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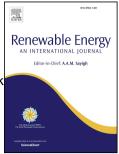
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An innovative energy pile technology to expand the viability of geothermal bridge deck snow melting for different United States regions: computational assisted feasibility analyses

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15 ABSTRACT

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Energy pile provides a sustainable way for snow removal of transportation infrastructure 17 while fulfilling its role in supporting the structural and service loads. In a previous study, 18 19 the authors have analyzed the potential of conventional energy pile to remove snow on a highway bridge deck, and found that the application is only technically feasible for 20 21 geographic regions with high underground thermal resources. To further expand its applications, this paper proposes an innovative energy pile technology where the concrete 22 pile is modified with phase change material (PCM) to improve thermal energy extraction. 23 A computational model is constructed to evaluate the performance of this new energy pile 24 technology. The results show that geothermal energy extraction is significantly enhanced 25 by incorporating PCM into concrete pile. Sensitivity analyses are conducted on the use 26 of energy pile modified with different mass fraction PCM for snow melting of a 27 prototype highway bridge deck in 10 different U.S. cities located in different climate 28 regions. The results indicate that the new energy pile technology can potentially 29 significantly expand the geographic regions where energy pile is viable for bridge deck 30 snow removal. Aspects to further improve the economic viability of the new PCM 31 modified energy pile technology are discussed. 32

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Keywords: Geothermal heat exchanger pile, Snow Melting, Phase Change Material,
 Finite Element Modeling

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