Graphex Calculations for use in Certified PH projects

How to use and limitations

Resene Construction Systems Insulated Façade System (Exterior Insulation and Finish System or EIFS). When considering the insulation benefit of a 40-60mm thick Neopor EPS (graphite infused brand name Graphex) EIFS on a drained 20mm cavity which is sealed at the top. Passive House project have thus far been required to use 'ventilated' R_{se}=0.13 m²K/W as the exterior boundary condition to represent the ventilated/drained cavity and EIFS cladding. This completely ignores the potential insulation benefit of the EIFS.

For NZ building code compliance, R-value calculations would result in an additional R0.69 for 40mm Graphex, R0.86 for 50mm and, R1.03 for 60mm which is the insulation value of the Graphex insulation discounted by 45% due to the presence of the drained cavity.

In order to determine the insulation benefit for use in Certified Passive House buildings it is required to calculate the performance per *ISO6946 Building components and building elements — Thermal resistance and thermal transmittance — Calculation method.* The main issue is determining the amount of ventilation in the cavity. As the ventilated/drained cavity is closed at the top the size of the openings at the bottom determine the air exchange rate and the performance per the standard. Photos would be required for use of these values in Passive House Certification submissions.

Table 1: R-values for varying thickness of Graphex and ventilation opening area. This value includes the exterior surface resistance value but is otherwise added onto the R-value of the other constructions in the walls.

R m2K/W	0.04 m GRAPHEX	0.05 m GRAPHEX	0.06 m GRAPHEX	0.1 m GRAPHEX
1000 mm² per m	R0.77	R0.92	R1.08	R1.70
1250 mm² per m	R0.45	R0.53	R0.60	R0.91
1500 mm² per m	R0.13	R0.13	R0.13	R0.13

To use the above table only the thickness of the Graphex and the size of the openings at the bottom need to be known. For example, in Figure 1 below with the cavity closer the openings are 1250 mm² per metre of wall and in Figure 2 the openings can be constructed to be 1000 mm² per metre of wall. Note in Figure 3 below this style of bottom cavity closer the ventilation opening area is not known – photos and drawings/measurements would need to be provided.

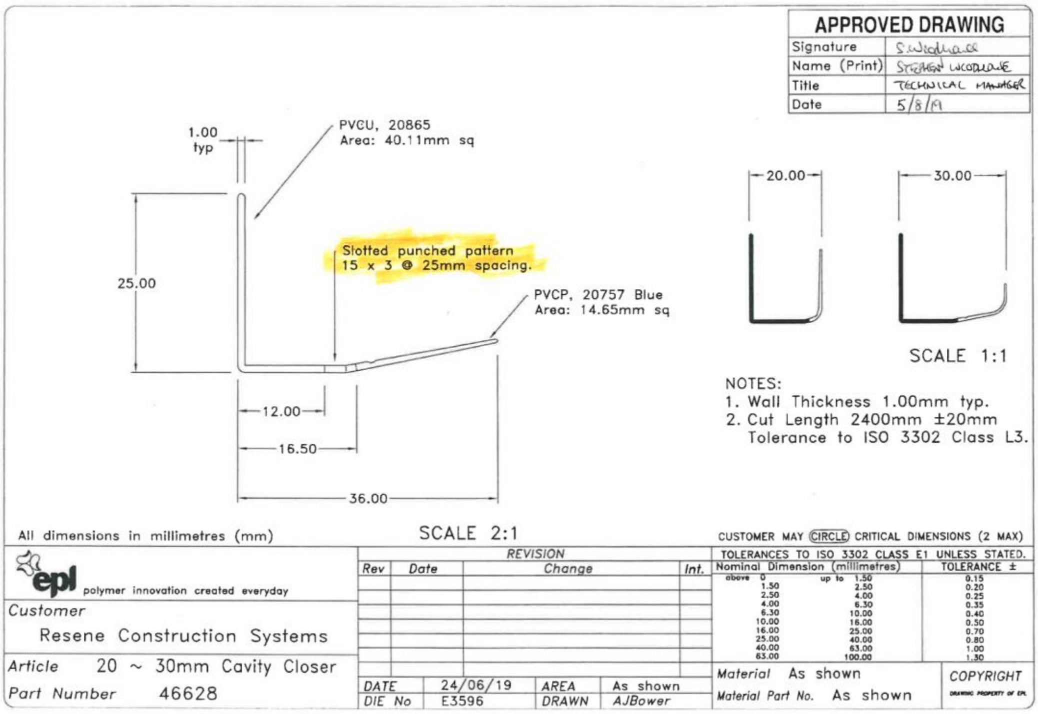

Figure 1: Resene 20 to 30mm cavity closer at bottom. This is 1250mm² per linear meter of wall.

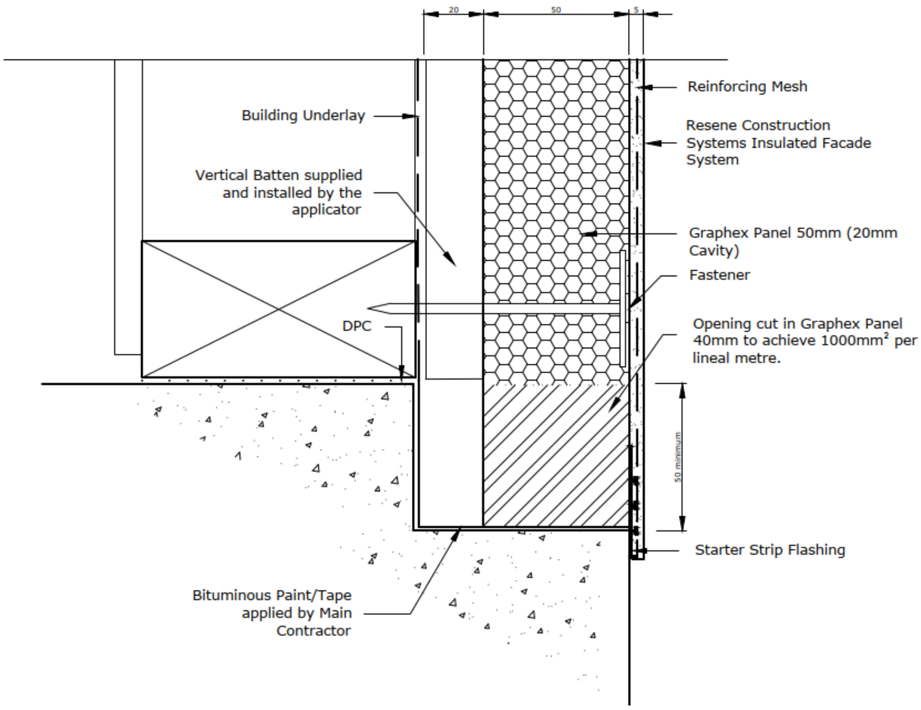

Figure 2: Ventilation openings at 1000mm² per linear meter of wall.

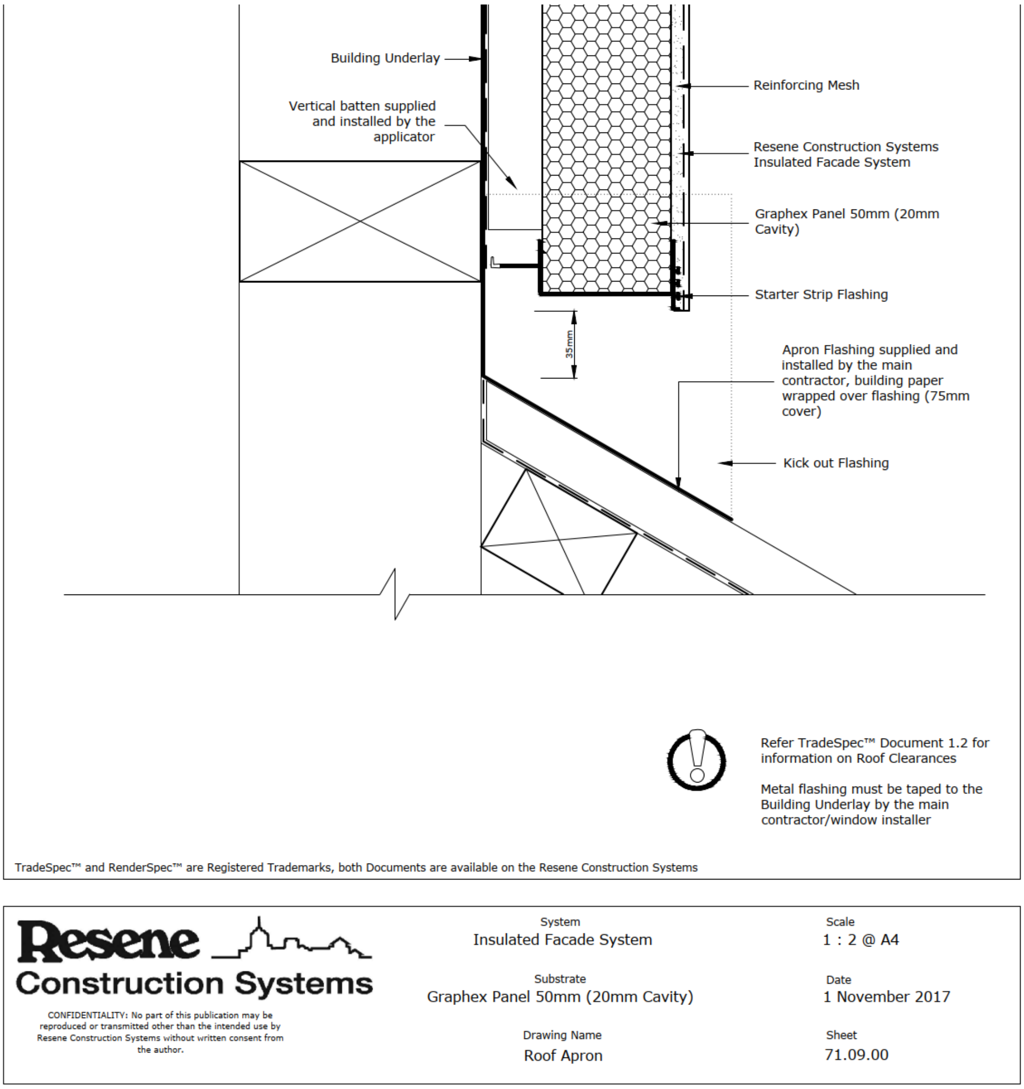

Figure 3: How big is the ventilation gap for the starter strip? 1000mm² per meter of wall or more? This needs to be determined.

Calculations methodology

Calculation methodology per ISO6946 Section 5.3.3.

Per ISO6946 section **5.3.3 Slightly ventilated air layer** is one with openings between 500 and 1500 mm² per metre of length in the horizontal direction for vertical air layers. This then provides a calculation process to estimate the total thermal resistance with slightly ventilated air layers.

Per ISO6946 section **5.3.4 Well-ventilated air layer** is one which has openings equal to or exceed 1500 mm² per metre of length in the horizontal direction for vertical air layers. For these walls would be R=0.13 and neglect everything to the exterior. This is what we have done in the past for Passive House Certifications.

5.3.3 Slightly ventilated air layer

A slightly ventilated air layer is one in which there is provision for limited air flow through it from the external environment by openings of area, A_v, within the following ranges:

— $> 500\ mm^2$ but $< 1\ 500\ mm^2$ per metre of length (in the horizontal direction) for vertical air layers;

— $> 500\ mm^2$ but $< 1\ 500\ mm^2$ per square metre of surface area for horizontal air layers.

The effect of ventilation depends on the size and distribution of the ventilation openings. As an approximation, the total thermal resistance of a component with a slightly ventilated air layer may be calculated as

$$R_T = \frac{1500 - A_v}{1000} R_{T,u} + \frac{A_v - 500}{1000} R_{T,v} \qquad (2)$$

where

$R_{T,u}$ is the total thermal resistance with an unventilated air layer in accordance with 5.3.2;

$R_{T,v}$ is the total thermal resistance with a well-ventilated air layer in accordance with 5.3.4.

Figure 4: Excerpt from ISO6946.

Note PHI has agreed (personal email 13July2020) for cases where the ventilation openings at the bottom, and the openings meet ISO6946section 5.3.3 criteria.

If we consider the additional heat losses due to the fasteners for the3.55mm diameter steel nails results in an additional heat loss of 0.01 to 0.04 W/(m²K) per ISO6946 Annex D. This would reduce the R0.5 example to from U= 2 W/(m²K) to 2.04 W/(m²K) or an R-value of 0.49 m²K/W as this is well within the accuracy of the methodology per Section 3.5.5 the fastener impact can be neglected.

PHOTOS OF SYSTEM CALCULATED:

Figure 5: Unacceptable installation without closure strip at bottom?? If the cavity closer is installed

Figure 6: Showing closure drained cavity strip at bottom.

Figure 7: System installed ready for plaster.

Figure 8: Graphex being installed with plastic washers and nails.