Exponent®
Engineering & Scientific Consulting

Kristen Hollingsworth, Ph.D.

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Professional Profile

Dr. (Hess) Hollingsworth specializes in the analysis, design, and development of engineered wood products, a class of materials that includes plywood, oriented strand board (OSB), and laminated veneer lumber (LVL). Her experience includes designing and drafting site construction plans for retail and multi-family residential projects.

Dr. Hollingsworth has developed and applied micromechanical moisture-induced deterioration models for wood polymer composites, and she has expertise in mechanical and microscopy characterization using load frame systems, atomic force microscopy (AFM), nanoindentation (NI), and x-ray computed tomography (XCT).

Prior to joining Exponent, Dr. Hollingsworth was a postdoctoral associate and graduate research assistant at the University of Colorado Boulder, where she earned her doctorate in civil engineering. During her postdoctoral work, she used material design and mechanical testing to transition a living building material that uses biomineralization to enhance fracture toughness from lab scale success toward construction applications. Her dissertation work focused on the hygromechanical behavior of natural fiber composites (NFCs) for construction applications to further understand and better predict the mechanical response of NFCs to environmental aggressors, such as humidity, water, and freezing temperatures. She developed and experimentally validated a micromechanical model that was used to predict the onset of moisture-induced damage for different wood polymer composite (WPC) formulations in relative humidity conditions corresponding to in-service placement. To expand from WPCs to all NFCs, the micromechanical model needed to be extended to the lignocellulosic polymer length scale. Consequently, she established a collaboration with the National Institute of Standards and Technology (NIST) to perform material property characterization of lignin and cellulose, the primary polymers in every natural fiber, using atomic force microscopy. Notably, she developed a new low total force AFM technique to measure viscoelastic properties of cellulose nanofibrils.

Academic Credentials & Professional Honors

Ph.D., Civil Engineering, University of Colorado, Boulder, 2020

M.S., Civil Engineering, University of Colorado, Boulder, 2015

B.S., Civil Engineering, University of Virginia, 2010

Professional Affiliations

Earthquake Engineering Research Institute (EERI)

American Society of Civil Engineers (ASCE)

Publications

Hess, K.M., Heveran, C.M., and Srubar III, W.V. (2020). A computational approach to design moisture-resistant wood polymer composites. Materials Today Communications, 25, 101594.

Noonan, K., K.M. Hess, and W.V. Srubar III. (2019). Moisture- and freeze-thaw-induced deterioration of natural fiber composites with low fiber contents. Academic Journal of Civil Engineering, 37(2), 398-404.

Foster, K. E., K.M. Hess, G.M. Miyake, and W.V. Srubar III. (2019). Optical Properties and Mechanical Modeling of Acetylated Transparent Wood Composite Laminates. Materials, 12(14), 2256.

Hess, K.M., J.P. Killgore, and W.V. Srubar III. (2018). Nanoscale Hygromechanical Behavior of Lignin. Cellulose, 25(11), 6345-6360.

Hess, K.M., and W.V. Srubar III. (2017, June). Predicting Freeze-Thaw Deterioration in Wood-Polymer Composites. In International Conference on Bio-based Building Materials.

Hess, K.M., and W.V. Srubar III. (2016). Activating relaxation-controlled diffusion mechanisms for tailored moisture resistance of gelatin-based bioadhesives for engineered wood products. Composites Part A: Applied Science and Manufacturing, 84, 435-441.

Hinchcliffe, S.A., K.M. Hess, and W.V. Srubar III. (2016). Experimental and theoretical investigation of prestressed natural fiber-reinforced polylactic acid (PLA) composite materials. Composites Part B: Engineering, 95, 346-354.

Hess, K.M., and W.V. Srubar III. (2015). Mechanical Characterization of Gelatin-Flax Natural-Fiber Composites for Construction. Journal of Renewable Materials, 3(3), 175-182.

Dorr, D.N., S.D. Frazier, K.M. Hess, L.S. Traeger, and W.V. Srubar III. (2015). Bond Strength of Biodegradable Gelatin-Based Wood Adhesives. Journal of Renewable Materials, 3(3), 195-204.

Presentations

Hess, K.M.*, J.P. Killgore, and W.V. Srubar III. Quantitative Viscoelastic Mapping of Cellulose Nanofibrils (CNFs) Using Low-Total-Force Contact Resonance Force Microscopy (LTF-CRFM). In 2021 International Scanning Probe Microscopy and Scanning Probe Microscopy on Soft & Polymeric Materials, Virtual, July 30, 2021. (Presentation, *Presenter)

Noonan, K.*, K.M. Hess, and W.V. Srubar III. Moisture- and Freeze-Thaw-Induced Deterioration of Natural Fiber Composites with Low Fiber Contents. In International Conference on Biobased Building Materials, Belfast, United Kingdom, June 26, 2019. (Presentation, *Presenter)

Hess, K.M.*, P.B. Murray, W.V. Srubar III, and A.B. Liel. The Effect of Urban Location on the Economic Viability of Repairing or Demolishing Buildings with Earthquake Damage. In EERI 2019 Annual Meeting, Vancouver, British Columbia, Canada, March 7, 2019. (Poster, *Presenter)

Foster, K.E.*, K.M. Hess, G.M. Miyake, W.V. Srubar III. Translucent Wood Composites: Fabrication, Characterization, and Mechanical Modeling. In 2018 National Graduate Research Polymer Conference, Minneapolis, Minnesota, June 10-11, 2018. (Presentation, *Presenter)

Hess, K.M.*, J.P. Killgore, and W.V. Srubar III. Nanoscale Hygromechanical Behavior of Lignin. In ASCE Engineering Mechanics Institute Conference, Boston, Massachusetts, May 30, 2018. (Presentation, *Presenter)

Hess, K.M., W.V. Srubar III*. Predicting the Freeze-thaw Deterioration of Natural Fiber Composites. In International Conference on Biobased Building Materials, Clermont-Ferrand, France, June 21-23, 2017. (Presentation, *Presenter)

Hess, K.M.*, E.A. Delesky, and W.V. Srubar III. Bio-Inspired Design for Resilient and Sustainable Infrastructure. In ASCE Structures Congress, Denver, Colorado, April 6, 2017. (Presentation, *Presenter)

Hess, K.M.*, and W.V. Srubar III. A Review of Natural Fiber Composites Research. In Symposium for Sustainable Infrastructure – Rocky Mountain Region, Boulder, Colorado, May 23, 2016. (Poster, *Presenter)

Srubar III, W.V.*, K.M. Hess, D.N. Dorr, L.S. Traeger, S.D. Frazier. In International Conference on Biobased Building Materials, Clermont-Ferrand, France, June 22-24, 2015. (Presentation, *Presenter)

Hess, K.M.*, S.A. Hinchcliffe, and W.V. Srubar III. Biobased FRPs for Retrofit and Rehabilitation of Civil Infrastructure. In ASCE Structures Congress, Portland, Oregon, April 22, 2015. (Presentation, *Presenter)