Abstract 1:
Fire poses one of the most serious risks to concrete buildings and structures because it often results in explosive spalling of concrete. There are two mechanisms by which concrete can be damaged due to fire. One is restrained thermal dilation resulting in biaxial compressive stress states parallel to the heated surface, which leads to tensile strain in the perpendicular direction. The other is the build-up of concrete pore pressure due to vapourisation of physically/chemically bound water resulting in tensile loading on the microstructure of the heated concrete. This study evaluated the behaviour of restrained high-performance concrete in response to the extreme heating associated with fire. This was done by estimating the thermal stress based on the strain induced in the restraining steel ring and the vapour pressure in the restrained concrete under the conditions corresponding to the RABT 30 rapid heating curve. The thermal stress was calculated based on the thin-wall cylinder model theory. A spalling failure model based on a tensile strain failure model was proposed. The results indicated that the model was suitable for determining the spalling initiation point as well as the spalling depth.

Abstract 2:
High-strength concrete (HSC) is widely used to construct high-rise buildings, bridges and other heavy structures in the world. However, the best way to reduce spalling risk of HSC structures when exposed to high temperature, such as fire, is still ongoing. According to the research, thermal stress and vapour pressure are the major factors that cause concrete spalling at high temperatures. In addition, Japan Concrete Institute Technical Committee previously examined the potential performance of concrete in high-temperature conditions (ref. JCI-TC154A) and proposed the ring restrain heating test. As a preventive way to reduce explosive spalling of HSC, commonly Polypropylene (PP) fibres are used. On the other hand, a lot of research shows that natural Jute fibre are also effective. However, there are few research and experimental studies regarding the study of preventive effect of spalling. Therefore, this study aims to confirm the difference of spalling property on various fibre-reinforced high-strength concrete (HSC) using ring-restraint specimen. Jute and PP fibre is 0.1 vol% and the heating condition is a RABT 30 rapid heating curve. The restrained stress and vapour pressure were measured. Spalling was observed for HSC and HSC with PP fibre specimen; no spalling occurred for HSC with Jute fibre specimen.

Speaker 1:
Dr Mitsuo OZAWA is Associate Professor at the Department of Environmental Engineering Science, Gunma University, Japan. He received his Doctor of Engineering from the Gifu University, Japan in 2003. He was Vice Chairperson in a Technical Committee for the potential performance of concrete in high-temperature conditions (ref. JCI-TC154A). He is a member of RILEMTC SPF: Spalling of concrete due to fire: testing and modelling. His research interests include mechanism of fire spalling of concrete during fire, development of ring restraining testing and spalling model of concrete at high temperature, durability assessment of concrete after exposure to high temperatures.

Speaker 2:
Miss Haruka AKASAKA is a Masters Student at the Graduate School of Science and Technology, Department of Environmental Engineering Science, Gunma University, Japan.
Seminars on

1. Behaviour of Ring-Restrained High-Performance Concrete under Extreme Heating and Development of Screening Test
2. Preventive Effect on Fire Spalling of High-Strength Concrete with Jute Fibre in Ring-Restrained Specimen

Abstract 3:
Progressive collapse of structures has received extensive focus in recent years. This presentation will introduce the research conducted by the speaker and his colleagues and students on the progressive collapse of structures, including the experiments, numerical simulation, collapse mechanism analysis and design and evaluation methodology. The experimental studies cover the interaction between slabs and beams, horizontal progressive collapse, and progressive collapse of flat plate structures. The numerical simulation further studied the threat-dependent progressive collapse including the collision-induced and fire-induced progressive collapse of buildings, and the construction defect-induced progressive collapse of bridges. An energy-conservation principle based design method is proposed, which can derive more reasonable values of the dynamic amplification factors for practical design. A pushdown-based assessment method is proposed, which can significantly reduce the computational efforts to assess the progressive collapse risk of structures. Finally, novel multi-hazard resistant concrete and steel frames are also proposed to overcome the conflict between seismic design and progressive collapse design.

Speaker 3:
Dr Xinzheng LU is a full Professor and the Head of the Institute of Disaster Prevention and Mitigation of Tsinghua University, Beijing, China. He is also the Editor-in-Chief of the Engineering Mechanics journal of China Society of Theoretical and Applied Mechanics.

Prof Lu's major research interests cover earthquake engineering and collapse prevention of structures. His publications have received more than 2500 citations in Scopus. His research outcomes have been adopted by Chinese national design codes, ACI design guidelines, and some important structural analysis programs. He also participated in the design and construction of several landmark buildings and bridges (e.g., the Beijing Z15 Tower (H = 528 m) and the Runyang Bridge (Main span = 1490 m)) and the emergency earthquake reconnaissance after Wenchuan (2008), Yushu (2010), Lushan (2013), Ludian (2014) and Nepal earthquake (2015).

Prof Lu has received several important awards including the Leading Researcher of “Ten Thousand Talent Program” of China (2016), the Young Scholarship of Cheung Kong Scholars Program of Ministry of Education of China (2015), the National Natural Science Award (Second Prize, 2013), the Excellent Young Scientist Fund of National Natural Science Foundation of China (2012), and the "Most Cited Chinese Scholars in Civil and Structural field" by Elsevier (from 2014 to 2017).

Date: 6 Aug 2018 (Monday)
Time: 10am to Noon
Venue: CEE Seminar Room A, Block N1, Level B1, N1-B1b-06
School of Civil and Environmental Engineering (CEE), Nanyang Technological University | Singapore