Abstract #3
Submitting author: Paulo Santos (pfsantos@dec.uc.pt)

A Parametric Study on Thermal Transmittance of External Facade Lightweight Steel Framed (LSF) Walls

Santos, P.[1], Lemes, G.[1], Mateus, D.[1]

[1] ISISE, Dep. of Civil Engineering, University of Coimbra, PORTUGAL

Abstract

Given its economical, functional and environmental advantages, Lightweight Steel Frame (LSF) construction is gaining market share, particularly for low-rise residential buildings, relatively to traditional concrete structure and masonry brick walls construction.

However, these LSF elements need to be well designed and protected against undesired thermal bridges caused by the steel high thermal conductivity. To reduce energy consumption in buildings it is necessary to understand how heat transfer happens in every kind of walls and their configurations, and to adequately reduce the heat loss through them by decreasing its thermal transmittance (U-value).

In this work, numerical simulations are performed to assess different setups for LSF exterior facade walls. Several parameters, such as: (1) thickness of steel studs; (2) clearance between studs; thermal break strips: (3) thickness and (4) material; (5) configuration of internal sheathings panels, and; (6) thickness of EPS external thermal insulation composite system (ETICS), were evaluated separately to measure their influence on the wall overall U-value.

The existence of an ETICS continuous thermal insulation on the outer side reduces itself the heat flux through the wall, particularly through the steel frame, resulting on a lower wall U-value and decreasing the importance of other evaluated parameters. In fact, the major and the minor U-value increment was found changing the thickness of the EPS insulation ETICS layer, i.e. an augment of +79.0% when there is no EPS (0.0 mm thick) and a decrease of -19.2% for 80 mm EPS thickness. Notice that the reference wall has 50 mm of EPS ETICS.

Decreasing the steel thickness (1.5 mm) to 0.6 mm allowed to reduce the U-value down to only -3.3% (-0.009 W/(m^2.K)). When changing the distance between the vertical studs from 600 mm to half (300 mm), doubling the amount of steel, the U-value increased only +17.0% (+0.047 W/(m^2.K)). The use of aerogel thermal break strips with different thicknesses (up to 10 mm) allowed to reduce the U-value down to -10.1% (-0.028 W/(m^2.K)). The use of different inner sheathing panels (GPB, OSB and XPS) allowed to obtain a U-value variation down to -7.2% (-0.020 W/(m^2.K)) for the XPS/GPB panels.

Topic: Advanced facade design, technology and materials.

Keywords: Facade wall, LSF construction, Numerical simulations, Parametric study, Thermal bridges, Thermal transmittance.

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