

# Spotlight on Structures

Research Journal of The Institution of Structural Engineers

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

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## Volume 10

### Editor's highlights

The latest issue of *Structures* is now available online. Editor-in-Chief, Professor Leroy Gardener, has selected the following highlights:

#### Prediction of Wear in Grouted Connections for Offshore Wind Turbine Generators

Paul Dallyn<sup>a</sup>, Ashraf El-Hamalawi<sup>b</sup>, Alessandro Palmeri<sup>b</sup> and Robert Knight<sup>b</sup>

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<http://doi.org/10.1016/j.istruc.2017.02.001>

#### Abstract

Insufficient axial capacity of large-diameter plain-pipe grouted connections has recently been observed in offshore wind turbine substructures across Europe. Aimed at understanding the implications of this phenomenon, a campaign of structural condition monitoring was undertaken. The measurements showed significant axial displacements occurring between the transition piece and the monopile, which in turn resulted in a considerable amount of wear. Given the existing lack of technical data on the implications that this relative movement has on the wear of grouted connections, a methodology was developed to quantify the likely risk to the foundation integrity of the wear failure mode. The proposed approach consists of a numerical model which applies the wear rate derived from previous experimental testing to the conditions experienced by typical offshore grouted connections, as indicated by the wind turbine generators' supervisory control and data acquisition systems. The output of

this model showed that, for a representative sample of the wind farm substructures analysed as a case study, the accumulated lifetime wear would be minimal in the majority of the grouted connection, i.e. less than 0.4mm over 75% of the connection, but a much greater loss in thickness, of the order of 4mm, was predicted at the very top and bottom of the connection. This assessment is based on the assumptions that no significant changes occur in the surrounding environmental conditions and that the degradation in the grouted connection does not significantly affect the dynamic response of the foundation structure over its life span. Importantly, these assumptions may affect the model's predictions in terms of cumulated wear over time, not in terms of identifying the individual connections to be prioritised when performing remedial work, which is indeed the main intended use of the model.

#### Full-scale Tests of Stabilized and Unstabilized Extended Single-plate Connections

Kristin Thomas<sup>a</sup>, Robert G. Driver<sup>b</sup>, Steven A. Oosterhof<sup>c</sup> and Logan Callele<sup>d</sup>

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#### Abstract

Little guidance is available in the literature that is suitable for use in the design of extended single-plate connections. In particular, these connections have not been studied sufficiently for scenarios that involve axial

load, which is relatively common in industrial applications. To address this shortcoming, an investigation into the behaviour of extended single-plate connections was completed by testing 23 full-scale specimens. Connections with and without stabilizer plates were tested that varied in plate thickness, plate depth, and the number of horizontal bolt lines. Horizontal loads varied from 500kN in compression to 200kN in tension. The influences of the test variables on connection behaviour, capacity, and failure mode are discussed. Among the findings of this research are that despite their slenderness these connections tend to be quite ductile, and the capacities of the unstabilized connections without axial load were much larger than those predicted by available design provisions.

#### Splice strength of deformed steel bars embedded in recycled aggregate concrete

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#### Abstract

Splice strength of deformed steel bars embedded in recycled aggregate concrete was experimentally investigated using 24 bottom-cast scaled splice beam specimens detailed with unconfined contact lap splices and tested under four-point bending. The following variables were investigated: concrete grade (normal- and high-strength), recycled concrete aggregate replacement

level (0%, 50% and 100%), rebar diameter (12mm and 20mm) and rebar surface characteristics. Bond behaviour and failure modes were noted to be similar in the natural and in the recycled aggregate concrete and a regression analysis of the results shows that  $fc^{1/4}$  provides a good representation of the influence of recycled aggregate concrete grade on splice strength. A descriptive bond strength equation has been proposed for recycled aggregate concrete and it is noted that the ACI Committee 408R-03 model (for conventional concrete) gave relatively the most accurate and conservative bond strength predictions for the recycled aggregate concretes under investigation.

## Full issue

The issue also includes the following papers:

**Finite Element Study of the Effect of Interfacial Gaps on the in-Plane Behaviour of Masonry Infills Bounded by Steel Frames**  
*Xi Chen and Yi Liu, Dept. of Civil and Resource Engineering, Dalhousie Univ., Halifax, Canada*  
<http://doi.org/10.1016/j.istruc.2016.11.001>

**Shear characteristics of Lean Duplex Stainless Steel (LDSS) rectangular hollow beams**

*J.K Sonu and Konjengbam Darunkumar Singh, Department of Civil Engineering, Indian Institute of Technology Guwahati, India*  
<http://doi.org/10.1016/j.istruc.2016.11.002>

**Full Plastic Resistance of Tubes Under Bending and Axial Force: Exact Treatment and Approximations**

*J. Michael Rotter and Adam J. Sadowski, Department of Civil & Environmental Engineering, Imperial College London, UK*  
<http://doi.org/10.1016/j.istruc.2016.11.004>

**An experimental analysis of a timber Howe truss**

*A.K.M Anwarul Islam and Daniel Phillips, Civil & Environmental Engineering, Youngstown State University, Youngstown, OH, USA*  
<http://doi.org/10.1016/j.istruc.2016.12.003>

**Alternative Admissible Functions for Natural Frequencies and Modeshapes of a Beam with Lumped Attachments**

*Farhad Mir Hosseini and Natalie Baddour, University of Ottawa, Department of Mechanical Engineering, Ottawa, Ontario, Canada*  
<http://doi.org/10.1016/j.istruc.2017.01.001>

**Buckling Analysis of Steel Frames Exposed to Natural Fire Scenarios**

*Thiago Silva<sup>a</sup>, Martina Cari<sup>b</sup>, Carlos Couto<sup>a</sup>, Paulo Vila Real<sup>b</sup>, Nuno Lopes<sup>a</sup> and Davor Skejic<sup>b</sup>*  
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<http://doi.org/10.1016/j.istruc.2017.02.003>

**Behavior of Concrete Filled Elliptical Steel Tubular Deep Beam under Bending-Shear**

*Kojiro Uenaka<sup>a</sup> and Hisao Tsunokake<sup>b</sup>*  
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<http://doi.org/10.1016/j.istruc.2017.02.002>

**Experimental and Numerical Modelling of Shear Behaviour of Full-scale RC Slabs Under Concentrated Loads**

*W.S.A. Nana<sup>a</sup>, T.T. Bui<sup>b</sup>, A. Limam<sup>b</sup> and S. Abouri<sup>c</sup>*  
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<http://doi.org/10.1016/j.istruc.2017.02.004>

**Bending Moment-Axial Force-Curvature Interactions for Metal Beam-Column Sections**

*J.A. Rodriguez-Gutierrez and J. Dario Aristizabal-Ochoa, School of Mines, National University, Medellin, Colombia*  
<http://doi.org/10.1016/j.istruc.2017.03.003>

**Optimizing the Cross-sectional Shapes of Extruded Aluminium Structural Members for Unitized Curtain Wall Facades**

*Adam D. Lee<sup>a,b</sup>, Paul Shepherd<sup>b</sup>, Mark C. Evernden<sup>a</sup> and David Metcalfe<sup>c</sup>*  
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## Highlights

- Efficient design reduces a curtain wall's embodied energy and construction cost
- Cross-sectional shapes of extruded aluminium members are optimized algorithmically
- Machine-generated solutions are superior to those of professional facade designers

**Seismic Performance Evaluation of Asymmetric Reinforced Concrete Tunnel Form Buildings**

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<http://doi.org/10.1016/j.istruc.2017.03.005>

**Nonlinear Dynamic Behavior of Cable Nets Subjected to Wind Loading**

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