Large Span Membrane Architecture: How to Accomplish Carbon Neutral with Innovative Photovoltaic and Adaptive Control Strategy

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ABSTRACT

As an important form of large-span space structure, membrane structure has encountered some problems in the development of photovoltaic integration,[1] and its engineering practicability has not been well verified, such as low energy conversion efficiency, and the integration of photovoltaic modules and structural system has not been achieved.[2] This paper introduces several new photovoltaic integrated building technologies, such as photovoltaic membrane structures, photovoltaic glass, PCM materials, semiconductor refrigeration, etc. A membrane structure system integrated photovoltaic was designed and manufactured to verify the practical engineering applicability of these new photovoltaic building technologies. The system consists of roof, facade, insulation, semiconductor air conditioner and monitoring cabinet. The photovoltaic membrane structures made of three kinds of building membrane materials (PTFE\ETFE\PVC) were used as the roof. The south facade is a photovoltaic glass curtain wall. The indoor wall is equipped with PCM materials to achieve heat storage and insulation. The indoor temperature is controlled through the air conditioning made of semiconductor refrigeration chips. The monitoring cabinet is used to monitor the structural performance, photovoltaic temperature, membrane film temperature, indoor air temperature and humidity, solar energy generation and other indicators all day for a long time. Through experiments, this paper verifies the engineering feasibility and economy of a variety of new photovoltaic integrated building technologies from multiple perspectives, providing a basis for the promotion of new technologies and the development of new membrane buildings integrated photovoltaic.

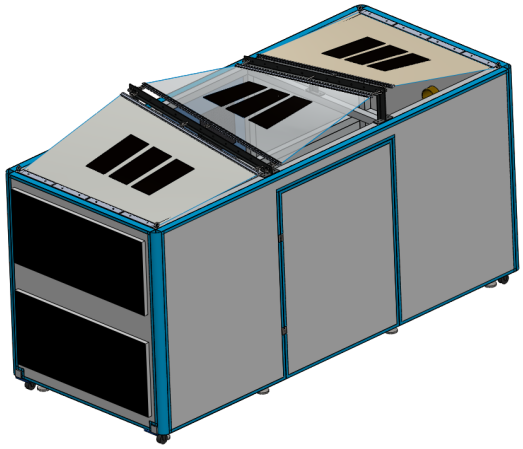

Figure 1. Model of New Photovoltaic Integrated Building Technology Experimental Device

REFERENCES

[1] J. Hu *et al.*, "Structural behavior of the PV–ETFE cushion roof," *Thin-Walled Struct.*, vol. 101, pp. 169–180, Apr. 2016.

[2] W. J. Chen, J. H. Hu, and H. Song, "Novel BIPV/T ETFE cushion," 2013, pp. 363–374. Accessed: Jun. 16, 2022.