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CASE STUDY

Feasibility of upgrading the energy performance of recent massive brick houses

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Abstract
Climate change policies imply significant reductions of energy use in buildings. For this, prevailing energy performance standards fall short, notwithstanding the emergence of stricter national building regulations. Regulations cover new built and renovation projects. New built houses that miss the best energy performance are soon candidate for energy upgrading. We investigate the architectural and economic aspects of upgrading recently built detached massive brick houses in Flanders (Belgium). For representing actual building practices, consecutive upgrading steps from lower to higher energy performance levels are considered. Questions addressed are: What is technically feasible in upgrading such houses? Which construction works are easy, which difficult? What are the architectural and financial consequences of a thorough upgrading?
The analysis shows that deep energy transformations are financially unacceptable, related to the irrevocable character of investments in energy efficiency attributes of massive brick houses. This confirms that energy performance endowment measures should be designed and implemented at the time of first construction of a building.

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1. Introduction

Climate policies cover long-term perspectives but in the built environment the future is literally casted in concrete. The Energy Performance of Buildings Directive (EPBD) 2010/31/EU (EU, 2010) wants new buildings and major renovations to apply the passive or near zero energy standards from 2020 onwards. The Flemish region responds to the EPBD by prescribing tighter energy performance standards year by year (VEA, 2010).

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Frontier energy performance concepts are not widely adopted by the housing market in Flanders. Builders chose among a range of energy performance levels because current standards lack tightness. They often believe that financial returns of low energy buildings do not compensate the higher investment costs, especially not in the nearby years. This myopic perspective perceives energy efficient measures as expensive. As a result, most recently built houses are designed to harshly meet the legally imposed standards (VEA, 2011). Many, e.g., Feist (1998), Verbeeck (2007), Verbeeck and Hens (2005), Versele et al. (2009), recommend higher energy performance levels in new houses of Central-Europe. Applying proper investment theory, Verbruggen et al. (2011) show that installing the frontier energy performance endowment is the financially sound option at first construction.

In Flanders long-lasting massive brick constructions are characteristic, especially within the housing market. Such houses own concrete floors installed in situ with raw materials or with prefabricated elements. The walls outside and inside are mostly brickwork. Outside walls are layered: inside wall, thermal insulation, a narrow cavity, and as façade some fancy brickwork. Fig. 1 shows at the top the reference house of this study. The bottom is a detail of the outer wall of the house. The insulation PUR plates are placed in cross-over for tightening the seams; the black colour outside brick is the finishing.

Currently new built massive brick houses are expected to remain part of the built environment for decades to centuries. Such buildings undergo systematic renovations in cycles of about thirty years (Liebregts and Persoon, 2009). For meeting evolving technical requirements, for maintaining market value (Eichholtz et al., 2009), (NBWO (Nederlands Bureau Waardebepaling Onroerende Zaken) [Dutch Agency Valuation of Immovable Property], 2008), for gratifying comfort demands, for minimizing energy use and associated costs, and for meeting social expectations and environmental regulations, house owners may like to improve energy performance during the midst of the house's first life cycle. Also refurbishments within usual renovation cycles must implement minimum energy performance requirements, according to article 7 of the 2010-EPBD (EU, 2010) "building components with a significant impact on the energy properties of the building envelope need retrofit or replacement".

The outside view of the nowadays brick houses in Flanders reflect the architectural taste of the owners. The long-lasting hull also covers functions like thermal insulation, water parry, security, etc. (see Fig. 1) Observed energy performance levels however do not anticipate future evolutions. This may create significant energy and sustainability challenges already within the first 30 years of the building's lifespan.

First we address the technical feasibility of upgrading recently built detached massive brick houses to higher energy performance levels, equivalent to levels owned by comparable newly built houses. Upgrading in reality is subject to physical constraints but may also pursue more sustainable living conditions in the house and in the overall built environment. The analysis adds to the knowledge about upgrading massive brick houses to a higher energy performance level, in particular within the Flemish context, on mainly three points.

First, most preceding studies can hardly stand the reality check on important issues, such as actual planning regulations in place, permanent occupation of the house during

Fig. 1 Reference house with detail of the outer wall, showing the functional layers of the house in a theoretical composition, displaying their durability (line weight) and interrelationship (overlap). (design/photo: arch. Cauchie).