# Insulation better than expected – U-value measurement saves cash

A house owner and energy consultant is planning to improve the insulation of his home which was built in 1952. Currently the wall is composed of a 30 cm brick layer which is plastered on both sides (see picture 1). He would like to optimize the insulation by using Aerogel® -damping matting and a plaster that fits with it.
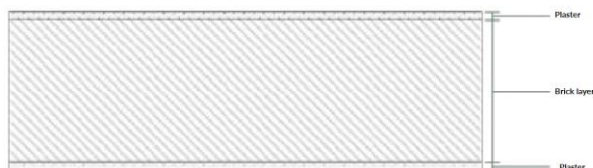
Picture 1: Original wall mounting

The house has two floors with a total wall area of 100 m². He looks up the typical U-values for the material used in buildings built in 1952 in the publication "Bekanntmachung zur Datenaufnahme und Datenverwendung im Wohngebäudeberstand" ("Notice of the rules for data acquisition and usage in residential buildings") dated 07.04.2015. According to this the building envelope should have a U-Value of around 1.5W/m²K. In addition to this he calculates the U-value using the known/historic thermic conductivity values (λ) as well as using the heat-transfer coefficient (R_{si}, R_{se})(see formula 1).

$$U = \frac{1}{R} = \frac{1}{R_{SI} + \frac{d_1}{\lambda_1} + \frac{d_2}{\lambda_2} + \cdots + \frac{d_n}{\lambda_n} + R_{SE}}$$

U = U-value
R = R-Value
R_{SI} = heat-transfer coefficient inside
R_{SE} = heat–transfer coefficient outside
d = thickness
λ= thermic conductivity

$\lambda_{Plaster} = 0.34 \frac{W}{mK}$

$\lambda_{Brick\ layer} = 0.58 \frac{W}{mK}$

Formula 1: U-value calculation

The result of these calculations is 1.29 W/m²K. Since he trusts both methods the historical estimated value and his calculations equally, he assumes a U-value of 1.38 W/m²K for his building envelope. In order to follow the recommendations of the Energy saving ordinance from 2014 (EnEV) he targets a minimal U-value of 0.24 W/m²K. In order to achieve this, a 20mm thick damping plaster with a λ value of 0.056 W/mK is installed on the outer side. For the damping mattings he decides to use 10mm thick Aerogel Spaceloft® mats with a λ value of 0.0131 W/mK. To achieve the requested U-value he would have to use 44mm thick Aerogel for which he would need to buy five 100m²-Aerogel mats at a total price of around 30'000 €. Since the building owner is insecure on whether his numbers/information are correct and he is aware of the fact that using too much insulation has not only an impact on his financials but also on the environment, he decides to acquire a gSKIN U-Value Kit from greenTEG. This instrument allows precise measurements of building envelopes.

The costs of this tool are around 1480€. After several representative measurements he determines that his building envelope has better insulation properties than he had assumed before. The walls have a U-value of 1.13W/m²K. Reasons for this differences might be that he misjudged the material. The homeowner assumed that the wall was made of solid brick which typically have a λ value of 0.60W/mK. Another possibility is that supplementary insulation had already been added or that the material developed differently to the common expectations. Humidity might have also played a role (in this case humidity might have been lower than expected).

To reach the target U-value 5 layers of damping mattings are required which still cost 30'000€ (43mm Aerogel® -damping matts needed). If there would be thinner Aerogel® -damping matts, he could therefore save money using less matts.
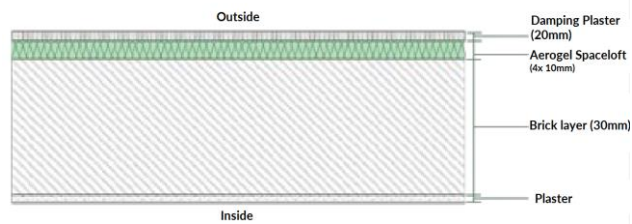
Picture 2: Wall mounting after additional damping

By using less material than originally expected, the homeowner could not only gain economic benefits but also ecological advantages. For instance the ventilation might not be suitable for the stronger insulation and therefore increased humidity might arise. Increased humidity may cause mould to grow and when the humidity enters the wall, the insulation effect might be impaired. Additionally, the homeowner should be aware that the production of damping material is linked to CO_2 emission and therefore embodied energy can be saved.

Do you have questions concerning the U-value? Please contact us: info@greenTEG.com