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Rainwater Management of Ventilated Facades: Impact of Joint Width and Cavity Size

Stéphanie Van Linden and Nathan Van Den Bossche

Ghent University, Faculty of Engineering and Architecture, Building Physics Group, Sint-Pietersnieuwstraat 41 B4, Ghent, Belgium, stephanie.vanlinden@ugent.be

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1 Introduction

It is evident that during a rain event a portion of the water reaching the exterior surface of a ventilated facade, will infiltrate through the open joints. Infiltrated water may either be drained in the cavity to the bottom of the wall or reach the insulation layer. In case any deficiencies are present at the insulation layer, the infiltrated water might introduce problems. Additionally, if the cavity is not able to drain all the infiltrated water or adhered droplets to one of the cavity surfaces do not dry out, moisture problems might occur. However, the amount of experimental work that quantifies the portion of infiltrating water through ventilated facades and the portion of water reaching the drainage layer at the back of the cavity, is very limited.

Recatala *et al*., (2017) assessed the watertightness performance of a full-scale ventilated façade specimen with joint widths of 10 mm and a cavity width of 10 cm. The laboratory experiments showed that only 0,54% of the impinging water on the external cladding averagely reached the drainage layer which was situated 10 cm behind the cladding panels.

The objective of this study is to assess the impact of the joint width and cavity size of a ventilated façade specimen on the amount of water infiltrating through the joints and the amount of water reaching the drainage layer at the back of the cavity. Additionally, the impact of a panel installed out of plane of the exterior surface on the infiltration rate was assessed. The results from the experimental assessment were used as input parameters for hygrothermal simulations to determine the risk of moisture problems.

2 Methodology

The performance of five ventilated facade specimens was evaluated. Three different joint widths between the façade panels were assessed, i.e. 5 mm, 10 mm and 15 mm and the air cavity size between the façade panels and a PMMA panel, simulating the insulation layer, ranged from 4 cm to 19 cm. Three gutters were installed collecting the water which flowed downward at the exterior side of the façade panels, in the air cavity or at the PMMA panel. Water was sprayed onto the test specimens at a spray rate of 120 l/h. No pressure difference was applied to the external cladding as Recatala (2017) already observed that pressure equalization was achieved for both leaky and sealed specimens.

The risk of mould growth or a reduced thermal performance of the insulation caused by the infiltrated percentage of driving rain through the open joints, reaching the inner leaf of the wall assembly through deficiencies in the insulation layer, is evaluated by means of hygrothermal simulations performed with WUFI PRO 5.3.

3 Results and Discussion

The experimental study showed that the infiltration percentage of raindrops through open joints of 5 mm (9,48% ± 1,13%) was significantly larger compared to the infiltration percentage through joints of 10 mm (40,30% ± 5,89%). Water bridges in the 5 mm joints, caused the water to splatter back, reducing the infiltration percentage. In contrast, water drops were able to flow freely through the 10 mm and 15 mm joints due to kinetic energy. Drops infiltrating through the 10 mm and 15 mm joints were also able to flow further into the air cavity resulting in larger infiltration percentages at the drainage layer compared to the infiltration through 5 mm joints. Water drops infiltrating through the 5 mm joints were able to reach 3 cm in front of the drainage layer for cavity widths of 7 cm and smaller compared to cavity widths of 10 cm and 19 cm for respectively joint widths of 10 mm and 15 mm. For a cavity width of 4 and 5 cm, a continuous runoff film was visible at the PMMA panel simulating the drainage layer, for both joint widths of 10 and 15 mm. For joint widths of 5 mm, no runoff was present for any of the cavity widths at the PMMA panel, only some drops reached the PMMA panel. One of the façade panels, installed out of the plane of the exterior surface caused an increase of 5,65% of the infiltration percentage reaching 3 cm in front of the drainage layer for a cavity width of 4 cm.

Hygrothermal simulations showed that the risk of mould growth at the interior surface of a ventilated wall assembly is limited for the measured infiltration percentages. The impact on the heat flux at the interior surface is however, significant. An infiltration percentage of 1% of the driving rain in the brick layer at the interior side of the insulation layer and an air change rate of 10 h^{-1}, caused an increase of the heat flux of 3,29%. The increase in heat flux is primarily attributed to the latent heat flow associated with vapour diffusion at the surface. In case of an infiltration percentage of 10%, the increase in heat flux measures 34,62% and 3,41% excluding the latent heat flow.

4 Conclusions

The impact of the joint width, cavity size and an incorrect installed façade panel on the water infiltration rate through the open joints and the amount of water reaching the insulation layer was assessed experimentally. The risk of mould growth and a reduced performance of the insulation due to the infiltration percentage was assessed by means of hygrothermal simulations. Only some water drops were able to reach the drainage layer through 5 mm joints for a cavity width of 4 cm. In contrast, a continuous runoff was present for joint widths of 10 and 15 mm. The risk of mould growth at the interior surface for the measured infiltration percentages is limited. The impact on the heat flux at the interior surface however, is significant.

ORCID

Stéphanie Van Linden: https://orcid.org/0000-0002-4102-2076
Nathan Van Den Bossche: https://orcid.org/0000-0002-8738-7249

References

Arce Recatala, M., Garcia Morales, S. and Van Den Bossche, N. (2017). Experimental assessment of rainwater management of a ventilated façade. *Journal of Building Physics*, 1-30.