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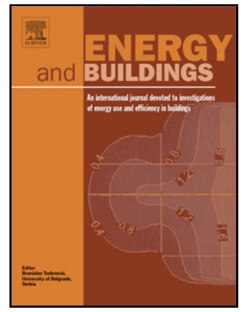

Title: Reliability of Energy Efficient Building Retrofitting - Probability Assessment of Performance and Cost (Annex 55, RAP-RETRO)

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Reliability of Energy Efficient Building Retrofitting - Probability Assessment of Performance and Cost (Annex 55, RAP-RETRO)

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Abstract

The scope of the annex has been to develop and provide decision support data and tools for energy retrofitting measures. A suggested risk management process is presented. Requirements on general guidelines, which can speed up the decision process and at the same time raise awareness for the associated risks, are suggested. A guideline for the retrofitting of a cold attic developed based on a probabilistic risk assessment method is demonstrated, which includes energy use, life cycle cost and functional performance.

Keywords

Risk assessment, retrofit, energy efficiency, random, probabilistic, Monte Carlo, mould growth, performance

Background

Nowadays energy and durability issues are some of the most important topics in industrialised countries. Even though considerable progress has been achieved concerning new buildings (low energy, passive houses, zero energy and so on) and advanced building services, the building sector still accounts for the largest share of energy-related carbon dioxide (CO_2) emissions. While in many industrialized countries new buildings are constructed every year corresponding to approximately 1% of the existing building stock, often more than 50% of the building stock dates from before the energy crises in the 1970s. Hence, a large potential for energy savings - and consequently a large reduction of greenhouse gas emissions - is presently available in the existing building stock.

Using good practice and well-proven solution when designing and erecting new buildings, most often lead to good and expected performances. However, this requires that the factors that the design concept is based upon fulfil certain standards and are within expected ranges. These factors could for instance be workmanship, the interior and exterior climate and material properties. Quality assurance procedures are a great help for this matter. However, when retrofitting or making changes in old buildings a lot of unexpected processes can take place (Fink, Holm and Antretter, 2015). For instance, the airtightness of new windows can change the air pressure distribution of the building; it changes the ventilation rate, which in turn changes the vapour content of the indoor air. This was not anticipated in practice, even though it could very easily be predicted, and led to indoor air quality and moisture damages after the oil crises in the 70’s. As a single measure to reduce the energy demand it was fast and inexpensive. Another example retrofitting with additional thermal insulation on the attic floor. Once again, an inexpensive single measure, that has caused moisture damages in attics. When adding insulation, the cold attic became colder and more susceptible for up-flowing indoor air. Also changes from one heating source to another can cause problem. Going from the use of a furnace based heating system with a chimney to district heating both changes the temperature in the attic as well as the air pressure distribution in the building. Both of these two consequences can lead to moisture damages in the attic.

Building physics related phenomena are very often strongly non-linear, i.e. small changes can lead to big changes in the hygrothermal conditions since heat, moisture and air transfer, and related conditions, are strictly linked to each other. Unfortunately, common sense cannot always give sufficient guidance.