Spotlight on Structures

Research Journal of The Institution of Structural Engineers

In this new section of *The Structural Engineer*, we shine a spotlight on papers recently published in *Structures* – the Research Journal of The Institution of Structural Engineers.

***Structures* is a collaboration between the Institution and Elsevier, publishing internationally-leading research across the full breadth of structural engineering which will benefit from wide readership by academics and practitioners.**

Access to *Structures* is free to all during 2015. From 2016, Institution members will continue to receive free access as one of their membership benefits. The journal is available online at: www.elsevier.com/locate/structures

Structures Volume 1, Issue 1 features the following articles and is available online at www.sciencedirect.com/science/journal/23520124

Ultimate capacity of structural steel cross-sections under compression, bending and combined loading
Andrew Liew and Leroy Gardner

Thermoelastic buckling and post-buckling of weakened columns
Guotao Yang and Mark A. Bradford

High strength rubberized concrete containing silica fume for the construction of sustainable road side barriers
Mohamed Elchalakani

Characterization of concrete specimen fracture response: 2D numerical study
N. Trivedi, R. K. Singh and J. Chattopadhyay

Economical design procedures for built-up box sections subject to compression and bi-axial bending
Osama Bedair

Engineering stress solutions for bolted and pressurized steel structures
Nelli Aleksandrova

Using the vibration envelope as a damage-sensitive feature in composite beam structures
Stavros Kasinos, Alessandro Palmeri and Mariateresa Lombardo

Sustainable reinforced masonry walls under lateral in-plane load: Experimental behavior and code-based predictions
Richard P. Clarke

In addition, corrected proofs of the following 'in-press' articles have been made available online since February:

Influence of confinement reinforcement on the compression stress–strain of grouted reinforced concrete block masonry boundary elements

Ahmad Abo El Ezz, Hany M. Seif Eldin and Khaled Galal, Department of Building, Civil and Environmental Engineering, Concordia University, Montréal, Canada

http://dx.doi.org/10.1016/j.istruc.2015.01.001

Reinforced masonry (RM) shear walls are widely used in medium- to high-rise masonry buildings as part of the lateral force resisting system to provide the lateral strength, stiffness and energy dissipation capacity required to resist lateral loads arising from earthquakes or wind. In the past few decades, there has been considerable advancement in the design of RM shear walls for new construction with variable types of confinement of the compressed boundaries of the wall for increasing ductility level. Recent codes and standards for design of masonry structures are introducing the use of Ductile Reinforced Masonry (DRM) Shear Walls with column-like boundary elements for the improvement of the ductility capacity of the walls. A key component in the evaluation of the ductility capacity of shear walls is evaluating the compressive response of their boundary elements. This paper presents an experimental and analytical investigation on the compression stress–strain behavior of fully grouted unconfined and confined reinforced concrete block masonry boundary elements. Full scale boundary elements were constructed and tested under concentric axial compression. An analytical stress–strain model was proposed that can be used in the design and assessment of DRM walls with boundary elements.

Time dependent behavior of a FRR thermal break pad under compressive loads

Matthew Oostdyk, Matthew Polhemus, Andreas Gabrielsen, Douglas B. Cleary and William T. Riddell, Rowan University, College of Engineering, Glassboro, NJ, USA

http://dx.doi.org/10.1016/j.istruc.2015.01.002

Fiber reinforced resin plates are used to provide thermal breaks where structural supports penetrate the building envelope. Tests were performed to evaluate the influence of these thermal plates on time-dependent load loss under compressive loading in bolted connections. Configurations considered included a base case without thermal barrier material, configurations with a 25.4 mm thermal barrier plate, and configurations with a steel plate of the same thickness as the thermal barrier. Additional cases also included thermal barrier material washers and two different size cover washers. The bolts in the connections were tightened to approximately 15% over the minimum specified pretension and then monitored for up to 1000 h. The total loss of clamping force measured from the sum of the initial tensioning force until a stable force was achieved were approximately the same for the base configuration all-steel connection and the configurations with thermal barrier, thermal washers and larger diameter hardened washers. Inclusion of the thermal washer resulted in load losses

between initial tightening and stabilization that were larger than found in the baseline all-steel assemblages, and larger than found when a 25.4 mm steel or 25.4 mm thermal barrier plate was included.

Plastic Hinge Relocation in Reinforced Concrete Frames as a Method of Improving Post-earthquake Fire Resistance

Behrouz Behnam, School of Civil and Environmental Engineering, Amirkabir University of Technology, Tehran, Iran, and Structural Retrofit Research Group, School of Civil Engineering, University of Queensland, Brisbane, Australia
Pang Jen Lim and Hamid R. Ronagh, School of Civil Engineering, University of Queensland, Brisbane, Australia
http://dx.doi.org/10.1016/j.istruc.2014.12.003
Post-earthquake fire (PEF) presents a risky situation to buildings that have been partially damaged in a prior earthquake, particularly in urban areas. As most standards ignore the possibility of fire after earthquake, buildings are not adequately designed for that possibility and thus PEF is a high-risk load needed to be scrutinized further, codified and become part of a routine design. An investigation based on sequential analysis inspired by FEMA356 is performed here on a two story RC frame, at the Life Safety performance level and designed to the ACI 318-08 code, after it has been subjected to a spectral PGA of 0.35 g. The results show that structures previously damaged by the earthquake and exposed to PEF are considerably more vulnerable than the structures, which have not been damaged previously. A method of strengthening using Carbon Fiber Reinforced Polymer (CFRP) wraps is introduced in order to relocate plastic hinges away from the column faces towards the beams. This method increases the structural load carrying capacity, and thus reduces the potential damage from a potential earthquake, improving the fire resistance. The results show a considerable improvement in the PEF resistance of the frame.

Prestress losses in pretensioned concrete beams cast with lightweight self-consolidating concrete

Jared C. Bymaster, Arkansas State Highway and Transportation Department, Little Rock, AR, USA
Canh N. Dang, University of Arkansas, USA
Royce W. Floyd, University of Oklahoma, Norman, OK, USA
W. Micah Hale, University of Arkansas, USA
http://dx.doi.org/10.1016/j.istruc.2015.01.003
The use of lightweight self-consolidating concrete (LW-SCC) for pretensioned concrete members offers advantages over the use of conventional, normal weight concrete. This study focused on investigating the prestress losses of 12 pretensioned concrete beams cast with LW-SCC or normal weight SCC (NW-SCC). Two LW-SCC mixtures were developed along with one NW-SCC mixture. The LW-SCC mixtures contained expanded shale or expanded clay coarse aggregates. Prestress losses were measured using vibrating wire strain gauges. The beams were loaded approximately 150 days after casting and losses were measured for an additional 75 days after casting. In addition to prestress losses, the modulus of elasticity (MOE) and shrinkage of the mixtures were measured. Experimental results indicated that the AASHTO-LRFD equation for MOE using a correction factor of 1.0 is appropriate to predict the MOE of LW-SCC. Shrinkage of LW-SCC was less when compared to NW-SCC due to the effect of internal curing. CEB MC90 was the most appropriate model to predict concrete shrinkage. The AASHTO-LRFD methods over-estimated instantaneous and long-time prestress losses. The AASHTO approximate method was more suitable to estimate total prestress losses for the beams using LW-SCC than the AASHTO refined method.

Erratum

In the Research article 'Evaluation of EC2 rules for design of tension lap joints' by Cairns and Eligehausen, published in *The Structural Engineer* in September 2014, there was an error on page 44. The sentence "Characteristic compressive strength is taken as the compressive strength reported for each specimen **plus** 8MPa" should have read "Characteristic compressive strength is taken as the compressive strength reported for each specimen **minus** 8MPa".
A corrected version of the article is available online at: www.thestructuralengineer.org