Impact of the different life cycle cost models on design decisions for insulation.

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Abstract :

Nowadays, the building sector is considered as the largest consumer of energy before industry and transportation with an energy consumption that reaches 40% of the global energy demand, it is so responsible of 30% of the total CO_2 emissions in the atmosphere.
Many researches proved that improving the energetic performances of buildings remains an economic means to combat climate change and to improve the energy security. However, contractors currently associate economic characters to facilities rather expensive and therefore to additional costs whereas an appropriate choice in the insulation materials during the design process would be sufficient to achieve these energetic and environmental goals at low prices.

Actually, to ensure energetic savings, a good insulation design becomes important. This design requires an appropriate choice of the insulation material associated to a thickness that is generally set according to the local climate. However, these materials are generally subjected to external factors that alter their thermal characteristics. Hence, these materials become subjected to uncertainty that can affect the reliability of the insulation.

In a first time, we propose to show the impact of these uncertainties on the reliability. Therefore, for the same insulation thickness, the reliability of an insulation estimated with the uncertain characteristics is compared to the initially estimated reliability, which is computed with the defaults values given by the manufacturers.
Then with the aim of ensuring economic savings, a reliability based design optimization is driven to show the impact of these uncertainties on the optimum thickness to be used. Therefore, the optimum thickness computed with the defaults characteristics is compared to the one obtained while considering uncertainties.

In a second time, we have noticed that the life cycle cost used for the optimization considers only the investment and energy costs, whereas other costs related to the local regions may influence the decision making process. These additional costs are principally related to the environment like the cost of pollution with the emergence of the carbon tax and other costs related to socio-economic factors such as the housing value of the region. Hence, a new life cycle cost model considering these indirect costs is proposed and a comparison is driven between the optimal insulation thicknesses obtained by considering the classical cost model and the ones obtained using the new cost model. Finally, the impact of each cost is quantified individually.