Presentation Length: 30 minutes

Schedule: Technical Session T13.1 - May 21, 3:30-5:00

Presenter: Neithalath, Narayanan

Title: Statistical Characterization of the Pore Structure of Enhanced Porosity Concretes

Author(s): Kathleen Low, D. Harz and Narayanan Neithalath

Abstract: The hydraulic properties of pervious concrete depend heavily on its pore structure - porosity, pore sizes, and pore connectivity. This study characterizes the pore structure of pervious concrete by: identifying the material parameters that have a significant influence on the pore structure; and modeling the distribution of pore areas (or sizes) proportioned using different material combinations. The pervious concrete specimens were subjected to determination of porosity by volume method, permeability by the falling head method, and pore connectivity by electrical conductivity method. A general trend of increasing permeability with increase in porosity and pore connectivity factor was observed. Image analysis techniques were used on sliced sections of EPC to obtain the pore area distribution. Statistical distribution functions were used to model the pore area distributions.

Presentation Length: 30 minutes

Schedule: Technical Session T13.2 - May 21, 3:30-5:00

Presenter: Mahboub, Kamyar

Title: The Effect of Compaction and Aggregate Gradation on Pervious Concrete

Author(s): Kamyar Mahboub, Jon Canler, Blake Davis and Robert Rathbone

Abstract: As a result of the unique behavior of pervious concrete, research into specimen compaction methods was conducted in order to determine how accurately laboratory methods emulate concrete that is constructed in the field. Therefore, the objectives of this research were to determine if current ASTM standards for compacting traditional PCC are suitable for pervious concrete, and to establish a predictive relationship between aggregate gradation and concrete void content. Based on the compressive strength and void content data, it was concluded that the traditional method of rodding cylinders does not accurately represent field compacted pervious concrete slabs. Vibratory compaction and pneumatically compacting the concrete at 10 psi did correspond with specimens cored from a slab. Interestingly, the various compaction methods did not exert a noticeable influence on the concrete permeability, but did substantially affect the void content and aggregate orientation.

Presentation Length: 30 minutes

Schedule: Technical Session T13.3 - May 21, 3:30-5:00

Presenter: Wang, Kejin

Title: Self-Consolidating Pervious Concrete for Overlay Applications

Author(s): Kejin Wang, John Kevern and Vern Schaefer

Abstract: This presentation describes research performed at Iowa State University on the development of self-consolidating pervious concrete. By tailoring workability and compactibility parameters, the mixtures can be designed to flow and be placed easily but, still maintain the required void structure for stormwater infiltration and skid resistance. The mixtures contained various combinations of an optimized crushed aggregate gradation, SCMs, polymer admixtures, and fibers. The effects of each component on workability were studied by low-pressure gyration testing and durability by surface abrasion, freeze-thaw (ASTM C666A), and deicer resistance tests. It is expected that the newly developed self-consolidating pervious concrete will have much improved uniformity. Improved density consistency will increase durability and allow more wide-spread use of pervious concrete as and overlay material and in higher traffic volume applications. The high durability, thin section pervious overlay material will also be useful for repairing pervious concrete sections that are experiencing unacceptable deterioration and raveling.

Presentation Length: 30 minutes

Schedule: Technical Session T14.1 - May 21, 3:30-5:00

Presenter: Rathbone, Robert

Title: The Fabrication of Low Energy Cements from Coal Combustion By-Products

Author(s): Robert Rathbone, Thomas Robl, Robert Jewell, and Kamyar Mahboub

Abstract: In this research the formulation, fabrication and characterization of two types of low energy cement was conducted with the objective of producing added-value construction materials from coal combustion byproducts. The cements included: calcium sulfoaluminate (CSA) cement, and cement based on gypsum combined with pozzolans. The CSA cement was prepared with limestone, fluidized bed combustion (FBC) ash, Class F fly ash, bauxite and flue gas desulfurization (FGD) gypsum. High-iron CSA cement was also produced using red mud as an ingredient. In some cases, the CSA cements comprised nearly 55% byproducts. The gypsum/pozzolan cements were produced from FGD gypsum (autoclaved to produce hemihydrate), FBC ash and Class F fly ash, and thus were composed of 100% byproducts. Mortar and concrete specimens were prepared from the cements and tested for compressive strength, as well as set time, drying shrinkage, and various durability-related properties.

Presentation Length: 30 minutes

Schedule: Technical Session T14.2 - May 21, 3:30-5:00

Presenter: Pike, Clinton

Title: High Volume Pozzolan Concretes (HVPC) with low CO2 emissions and energy consumption: 3 Years of Industrial Experience in Texas

Author(s): Clinton Pike, Vladimir Ronin, and Lennart Elfgren

Abstract: The energetically modified cement (EMC) technology consists of mechanical processing a blend of ordinary portland cement (PC) and a pozzolan (Class F fly ash) through multiple high intensity grinding mills to impart increased surface activation of the PC and pozzolan particles. Fly ash may be processed together with all cement forming ready-to-use cement, or alternatively processed with a small amount of cement and used as a pozzolan added to the concrete mixer. The later product called EMC-CemPozz (CemPozz) can replace up to 60% of PC in concrete. Performance of CemPozz in concrete is equivalent to blast furnace of the grade 100 (ASTM C 989). The strength of HVPC with 50% CemPozz is comparable to PC, the setting time is similar, and alkali-silica reactivity is lowered as well as drying shrinkage. Concretes produced with CemPozz have much higher sulfate resistance, very low chloride permeability and characterized by significantly reduced cracking.

Presentation Length: 30 minutes

Schedule: Technical Session T14.3 - May 21, 3:30-5:00

Presenter: Akkapeddi, Srikanth

Title: Impact of Using Alternative Fuels to Produce Portland Cement on Cement and Concrete Properties

Author(s): Srikanth Akkapeddi, Dustin Swart, Anton Schindler, and Steve Duke and Don Stafford

Abstract: Portland cement manufacturing involves combustion of fuels with different raw materials at approximately 1,500 °C to produce clinker. Fuel costs and environmental concerns have encouraged the cement industry to explore alternatives to the conventional fossil fuels. The key objective is to maintain the cement production and quality while extracting energy from industrial waste fuel, or bio fuels, while keeping the impact on the environment and costs to a minimum. In this study, portland cement was produced at a full-scale cement plant during 3-day trial burns of various alternative fuels along with coal. The fuels investigated are: coal only; coal and tires; coal, tires and waste plastics; and coal, tires and broiler litter. Chemical analyses showed that the primary chemical compounds in cement (Al2O3, CaO, Fe2O3 and SiO2) exhibited no significant changes during the trial burn periods that included alternative fuels. Cement and concrete properties for each fuel burn were determined. It is concluded that tires, waste plastics and broiler litter are potential alternative fuels for cement production.

Presentation Length: 30 minutes

Schedule: Technical Session T15.1 - May 22, 8:00-10:00

Presenter: Bury, Mark

Title: The Role of Admixture Technology on the Sustainable Development of Concrete Projects

Author(s): Mark Bury

Abstract: It is well established that concrete is a versatile building material and plays an important part in sustainable development. What may not be known is the role that chemical admixtures play in the process. When the general public hears the word chemical, green is not exactly the word that describes their perception. However, chemical admixtures can significantly enhance concrete performance while in many cases address environmental issues facing the industry. This presentation will examine and review historical, present day, and future admixture technologies and their ability to help achieve sustainable development in concrete construction. Test data, and case study examples will illustrate for producers and contractors the viability of chemical additives for increasing concrete performance, profitability, and public perception in a green way.

Presentation Length: 30 minutes

Schedule: Technical Session T15.2 - May 22, 8:00-10:00

Presenter: Jeknavorian, Ara

Title: Optimizing Admixture Selection for Use of SCMs in Concrete

Author(s): Ara Jeknavorian, Peter Zhou and Chris Forgey

Abstract: Significant benefits are realized toward the sustainable production of concrete mixtures when supplementary cementitious materials (SCMs) are replaced large proportions of cement. However, in order to achieve large substitutions, 50% and above, with a combustion by-product such as fly ash, delays in setting and early strength compared to the performance of conventional portland cement concrete, must be addressed. Polycarboxylate-based superplasticizers have the ability to fluidify and maintain the workability of concrete at low dosage rates relative to other cement dispersing additives. This capability results in minimal impact on setting characteristics, and contributes to increased strength development and durability, which can enable high levels of cement replacement with various SCMs. This presentation will describe the use of polycarboxylates with calcium-based set accelerators to produce synergistic strength increases allowing for further optimization of admixture systems for concrete containing high levels of SCMs.

Presentation Length: 30 minutes

Schedule: Technical Session T15.3 - May 22, 8:00-10:00

Presenter: Biddle, Dan

Title: Next-Generation Macro-Synthetic Fibers: Advances in Durability, Ductility, and Joint-Spacing

Author(s): Dan Biddle

Abstract: Synthetic fiber reinforcement for concrete was brought to the U.S. construction market in 1978. These first-generation fibers were made of polypropylene and other like-synthetics, and were primarily used to reduce shrinkage cracking during the early life of concrete. Since that time, synthetic fibers have become a staple in a wide variety of precast, shotcrete, and flatwork projects and applications. In 1999, the next generation of macro-synthetic fibers were introduced that used better shapes, lengths, chemistries, and dosages to greatly expand the performance and capabilities of these fibers. Reducing and/or replacing conventional steel reinforcement, extension of normal joint-spacing, and ductile mode of failure properties have pushed these fibers to the forefront on scores of innovative and forward-thinking projects worldwide.

Presentation Length: 30 minutes

Schedule: Technical Session T15.4 - May 22, 8:00-10:00

Presenter: Zubrod, Rodney

Title: Advances in Cost-Effective Cement Reduction

Author(s): Rodney Zubrod, Charles Welker and Pieter VanderWerf

Abstract: New polymer-based air entrainment systems (PBAES) do not rely on the reaction between water, cement, and chemicals, but are independent of internal mixture influences. It is believed to improve workability, and not vary in the presence of water reducing admixtures (WRAs) or carbon. In addition, its consistency is believed to reduce the variance in concrete strength, allowing mix design strengths closer to specified strength without undue risk. As reported in this research, analysis of field data largely confirms these properties of PBAES. The data are derived from side-by-side production of contrasting concrete mixes in the plants of a commercial ready mixed producer over several months. Statistical analysis of the results indicates that, compared with concrete using surfactant air entraining admixtures, mixes using the PBAES: exhibit high workability and stability over a wide range of WRA dosages, permitting significant water and cement reduction; is significantly less affected by the amount or type of fly ash used; and results in more consistent concrete strength.

Presentation Length: 30 minutes

Schedule: Technical Session T16.1 - May 22, 8:00-10:00

Presenter: Basham, Kim

Title: Wal-Mart's Experiences with Adding Fly Ash to Concrete Mixes for Floor Construction

Author(s): Kim Basham

Abstract: Wal-Mart Stores Inc. has changed their construction specifications to require all steel-troweled concrete floors placed at Wal-Mart Stores, Supercenters, Neighborhood Markets, Sam's Clubs and Distribution Centers to contain 15-20% fly ash by cement substitution. This change is part of a larger sustainability effort by Wal-Mart to reduce their greenhouse gas footprint and based on results of a concrete research program that investigated the feasibility of substituting fly ash for portland cement in integral-colored, steel-trowel floors. This presentation will cover the findings of this research program including: mix designs, concrete set times, window of finishability, finishing techniques, curing and polishing. Results from evaluating the hardened test floors including gloss, resistance to staining and abrasion will also be discussed. The challenges and risks versus benefits of adding fly ash to steel troweled floors will be presented.

Presentation Length: 30 minutes

Schedule: Technical Session T16.2 - May 22, 8:00-10:00

Presenter: Obla, Karthik

Title: Use of Maturity Concepts for High Volume Fly ash Concrete

Author(s): Karthik Obla

Abstract: The use of fly ash in concrete has reached significant attention over recent years due to environmental concerns regarding its disposal from one hand and significant benefits to concrete on the other, when it is used as a supplementary cementitious material. While low fly ash contents are in some cases routinely used in concrete, high volume fly ash (HVFA) concrete is not so frequently used due to perceived lower early age strengths. The objective of this study was to demonstrate using maturity based techniques that the beneficial effects of high in-place temperature may be able to compensate for the slower rate of strength gain in HVFA concrete. Furthermore, different methods (match cured cylinders, pull out testing) estimating the early-age in-place strength of HVFA concrete were examined so as to confirm the maturity predicted strengths.

Presentation Length: 30 minutes

Schedule: Technical Session T16.3 – May 22, 8:00-10:00

Presenter: Cecere, Joseph

Title: Innovations and New Initiatives for Sustainable Development of Concrete Technology

Author(s): Joseph Cecere and Alex Aswad

Abstract: Concrete is very common in the U.S. and in the world. In fact, the rest of the world uses concrete structures much more than the U.S. Aggregates and cement ingredients are obtained from river beds and quarries and can be considered non-renewable materials. Therefore, efficient use of these materials is a prime objective in the pursuit of sustainability. The worldwide dependency on concrete usage as building material is unavoidable. So attention must be focused on minimizing the environmental impact of its production and usage. This presentation will discuss a research project that studied the utilization of lesser cement in the concrete mix by substituting a significant portion (up to 40%) of the cement with fly ash. This high-volume fly ash concrete (HVFA concrete) presents several environmental and economic advantages considering that about 70% of the fly ash produced in the U.S. goes to landfills. In addition to these advantages, durability of concrete using fly ash is improved.

Presentation Length: 30 minutes

Schedule: Technical Session T16.4 - May 22, 8:00-10:00

Presenter: Koehler, Eric

Title: Selecting Aggregates to Optimize Cement Content

Author(s): Michael De Moya Hahn, Marc Rached, David Fowler, Eric Koehler

Abstract: By carefully selecting aggregates and optimizing mixture proportions, the quantity of cement provided for workability can be minimized while achieving adequate workability and hardened properties. Two approaches to reducing the cement content for workability were evaluated. First, aggregate shape and grading were improved to allow a reduction in paste volume. Second, the paste volume was held constant and dust-of-fracture aggregate microfines were used as part of the powder volume. For each mixture, the high-range water-reducer dose was adjusted to maintain constant slump. The effects on workability, compressive strength, drying shrinkage, rapid chloride permeability, and abrasion resistance were measured. The results quantify the extent to which the cement content provided for workability can be reduced through aggregate selection. Recommendations are given for selecting aggregates and optimizing mixture proportions for a given aggregate.

Presentation Length: 30 minutes