Some Information on Concrete Research in Hong Kong

Jian-Guo DAI, Assistant Professor, Department of Civil and Structural Engineering, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, E-mail: cejgdai@polyu.edu.hk

As a loyal reader of "Newsletter of JSCE Concrete Committee" as well as a correspondence member of "Subcommittee on International Activities of JSCE Concrete Committee", I am very pleased to take this opportunity to share some information related to current concrete engineering in Hong Kong with other readers. Hopefully my feedbacks would help to promote the information exchanges and international collaborations between Japan and Hong Kong concrete society.

Last July, I moved from the LCM Research Center, Port and Airport Research Institute, Japan to the Department of Civil and Structural Engineering, The Hong Kong Polytechnic University to become an assistant professor. Before starting my teaching and research career in the university, I was arranged a two-month stay in Maunsell Consulting Co., one of the most prestigious international consulting companies in Hong Kong, for some local industry experiences. Due to my short experiences in Hong Kong I am not capable of writing a comprehensive review on the state-of-the-art of all the aspects of concrete engineering in Hong Kong. Instead, in this article I just report several specific research topics which are believed to be of great importance to Hong Kong's concrete researchers and engineers.

The first topic I would like to report is about the "Code of Practice for Structural Use of Concrete in Hong Kong", hereafter HK2004 Code. Hong Kong published its local design code for structural concrete in 2004, which is based on limit state design philosophy. Interested readers can download this code at http://www.bd.gov.hk/english/documents/code/concrete/e_concrete2004_reprinted.htm. HK2004 Code is quite different from British code BS8110, which is still being popularly used by local engineers to design concrete structures in Hong Kong. An important change in HK2004 is the introduction of beam-column joint design provisions, which are largely based on the New Zealand Standard NZS3101 (1995). There have no specific requirements for the design of beam-column joints in the previous Hong Kong code and BS8110. Most design engineers in Hong Kong, however, are not familiar with how beam-column joints could be better designed. When I discussed this with local engineers, they even complained that there is often a problem that the joint does not have sufficient space to accommodate the required anchorage length of the reinforcing bars coming in from the beams and the arrangement of the required transverse reinforcement. For solving such a construction difficulty and achieving better joint performance, I feel that researchers and industry may be stimulated to develop new types of beam-column joints, e. g. steel beam/concrete column joints, pre-cast beam/columns joints etc. A positive adoption of self-compacting concrete may also be expected. In this respect Japanese experiences

would be very useful for references.

Another important trend read in HK2004 code is that increased attention has been paid to the structure ductility while seismic design provisions are not explicitly available in the current code. A new chapter on the structural detailing for ductility has been presented in HK2004 code. However, local engineers seem to know little about the importance of ductility and the differences in design for wind loads and seismic loads since seismic design is not introduced in Hong Kong's university lectures. The recent "Wen-Chuan Earthquake" in Sichuan Province, Mainland, China has called on increasing attention from the public on the importance of seismic design for concrete buildings because Hong Kong in fact has a seismic intensity the same as Wen-Chuan. Hence it is believed that the seismic design provisions will sooner or later be introduced in the future structural concrete code in Hong Kong. Moreover, the update of design code for structural concrete has created a massive need in strengthening the existing concrete buildings, which were designed based on old codes and have poor structural detailing, e.g. no transverse confinement in beam/column joints, existence of splices within the hinge zones of columns providing no additional transverse confinement etc.

Japanese experiences have shown that using fiber reinforced polymer (FRP) sheets to strengthen concrete buildings is a promising technology. However, Hong Kong's building authorities and industry keep quite a prudent attitude toward this technology because the fire resistance of structure is a great concern in Hong Kong due to its densely-populated urban environment. Recently, the research group, which I belong to, is playing a leading role in developing a "Hong Kong Guideline for the Strengthening of Concrete Structures Using FRP Composites". I am personally doing some research on the fire resistance of FRP-strengthened concrete structures.

The second topic I would like to report is the concrete recycling in Hong Kong. The construction activities in Hong Kong generate about 14 million tons of construction and demolition materials each year. But Hong Kong is running out of both reclamation sites and landfill space for the disposal of construction and demolition materials/waste. Therefore it is very important for Hong Kong to adopt a strategy to reduce and recycle C&D materials/waste and handle it in a more environmentally responsible way. Since the experience in using recycled aggregates is still limited in Hong Kong, a prudent approach of using recycled concrete has been adopted. For lower grade applications, concrete with 100% recycled coarse aggregate is allowed. Recycled fines are not allowed to be used in concrete. The target strength is specified at 20 MPa and the concrete can be used minor concrete structures. For higher grade applications (up to C35 concrete), the current specifications allows a maximum of 20% replacement of virgin coarse aggregates by recycled aggregates and the concrete can be used for general concrete applications except in water retaining structures.

My department plays a leading role on the research of recycle aggregate concrete in Hong Kong. It is suggested by my colleague that one of the most practical ways to

utilize a high percentage recycled aggregate in structural concrete is in precast concrete products produced with an initial steam curing regime after casting. At the moment, continuing research is being conducted by Hong Kong Government, universities and the industry to extend the scope of applications of recycled aggregates in Hong Kong. This includes studies on the production of precast bricks and blocks, the influence of the initial moisture states of recycled aggregates on the properties of concrete produced, the use of PFA, and the production of C45 recycled aggregate concretes. Interested readers can find further information at http://www.cse.polyu.edu.hk/~cecspoon/gd.pdf. My colleagues and I also look forward to cooperation from Japan to promote the use of recycled aggregates in Hong Kong toward sustainable infrastructure construction.

The last topic I would like to report briefly is related to the fire resistance of high strength concrete. The development of high strength concrete is of particular interest because Hong Kong is a densely populated urban environment which is characterized by a massive number of high-rise buildings and a shortage of land. HK2004 Code allows the use of concrete with strength up to 100MPa instead of 60MPa allowed in BS 8110. In Japan it may have become common to use strength over than 100MPa for high-rise building design. However, the building authorities of Hong Kong keep a very prudent attitude toward the use of concrete with strength higher than 60MPa. Major consulting companies in Hong Kong are continuing their efforts in convincing the government authorities to permit the use of high strength concrete. However, currently no well established technology for producing fire-durable high strength concrete is available in Hong Kong, My department conducted some research on the fire resistance of high-performance concrete. But further study is deemed to be necessary to accumulate sufficient experience so as to provide sufficient consultancy for confident applications of high strength concrete for building construction in Hong Kong.

Japan concrete society is very active and advanced in the research fields of pre-cast concrete members, high performance concrete, recycled concrete and many others. I am encouraging my colleagues to read the newsletters on a regular basis to learn the most updated research activities of JSCE concrete committee. Taking this opportunity I also would like to encourage Japanese concrete researchers and industry to strengthen their collaborations with Hong Kong. I will be very happy to involve in or play a bridging role on any international collaborations and to provide local information if requested. Interested readers please feel free to contact me at cejgdai@polyu.edu.hk.