For the JSCE Concrete Committee Newsletter

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I appreciate the opportunity to report on a major research initiative launched at the University of British Columbia in the form of a Canada Research Chair in Infrastructure Rehabilitation and Sustainability. As the chair-holder, my purpose here is two-fold: first to inform the readers of the JSCE Newsletter of this initiative, and second to encourage Canada-Japan collaboration in the area in which this research chair is created.

Reading previous issues of the JSCE Newsletter, I am truly impressed with the quality of the articles brought forward under the able guidance of Prof. Koji Sakai, Editor-in-Chief of the Newsletter. The articles are of the highest quality and relevance and I continue to encourage my Canadian colleagues to read the newsletter on a regular basis. The Newsletter has a very progressive outlook and is a catalyst in bringing innovation to every aspect of concrete engineering including materials, design, construction and maintenance.

The Canada Research Chair program (http://www.chairs.gc.ca/) was launched by the Government of Canada to promote and accelerated research activities in science, technology and humanities by creating research professorships—Canada Research Chairs—in universities across the country. The program invests $300 million a year to attract and retain some of the world's most accomplished and promising minds. A Chair on Infrastructure Rehabilitation and Sustainability was recently approved with me as the chair-holder.

Repairing and strengthening concrete structures has become a critical issue in Canada and indeed all over the world. Severe corrosion of steel in concrete, changes in code provisions, and increases in design loads have all created an enormous infrastructure "backlog." To make matters worse, the production of cement has been found to have negative environmental effects: The production of one ton of cement releases nearly a ton of carbon dioxide and other greenhouse gases into the atmosphere. Since repair materials use large amounts of cement, there is an urgent need to develop repair materials that consume less cement and employ large amounts of industrial by-products and wastes.

Another issue the Chair will deal with is that of global warming and concrete structures. An increase in the atmospheric concentration of CO_2 from 280 ppm to 370 ppm in the last two centuries and its projected rise to nearly 1000 ppm by 2100, will have major impact on our concrete structures. This is also likely to cause an average warming of the earth's surface by up to 5.8^{o}C. The increased levels of CO_2 and higher temperatures will make concrete structures far less durable and robust by influencing concrete chemistry. For example, increased levels of CO_2 in the atmosphere will enhance carbonation in concrete (atmospheric CO_2 reacts with $Ca(OH)_2$ produced during cement hydration to revert it back to $CaCO_3$). Carbonation reduces pH of concrete thereby promoting rebar corrosion and increasing the possibility of carbonation induced shrinkage cracking. Higher temperatures will enhance thermal stresses in concrete, promote rebar corrosion, exacerbate plastic and drying shrinkage, and increase internal cracking in mass concreted structures such as large dams. Very little or no research is currently being conducted on how to adapt concrete chemistry to the higher temperatures and greater CO_2 concentrations being brought about by climate change. To complicate matters further, concrete structures will need even greater strength and durability to withstand the increase in extreme weather events caused by climate change. Instances of flash floods have increased everywhere increasing the severity of abrasion, scour, slope failures, etc.

The Canada Research Chair in Infrastructure Rehabilitation and Sustainability will first and foremost study the overall influence of climate change on concrete structures. Second, it will develop crack-free and durable repair materials that use far less cement and large amounts of industrial by-products and wastes. Thirdly, it will develop life-cycle model for performing strategic decision analysis of infrastructure needing rehabilitation, and finally, will apply the research findings to field demonstrations projects including bridges, parking garages, buildings, and marine structures.

I encourage the Japanese colleagues to strengthen the efforts of this Chair. For more information, please feel free to contact me at banthia@civil.ubc.ca.