4th JCI & ACI Joint Seminar

Sustainable and Resilient Concrete Structures -Codes and Practices-

2019/7/12 8:50 - 15:20

Small Hall, Sapporo Convention Center, Sapporo, Japan

Abstracts and Speakers

JCI presentation # 1

Title: Life-cycle management of concrete structures under the framework of sustainability
Author: Hiroshi Yokota, Professor, Dr. Eng.
Affiliation: Hokkaido University

ABSTRACT The service life of a structure is made up of the planning, basic and detailed design, execution including material selection, production and construction, use, and decommissioning stages. It is extremely important to appropriately connect these stages one after another. Life-cycle management (LCM) is an organized system to pursue coordination of these stages through which suitable engineering-based decision making would be supported. The introduction of LCM for a structure contributes to all aspects of sustainability while maintaining the functions and performances to fulfil its purposes. Understanding and achieving a balance between environmental, social and economic aspects, ideally in mutually supporting ways, is considered essential for making progress towards achieving sustainability in the LCM system. The presentation introduces the concept and framework of the LCM system of concrete structures (ISO/CD 22040 Life cycle management of concrete structures) that will achieve sustainability.

JCI presentation # 2

Title: Durability design for highway bridges

Author: Yoshinobu Oshima, Dr. Eng.

Affiliation: CAESAR, PWRI

ABSTRACT Japanese Specifications for Highway Bridges (referred to as SHB hereafter) was revised in July 2017 and issued to road administrators. SHB is the legally-binding design codes for national highways and expressways and the de-facto standards for other roads. In the 2017 revision, the performance-based code structure was adopted, and the durability strategies had been newly introduced: bridge durability comprises not only material durability but also the feasibility of inspection, maintenance, and repair to sustain its performance level for design service period. Accordingly, variation and uncertainty of durability should be compensated by proper maintenance action in the design process. Several deterioration and defects actually found in highway bridges will be demonstrated in the presentation, and the concept of durability strategies for highway bridges in Japan will be discussed.

JCI presentation # 3

Title: Toward a development of resilient structures using precast and prestressed concrete structural components

Author: Tomohiro Miki, Associate Professor, Dr. Eng.

Affiliation: Department of Civil Engineering, Kobe University, Japan

ABSTRACT Startup research on precast and prestressed concrete structural components is presented to discuss the development of resilient infrastructure. A prestressed concrete column specimen with a joint and a monolithic prestressed concrete column specimen as a reference were prepared to use in the static reversed cyclic loading test. The joint was made at the base of the column to simulate a connection of precast prestressed concrete members. The experiment shows that the relationship between the lateral load and drift angle, accumulated energy absorption and residual lateral displacement differed in each specimen. The main reason of the difference is that the specimen with a joint has non-continuous axial rebars at the joint. The influence of the discontinuity of the longitudinal rebars at the joint on the failure mode and the deformation performance was experimentally confirmed based on the strains of PC bars and the longitudinal rebars. The presentation will extend to the research on damage visualization for the strain distribution by means of an image analysis using digital images of the specimen surface taken before and after deformation during loading test.

JCI presentation # 4

Title:

Author: Shuuei Ikeda, Dr. Eng.

Affiliation: Research center of Takenaka Co. Lt.

ABSTRACT

JCI presentation # 5

Title: Standards and guidelines from the AIJ Reinforced Concrete Committee

Author: Susumu Kono, Professor, Ph.D[1], Koji Muramatsu[2], Tsutomu Komuro[2]

Affiliation: 1: Tokyo Institute of Technology

2: Taisei Corporation

ABSTRACT The AIJ Standard for Structural Calculation of Reinforced Concrete Structures was first published in 1933 together with the Standard Specification for Concrete and Reinforced Concrete Work. The former document was intended to help practicing engineers in the design calculations for reinforced concrete building structures. The Standard was revised in 1947 when it was completely rewritten in accordance with the newly-established Japanese Architectural Standard No. 3001, which incorporated the concept of two-stage allowable stress design for long-term and short-term loadings. Since then, the Standard has been revised many times until 2018 to adopt into practice the results of advances in research work and the development of new materials. The status of standards and guidelines published from the AIJ and their relation to the related laws and commentaries published from the government will be discussed.

ACI presentation # 1

Title: U.S. Strategies for Concrete Highway Bridge Durability and Management

Author: Michael C. Brown, Ph.D., P.E., FACI

Affiliation: WSP USA, Herndon, Virginia, USA

ACI-SEI 343 committee chair

ABSTRACT The U.S. highway system comprises about 4.1 million centerline miles of roads which incorporate over 614,000 bridges. This network is managed by a range of owners ranging from state departments of transportation, federal agencies, highway toll commissions, county, parish and municipal entities, as well as some private owners. The network as we know it was

developed over the course of the 20th century, with surges during the post-World War II era and implementation of the Interstate system. Today the rate of new development has declined to less than 0.5% per year; however, more than 40% of the bridges in the network are over 50 years old and replacement and rehabilitation needs are mounting. The two primary materials used to construct highway bridges are concrete and steel. There have been steady innovations to improve the quality, efficiency and sustainability of concrete structures both at original construction and via methods to extend the service life of existing structures through strategic preservation and rehabilitation activities. This paper will provide an overview of recent trends in U.S. practice for overall management and preservation of highway bridges. The discussion will highlight strategies and technologies that are being employed to improve design, construction, inspection, preservation, and management of concrete bridge structures.

ACI presentation # 2

Title: Risk-Based Evaluation of Existing Highway Bridges: Past, Present and Future

Speaker: F. Michael Bartlett
Professor, Ph.D., F.ACI, F.CSCE, F.IABSE, P.Eng.
Affiliation: The University of Western Ontario, Canada
Department of Civil and Environmental Engineering

ABSTRACT Since 1990, existing highway bridges in Canada have been evaluated using risk-based methodology to determine appropriate target safety levels for elements based on the consequences of element failure. The procedures have reduced the need to strengthen elements that are ductile, readily inspected, and part of multiple load path structures. This has favourable economic effects because, although traffic loadings have markedly increased from historical design values, elements with relatively high live load fractions tend to require lesser target safety levels. Recent research addresses the quantification of "warning of failure" and suggests the possible improvements to the current criteria.

ACI presentation # 3

Title: Reliability of Concrete Repairs – The Missing Links

Author: Ali Abu Yousef[1] and Randall W. Poston , PhD, PE, SE, NAE[2]
Affiliation: 1&2 Pivot Engineers, Austin, TX, U.S.A
2 President American Concrete Institute

ABSTRACT Concrete repair design of an existing structure is a distinctly different process than the design of a new concrete structure. In US practice, reliability of repairs is dictated to an extent by provisions in the ACI 562 Repair Code. However, there are unknowns and intangibles

that are not easily captured by the requirements in the current ACI 562 Repair Code. These include the following:

1. Consideration that repairs often fail at early age, so there is a need for conservatism in design and implementation of stringent QC measures. At present there is no clear guidance in the industry of how to capture this consideration.
2. Need for additional conservatism in repair design to achieve similar level of reliability expected in new construction reliability (belts and suspenders approach in repair design). The added conservatism is needed to account for unknowns and the often-unique repair conditions.
3. The use of detailed condition assessments to reduce level of design conservatism while maintaining same level of repair reliability.
4. The difference in QC requirements between new construction and repair construction.
5. Role of maintenance in maintaining repair reliability.

In addition to a general discussion, this presentation includes a discussion of an example repair project. The role of repair design and quality control in ensuring reliable repairs will be addressed through the case study.

ACI presentation # 4

Title: Sustainability and the ACI 318 Building Code

Author: Andrew W. Taylor, Ph.D.[1], S.E., FACI, and Shana T. Kelley, S.E.[2]

Affiliation: 1&2 KPFF Consulting Engineers, Seattle, Washington, USA

1 ACI 318 committee chair

ABSTRACT Since the early 1990s there has been a steady increase of interest in the impacts of building design, building construction methods, and building materials on the environment. In particular, architects, engineers, and regulators have focused on the effects that construction processes and building materials have had on the emission of greenhouse gases, especially CO_2. Globally, producers of engineered structural materials, such as concrete, have sought ways to reduce greenhouse gas emissions, without adversely affecting the engineering design properties, quality, consistency, and economy of the materials. Most efforts have focused on the production processes for the materials themselves: the objective has been to reduce the emission of greenhouse gases created during creation of the bulk material. There has been progress on this front, and materials producers continue to search for ways to reduce greenhouse gas emissions. What impacts, however, can be made on reducing the environmental impacts of concrete structures through innovations in the *structural design* process? While forward strides have been made in reducing the influence of cement production on the environment, it is also possible to re-examine structural building codes with the goal of modifying the regulations for structural design and materials specifications in ways that would benefit the environment. This paper explores areas of the ACI 318 *Building Code Requirements for Structural Concrete* that could be examined for

opportunities to directly or indirectly reduce greenhouse gas emissions. These areas could include allowing the use of a broader range of alternative cementitious materials; creating provisions that would promote the design of more compact structural sections; developing guidelines for voluntary reporting of the environmental product declaration (EPD) or the global warming potential (GWP) of concrete mixtures; promoting a longer timeframe for evaluating concrete strength (e.g. 42 or 56 days instead of 28 days); expanding the potential uses of recycled aggregates; and revising existing durability provisions so that, when there is sufficient data to justify it for a given exposure condition, a reduction in the required specified concrete strength, f'_c, could be permitted.

ACI presentation # 5

Title: Durability Design for Concrete Structures – A Review of International Building Codes

Author: Keith Kesner, Ph.D., P.E., S.E., FACI[1] and Tracy Marcotte, Ph.D., P.E., FACI[2]

Affiliation: 1&2 CVM Engineers, King of Prussia, PA, USA

1. ACI 562 Committee Chair
2. ACI 563 Committee Chair

ABSTRACT In effort to improve durability design practice in the United States, a review of the durability provisions in international building codes and standards was completed. The reviewed documents included model building codes, design standards and durability guidelines from Australia, Europe, Japan, and the United States. Provisions for durability design, as a code-based framework to create durable concrete structures, were found to vary significantly in the reviewed documents. Features included in the documents include service life modeling, consideration of concrete cracking in design, and specific materials requirements for concrete structures located in aggressive environments. The review indicated the ACI 318 design code does not approach durability in an integrated or systematic manner, particularly when compared to parallel documents produced in other countries. The presentation will describe the results from the international code review and will discuss how the results are being used to develop ACI documents for durability design.