BUILD SIMUL (2011) 4: 283 – 291
DOI 10.1007/s12273-011-0050-7

Double skin facades in the hot summer and cold winter zone in China: Cavity open or closed?

Guoqing He (✉), Lifang Shu, Sanming Zhang

Department of Architecture, College of Civil Engineering and Architecture, Zhejiang University, ZiJinGang Campus, Hangzhou 310058, China

Research Article

Abstract

Double skin facades (DSFs) have gained increasing popularity worldwide for potential building energy savings. Such energy advantages are widely thought to be attributed to the ventilation feature of the DSF cavity. Keeping the cavity open to the outside, however, practically causes noise problems, dust pollution, and safety issues and thereby raising the maintenance cost of DSFs. This paper attempted to bring up this issue for more attention. We first numerically examined the thermal performance of DSF windows based on the climate of Hangzhou City featured by hot summer (>30℃) and cold winter (~4℃). Then we discussed the potential energy benefits of DSFs and the ventilation design of the cavity. Results from our simulations showed that the DSF window was more energy efficient than a double glazing window in summer regardless of the cavity open or closed. Such energy advantages were more due to the additional pane of the DSF window to reduce the solar transmittance than due to ventilation of the cavity. Although ventilation is beneficial in summer, the annual energy gain may be limited. Our simulations showed that ventilation can save annual energy by no more than 8% under Hangzhou climatic conditions. Therefore, to justify the use of ventilation in a DSF, we recommend a comprehensive evaluation to be performed by balancing the annual energy gains and investment increase associated with the open cavity.

Keywords

double skin facade window,
ventilation,
thermal performance,
hot summer and cold winter region

Article History

Received: 30 June 2011
Revised: 14 September 2011
Accepted: 18 September 2011

1 Introduction

Double skin facades (DSFs) have gained increasing popularity due to their advantages in sound proof and aesthetic appearance. DSF windows are also claimed to be energy efficient by providing better thermal insulation and having air ventilation taking away extra unwanted heat during the cooling season (Balocco 2001; Tanaka et al. 2009). Today, the DSFs can be found in many regions with different climates around the world (Zerrin and Ferit 2005; Wong et al. 2005; Xu and Ojima 2007; Chan et al. 2009).

Whether DSFs save building energy, however, is a much debated topic. Although it was mostly promoted by the designers and manufacturers, detailed analyses of existing buildings showing the energy benefit of DSFs are scarce and the evaluation method varies. Tanaka et al. (2009) reported results from measurements in a public building with DSFs and showed that the heat removal by ventilation of the cavity accounted for 25% of the incident solar heat. Xu and Ojima (2007) reported results from measurements in a residential house showing that 10% to 30% of energy was saved if a single facade consisting of only one glass pane was replaced by DSFs. More studies supporting DSFs came from computer simulations (Chan et al. 2009; Hensen et al. 2002; Manz 2004; Safer et al. 2005; Høseggen et al. 2008). Still many researchers were cautious about promotion of this more expensive product. For example, Høseggen et al. (2008) used computer simulations and indicated that the benefits of DSF could also be achieved by using a single skin facade alternative with reduced heat transfer coefficient (*U* value). Because experiments are expensive, a great deal of effort has been devoted to find a validated computational fluid dynamics (CFD) model for the design purpose (Tanaka et al. 2009; Manz 2004; Jiru and Haghighat 2008; Hamza 2008; Pappas and Zhai 2008; Fuliotto et al. 2010).

Among all the features, blinds and ventilation seem to be the focus of discussions. Blinds are effective in blocking the direct solar radiation while ventilation is believed to be

E-mail: guoqinghe@zju.edu.cn

Building Thermal, Lighting, and Acoustics Modeling