Integration of photovoltaic cells into multifunctional sandwich structures for building construction

C. Pascual, J. de Castro, A.P. Vassilopoulos, T. Keller
Composite Construction Laboratory (CCLab)
Ecole Polytechnique Fédérale de Lausanne(EPFL)
Station 16, Bâtiment BP, CH-1015 Lausanne (Switzerland)
carlos.pascual@epfl.ch

Abstract

Integration of photovoltaic (PV) cells into load bearing glass fiber-reinforced polymer/polyurethane (GFRP/PU) sandwich structures contributes to the design of new self sustaining energy buildings. Nowadays composite sandwich construction allows for multifunctional elements (Figure 1) that integrate structural resistance, stiffness, lightweight and low thermal conductivity properties. In this research, the feasibility of encapsulating thin flexible PV cells into the external transparent GFRP face sheet of sandwich structures (Figure 2) is investigated. The two main topics of interest are the light transmittance through the face sheet and the mechanical interaction between PV cells and GFRP layers. The optical properties of GFRP structural laminates are studied in order to optimize the light transmittance and ensure high efficiency of the encapsulated PV cells. The mechanical behavior of different GFRP/PV configurations is investigated to optimize the performance of the multifunctional structure and avoid delamination between PV cells and GFRP layers. Further research concerns the influence of curved surfaces on the optical and mechanical performance of the structure since the selected materials and PV cells are flexible and allow establishing complex shapes of facades and roofs structures.

Figure 1: Multifunctional sandwich structure for the roof of Novartis Campus Main Entrance Building (Basel, CH).

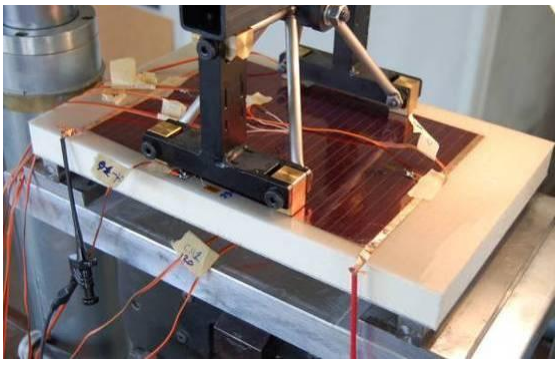

Figure 2: Mechanical investigation of a GFRP/PU sandwich with a PV cell encapsulated into the external face sheet