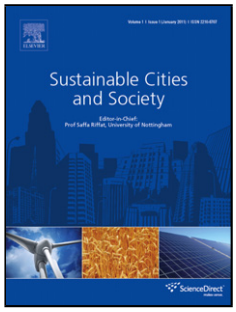

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PII: S2210-6707(17)31316-1
DOI: https://doi.org/10.1016/j.scs.2018.01.011
Reference: SCS 924

To appear in:

Received date: 29-9-2017
Revised date: 2-12-2017
Accepted date: 8-1-2018

Please cite this article as: Arkar, Ciril., Domjan, Suzana., & Medved, Sašo., Lightweight composite timber façade wall with improved thermal response.*Sustainable Cities and Society* https://doi.org/10.1016/j.scs.2018.01.011

Lightweight composite timber façade wall with improved thermal response

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Highlights

- Thin (68 mm) composite timber façade wall with improved thermal response was designed.
- Beside timber, commercially available vacuum thermal insulation and phase change material were used.
- VIP and PCM layer position within composite wall was optimized with numerical analysis.
- Dynamic boundary conditions on both sides of composite wall were anticipated in the analysis.
- 9-12 h time lag, comparable to heavyweight constructions, was achieved for optimized composite wall.
- Night-time heat losses of composite façade wall are at least 90% lower than by laminated timber wall.

Abstract
For the construction of modern energy-efficient buildings, lightweight construction is becoming very popular among designers. EU legislation encourages such design, especially if wood, as a sustainable material, is used. However, lightweight building envelope construction, in general, exhibits poor dynamic thermal properties, which are particularly pronounced in prefabricated metal walls and thin wooden or composite building panels, such as door fillers or opaque parts (parapets) of prefabricated walls with the glazing of the skeleton-built buildings. The aim of this research was the development of a composite timber façade wall, which will not exceed the thickness of building elements, such as doors and windows, and will meet the requirements of energy efficiency and have improved dynamic thermal properties. The composite timber building element with a thickness of 68 mm, which includes two layers of advanced technologies: vacuum insulation panel (VIP) and phase change material (PCM), was developed and optimized. The optimization included a parametric study on VIP and PCM panels' position in the thin, lightweight building wall. The research has shown that dynamic thermal properties comparable to the heavyweight building envelope constructions (time lag of the heat wave up to 12 hours) can be achieved; moreover, the thermal transmittance is considerably reduced.

Keywords:

Lightweight building envelope, Composite timber wall, Vacuum insulation panel, Phase change material, Sustainable buildings