Is the ventilation of timber façades essential?

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R+D «Timber and Composite Construction»
Definitions

1. Ventilated
2. Vented
3. Non-ventilated with air space and large number of joints
4. Non-ventilated without air space
Background

R+D Project: Fire safety of timber façades
→ fire tests of timber façades at the MFPA Leipzig (Germany)
Does a vented façade work successfully?

What is the air change in the ventilation space?

Old investigations (Helmut Künzel 1980)
Field tests with very wet aerated concrete

a) glued fibrecementboard
b) Non-ventilated with air space with large number of joints (tongue and groove)
c) Ventilated (tongue and groove)
Validation with WUFI®

a) Glued fibercement board

b) Non-ventilated with air space tongue and groove

c) ventilated tongue and groove
Results

Air change per hour (ach) behind different façades

- Ventilated façade: ~ 50 ach
- Non-ventilated façade with an air space and with a lot of joints in the façade (e.g. tongue and groove): ~ 20 ach
- Vented façade: ~ 20 ach

(all values for a 30 mm air space)

In comparison to others:

- Künzel / Kehrer 2007: 50 ach (WUFI® at test building ORNL USA)
- Salonvaara et.al. 2007: 30 ach (parameter study)
- Finch / Straube 2007: model for unsteady ventilation and constant 140 ach (WUFI® different buildings in Vancouver)
- Nore PhD 2009: model for unsteady ventilation max. 220 ach (PhD / paper NSB 2011)
To get conservative results

- reduction of air change per hour:
  50 ach → 32 ach
  20 ach → 13 ach (for normal shielded: f.e. urban conglomerate)
  7 ach (for highly shielded: f.e. in forest)
  0 ach (non ventilated façade without any openings)

- 1% of the wind driven rain penetrating at the back side of the façade (ASHRAE 160: 2009)

- The construction is not airtight
  (moisture source of 150 g/m² from inside)

Parameter study:
- Different kinds of coatings
  no coating / s_d-value: 1 and 2 m
Investigated building constructions

Timber frame construction

Brick construction

dry and wet
Two different climates

**Zürich**
- average temperature: 8,3 °C
- average wind speed: 2,1 m/s
- Main wind direction: SW
- wdr : SW 340 mm/a
- N 100 mm/a

**Davos**
- average temperature: 3,2 °C
- average wind speed: 2,4 m/s
- Main wind direction: NE
- wdr : 475 mm/a
Parameter study timber construction

Moisture content façade [M-%]

- Orientation North
- Zürich
- 13 and 32 ach
- 1 % wdr back side

steady state
Parameter study timber construction

Moisture content façade [M-%]

- Orientation North
- Davos
- 0, 7 and 13 ach
- 0 and 1 % wdr back side

steady state
Field test in Rain (CH)

RH and Temp. in the air space: ventilated and non-ventilated façade with large number of joints

“Gewerbegebäude Grossweid“, Rain
Timber construction engineer: Pirmin Jung

RH: fully-ventilated facade
RH: non-ventilated facade with large number of joints
Temp.: fully-ventilated facade
Temp.: non-ventilated facade with large number of joints
# Simple guideline

<table>
<thead>
<tr>
<th>Construction behind the façade</th>
<th>Kind of ventilation</th>
<th>Kind of façade</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>large number of joints e.g. boards</td>
</tr>
<tr>
<td></td>
<td></td>
<td>without</td>
</tr>
<tr>
<td>Timber construction with $s_{d,i} \geq 2.4$ m</td>
<td>ventilated</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>vented</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>non-ventilated with air space</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Non ventilated without airspace</td>
<td>-</td>
</tr>
<tr>
<td>Brick wall dry (retrofitting)</td>
<td>ventilated</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>vented</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>non-ventilated with air space</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Non ventilated without airspace</td>
<td>-</td>
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<tr>
<td>Brick wall wet (new building)</td>
<td>ventilated</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>vented</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>non-ventilated with air space</td>
<td>0</td>
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<td></td>
<td>Non ventilated without airspace</td>
<td>-</td>
</tr>
</tbody>
</table>

+ Recommended  
O Possible, but it must be proved (depend on location and $s_{d,i}$-value)  
- critical / not possible
Thank you for your attention