

## Neutron Diffraction and the Art of Infrastructure Maintenance

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Potholed roads, failed bridges, leaking water systems and abandoned factories seem to be endemic in this Indispensable Nation of the USA. Most of the nation's infrastructure seems to be in a state of decrepitude. On the other hand, maintenance funds are hard to come by and even harder to spend efficiently since the optimal approaches for remediation: maintenance, repair and/or replacement have political and engineering dimensions. In this presentation I will focus mostly on the engineering dimension. Over the past seven years we have been using neutron diffraction to measure the partitioning of loading and clamping strains within realistic models of suspension-bridge cable strands. I will present an overview of our experiments which have shown that the current models used in analyzing cable structures contain weak assumptions and need to be "adjusted". The nature of such adjustments and future studies which are needed to verify and validate numerical models of large infrastructure-scale structures will also be presented.

### References:

"Measurement of Strain/Load Transfer in Parallel Seven-wire Strands with Neutron Diffraction" I.C. Noyan, A. Brügger, R. Betti and B. Clausen, *Experimental Mechanics*, 50 (2010) 265–272.

"Load Transfer and Recovery Length in Parallel Wires of Suspension Bridge Cables", H. Waisman, A. Montoya, R. Betti, I. C. Noyan, *Journal of Engineering Mechanics*, 137 (2011) 227-237.

"Neutron diffraction measurements of stress redistribution in parallel seven-wire strands after local fracture", F. Mei, I. C. Noyan, A. Brügger, R. Betti, B. Clausen, D. Brown, T. Sisneros, *Experimental Mechanics*, 53 (2013) 183-190

"Partitioning of Clamping Strains in a Nineteen Parallel Wire Strand", *Experimental Mechanics*, A. Brügger, S-Y Lee, J. A. Mills, R. Betti, I. C. Noyan (in print)

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