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Potential of Thin Glass-Polycarbonate Composite Panels

Authors

M.Sc. Sebastián Andrés López,
Universität Siegen, Chair of Building Structure,
andres-lopez@architektur.uni-siegen.de
Univ.-Prof. Dr.-Ing. Thorsten Weimar,
Universität Siegen, Chair of Building Structure,
weimar@architektur.uni-siegen.de

Abstract

Modern architecture uses large glass elements in the building façades. In this context, Mike Davies establishes in 1981 the vision of a polyvalent wall. His vision deals with properties of a transparent wall which are adjusted adaptively by producing its own energy between two glass panes. The polyvalent wall should offer heat, noise, weather, fire and sun protection and, at the same time, ensures possibilities of design, energy, media and security. In today's intelligent façades, several properties are already integrated, but the vision of a self-adapting intelligent façade as polyvalent wall is still unreached. However, more demands on the building envelope result in an increase of the material with larger nominal thickness and higher dead load of laminated safety glass. The combination of brittle thin glass with ductile polycarbonate as a composite panel leads to a serious and innovative alternative for laminated safety glass with the simultaneously activation of several demands to implement the approach of a polyvalent wall.

Besides the implementation of the passive security in the multi-layered system, the active security with resistance against manual attack is achieved as well. Common security glazing of several glass panels possesses cross-sections of 36 mm and dead loads of 80 kg/m^2 as single glazing. A thin glass-polycarbonate composite panel with the same resistance class P8B against manual attack shows a thickness of 20 mm and a dead load of about 28 kg/m^2. Furthermore, the plastic glazing material polycarbonate improves the heat protection and the resistance against manual attack, the added flexible resin interlayers offer higher noise protection and, anyway, the luminous and solar characteristics are unchanging compared to common glazing. Therefore, the composite panel might be a serious alternative to laminated safety glass with numerous functions.

Meanwhile, linearly supported (thin)glass-polycarbonate composite panels are already used in the building sector, and, in addition, the research on point fixed glazing shows a favourable behaviour in the intact and broken state. Even with a pressure load more than 19 kN the composite panel does not slide from the plate of the plate holders of an all-over linearly clamped composite panel with a centred point fix. At the end of the life cycle of the composite material, a waste product results to be put to further use. There are already concepts for recycling and separating laminated safety glass. These concepts are transferred to and tested on thin glass-polycarbonate composite panels. Research on the implementation of the single composite panel into triple glazing leads to a multi-pane glass with the highest resistance class against manual attack P8B with a nominal thickness of 52 mm, a dead load of 45 kg/m^2 and an U_g-value of 0.7 W/(m^2.K). In a current research project, the combination of vacuum insulating glass and the experience of the manufacturing of thin glass-polycarbonate composite panels offers a never achieved burglary protection with highest noise and heat protection. In addition, the development of laminated safety glass made of thin glass and polycarbonate with adaptive properties allows to a more controllable solar characteristic. Hence, the winter and summer heat insulation will be individual adjustable. Finally, the main part of the vision of the polyvalent wall is achieved with a further processing to multi-pane glazing or vacuum insulating glass. Using additional adaptive interlayer implements design and media. Altogether, the material combination synergises favourable properties in one transparent cross-section.