

**Zhenglai Shen, Ph.D**  
**R&D Associate Staff at Oak Ridge National Laboratory**  
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**Appointment and Experience:**

- R&D Associate Staff, Oak Ridge National Laboratory (July 2023 – Current)
- Postdoctoral Research Associate, Oak Ridge National Laboratory (July 2021 – June 2023)
- Research Associate, Civil and Environmental Engineering, University of Tennessee, Knoxville (January 2020 – June 2021)
- Graduate Research/Teaching Assistant, Civil and Environmental Engineering, the University of Alabama in Huntsville (May 2014 - December 2019)
- Graduate Research Assistant, Del E. Web School of Construction, Arizona State University (January 2013 - December 2013)

**Education:**

- Ph.D. 2019 Civil and Environmental Engineering, Univ of Alabama Huntsville, USA.
- M.S. 2010 Civil Engineering, Tongji University, China.
- B.S. 2006 Civil Engineering, Central South University of Forestry and Technology, China.

**Research Interests:**

- Improve building energy efficiency through integrating renewable energy, thermal energy storage system, and advanced control strategies into building envelope
- Reduce the high computational cost in thermal energy storage system/active building envelope design and optimization through machine-learning-assisted applications
- Building envelope inspection by multiple sensor data fusion (e.g., temperature, thermal image)
- Building envelope retrofitting by developing flexible mounting features and modularized high-performance panel
- Risk-based analysis, design, and decision-making for building thermal and structural resilience
- Innovative building materials (e.g., PCM, high-performance insulation)

**Memberships:**

Associate member of ASHRAE

**Services:**

- Reviewers for the journals: Journal of Cleaner Production, Journal of Sustainable Cement-Based Materials, Journal of Building Performance Simulation.

**Experiment Skills:**

- Characterize the thermal conductivity of insulation and PCM using Heat Flow Meter Apparatus (HFMA) following ASTM C518
- Characterize the latent heat of PCM using HFMA (ASTM C1784-20) and DSC (ASTM D3418)
- Characterize the thermal performance of full-size building envelope panels using Rotatable Guarded Hot Box (RGHB) (ASTM C1363)
- Data acquisition (DAQ) system programming through LoggerNet of Campbell Scientific and LabView of National Instrumentation

**Computing and Modeling Skills (Proficient level):**

- Programming Languages: Python, Matlab, LabView
- Building Energy Simulation: EnergyPlus
- Finite Element Analysis: COMSOL, Abaqus, OpenSees, SAP2000
- Other Software: Office, AutoCAD, Building Controls Virtual Test Bed (BCVTB), Solidworks, Grasshopper, Origin

### **Peer-Reviewed Journal Publications:**

- [1] **Shen Z**, Shrestha S, Howard D, Feng T, Hun D, She B. Machine learning – assisted prediction of heat fluxes through thermally anisotropic building envelopes. *Building and Environment* 2023;234:110157. <https://doi.org/10.1016/j.buildenv.2023.110157>.
- [2] **Shen Z**, Chen C, Fefferman N, Zhou H, Shrestha S. Community Vulnerability is the Key Determinant of Diverse Energy Burdens in the United States. *Energy Research & Social Science* 2022:102949. <https://doi.org/10.1016/j.erss.2023.102949>.
- [3] Xiao R, **Shen Z**, Polaczyk P, Huang B. Thermodynamic Properties of Aggregate Coated by Different Types of Waste Plastic: Adhesion and Moisture Resistance of Asphalt-Aggregate Systems. *Journal of Materials in Civil Engineering* 2023. <https://doi.org/10.1061/JMCEE7.MTENG-15679>.
- [4] Xiao R, Nie Q, He J, Lu H, **Shen Z**, Huang B. Strategies for Using Lowly-Reactive Coal Gasification Fly Ash (CGFA) to Stabilize Aggregate Bases. *Journal of Cleaner Production* 2022. <https://doi.org/10.1016/j.jclepro.2022.133320>.
- [5] Xiao R, **Shen Z**, Si R, Polaczyk P, Li Y, Zhou H, Huang B. Alkali-activated slag (AAS) and OPC-based composites containing crumb rubber aggregate: Physico-mechanical properties, durability and oxidation of rubber upon NaOH treatment. *Journal of Cleaner Production* 2022. <https://doi.org/10.1016/j.jclepro.2022.132896>.
- [6] Chen C, Liu Y, Greig JA, **Shen Z**, Shi Y. The impacts of COVID-19 on clean energy labor markets: Evidence from Multifaceted analysis of public health interventions and COVID-health factors. *Energy Policy* 2022;164:112880. <https://doi.org/10.1016/j.enpol.2022.112880>.
- [7] **Shen Z.**, Brooks AL, He Y, Wang J, Zhou H. Physics-guided multi-objective mixture optimization for functional cementitious composites containing microencapsulated phase changing materials. *Materials and Design*. 2021;207:109842. <https://doi.org/10.1016/j.matdes.2021.109842>.
- [8] **Shen Z.**, Brooks AL, He Y, Shrestha SS, Zhou H. Evaluating dynamic thermal performance of building envelope components using small-scale calibrated hot box tests. *Energy and Buildings*. 2021;251:111342. <https://doi.org/10.1016/j.enbuild.2021.111342>.
- [9] **Shen Z.**, Zhou H., Brooks AL., and Dominic H. Evolution of elastic properties of lightweight cementitious composites containing polydispersed core-shell particles under elevated temperature: Experimental and analytical studies. *Cement and Concrete Composites*. 2021. <https://doi.org/10.1016/j.cemconcomp.2021.10393103931>.
- [10] Brooks AL, Fang Y, **Shen Z**, Wang J, Zhou H. Enabling high-strength cement-based materials for thermal energy storage via fly-ash cenosphere encapsulated phase change materials. *Cement and Concrete Compositions*. 2021. <https://doi.org/10.1016/j.cemconcomp.2021.104033>.
- [11] **Shen Z.**, Zhou H., and Shrestha SS. (2020) LCC-based framework for building envelope and structure co-design considering energy efficiency and natural hazard performance. *Journal of Building Engineering*.

2020. <https://doi.org/10.1016/j.jobe.2020.102061>.

[12] Asadi E., **Shen Z.**, Zhou H., Salman A., and Li Y. (2020), Risk-informed multi-criteria decision framework for resilience, sustainability, and energy analysis of reinforced concrete buildings. *Journal of Building Performance Simulation*, 2020: <https://doi.org/10.1080/19401493.2020.1824016>.

[13] **Shen Z.**, Zhou H. (2020), Predicting effective thermal and elastic properties of cementitious composites containing polydispersed hollow and core-shell micro-particles. *Cement and Concrete Composites*, 2020: 103439. doi:10.1016/j.cemconcomp.2019.103439.

[14] Brooks AL, **Shen Z.**, Zhou H. (2020), Development of a high-temperature inorganic synthetic foam with recycled fly-ash cenospheres for thermal insulation brick manufacturing. *Journal of Cleaner Production*, 2020:118748. doi:10.1016/j.jclepro.2019.118748.

[15] **Shen Z.**, Zhou H. (2017) Mechanical and electrical behavior of carbon fiber structural capacitors: Effects of delamination and interlaminar damage. *Composite Structures*, 2017; 166:38–48. doi:10.1016/j.compstruct.2016.12.062.

[16] Brooks AL, Zhou H, **Shen Z.** (2017) A monolithic “unibody” construction of structural assemblies through vacuum-assisted processing of agro-waste fibrous composites. *Construction and Building Materials*, 2017;153:886–96. doi:10.1016/j.conbuildmat.2017.07.082.

[17] Tang, P., Chen, G., **Shen, Z.**, and Ganapathy, R. (2016) A Spatial-Context-Based Approach for Automated Spatial Change Analysis of Piece-Wise Linear Building Elements. *Computer-Aided Civil and Infrastructure Engineering*, 2016;31:65–80. <https://doi.org/10.1111/mice.12174>.

[18] Tang, P., **Shen, Z.**, Olson, M. P., and Ariaratnam, S. T. (2015) Time Series Analysis of Hydraulic Data for Automated Productivity Monitoring of Pilot Tube Microtunneling. *Journal of Pipeline Systems Engineering and Practice* 2015, American Society of Civil Engineers, 04015022, DOI: 10.1061/(ASCE)PS.1949-1204.0000225

#### **Peer-Reviewed Conference Paper (Full papers):**

[1] **Shen Z.**, Shrestha S, Howard D, Feng T, Hun D, She B. A Machine Learning-Assisted Framework to Control Thermally Anisotropic Building Envelopes in Residential Buildings. *Build. XV Conf., Clearwater, Florida: 2022*.

[2] Rendall J, **Shen Z.**, Shrestha S, Gehl T, Atchley J. “An experimental method to determine the contact thermal resistance of PCM materials undergoing large volume change.” *Proc. 19th Int. Refrig. Air Cond. Conf. Purdue, West Lafayette, Indiana, US: 2022, p. 1–10*.

[3] Asadi E., **Shen Z.**, Zhou H., Salman A., and Li Y. (2020) “Life-Cycle Resilience and Sustainability Assessment of Reinforced Concrete Buildings with Thermal-Mass Walls.” *IALCCE 2020 The Seventh International Symposium on Life-Cycle Civil Engineering, 2020, Shanghai, China, October 27-30*.

[4] Zhou H., **Shen Z.**, Brooks A.L., Hanna D., and Salarieh B. (2018) “Thermal and Mechanical Properties of Cementitious Composites for Additive Construction of Energy-saving Habitats.” *2018 ASCE Earth and Space Conference, Cleveland, OH, April 11 – 15, 2018*.

[5] **Shen Z.**, Zhou H. (2017) “Behavior of Curved Steel I-Girder During Early Stage of Construction: Field Evaluation” *TRB 96<sup>th</sup> Annual Meeting, Washington DC, 2017*.

[6] **Shen Z.**, Zhou H. (2016) “Carbon fiber-based structural electric capacitors: coupled mechanical-

electrical behavior and effect of interlaminar damage” *Proc. 2016 ASCE Earth and Space Conference, Orlando, FL, April 11-15, 2016.*

[7] Zhou H., Brooks A.L., **Shen Z.**, and Hanna D. (2016) “Monolithic “Unibody” Light-Frame Structures: An Integrated Solution for Multi-hazard Mitigation and Building Energy Enhancement” *Proc. 2016 Geotechnical and Structural Engineering Congress, Phoenix, AZ, 2016.*

[8] **Shen, Z.**, and Tang, P. (2014). “Time-Quality Analysis of Spatial Data Processing for Bridge Management.” Proceedings of the International Conference on Computing in Civil and Building Engineering - 2014, R. Issa and I. Flood, eds., ASCE, Orlando, Florida, USA, June 23 – 25, 2014. 12.

[9] Song, M., **Shen, Z.**, and Tang, P. (2014). “Data Quality Oriented 3D Laser Scan Planning.” Proceedings of the 2014 Construction Research Congress - Construction in a Global Network, D. Castro and Javier Irizarry, eds., ASCE, Atlanta, GA, Pages 984-993, May 19, 2014 13.

[10] **Shen, Z.**, Tang, P., and Ariaratnam, S. T. (2014). “Analyzing Abnormal Cycles of Pilot Tube Microtunneling through Pattern Recognition in Time-Series Data of Hydraulic Pressure.” Proceedings of the 2014 Construction Research Congress Construction Research Congress 2014 - Construction in a Global Network, D. Castro and Javier Irizarry, eds., ASCE, Atlanta, GA, Pages 994-1003, May 19, 2014.

[11] Tang, P., **Shen, Z.**, Olson, M., and Ariaratnam, S. T. (2013). “Automated Productivity Analysis of Pilot Tube Microtunneling Installations through Workflow Recognition in Time Series Data of Hydraulic Pressure.” Proceeding of the 4th International Conference on Pipelines and Trenchless Technology for Construction (ICPTT 2013), M. Najafi and B. Ma, eds., American Society of Civil Engineers, Xi’an, China, P.R. (presented on 2013 conference, to be included in 2014 proceeding) November 20, 2014.

[12] Tang, P., **Shen, Z.**, & Ram Ganapathy. (2013). “Automated Spatial Change Analysis of Building Systems Using 3D Imagery Data.” In CIB W78 2013: 30th International Conference on Applications of IT in the AEC Industry. Beijing, China: CIB, October 15, 2013.

[13] Tang, P., **Shen, Z.**, Kannan, O., and Cho, Y. K. (2013). “As-Built Error Modeling for Effective 3D Laser Scanning on Construction Sites.” 2013 ASCE Workshop of Computing in Civil Engineering, Los Angeles, CA, USA, June 23 – 25, 2013.

[14] Tang, P., Olson, M., **Shen, Z.**, and Ariaratnam, S. T. (2013). “Automated Monitoring of Pilot Tube Microtunneling Installations through Pattern Recognition in Time-Series Data of Hydraulic Pressure.” Proceeding of ASCE’s Pipelines 2013 Conference, M. Najafi and B. Ma, eds., American Society of Civil Engineers, Fort Worth, TX, USA, June 23 – 26, 2013.

[15] Cheng, W., **Shen, Z.** “An Improved Method to Calculate the Directions and Weights in Microplane Constitutive Model”, FramCos7, Jeju, S. Korea, 2010.