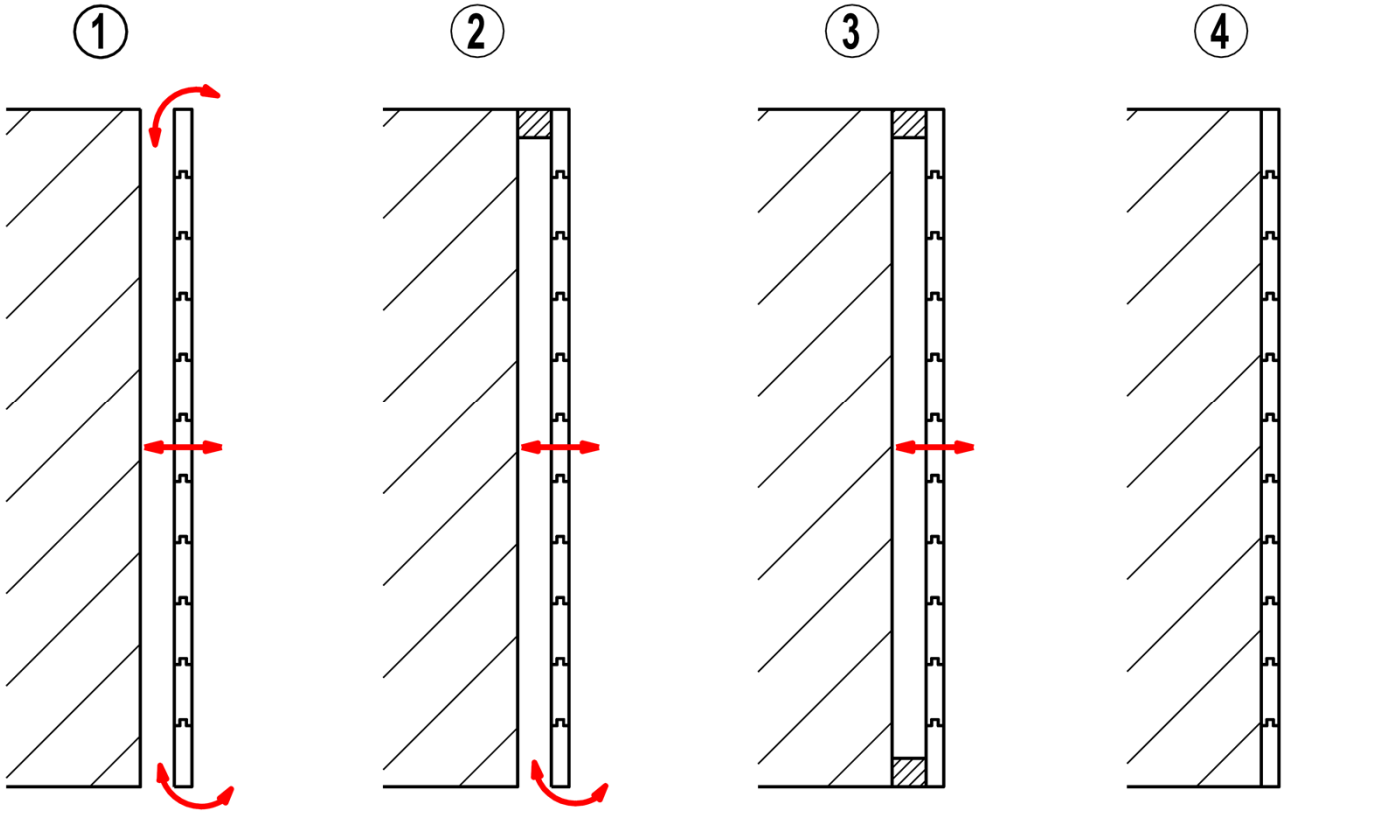
Is the ventilation of timber façades essential?

Daniel Kehl, Severin Hauswirth, Heinz Weber
R+D «Timber and Composite Construction»

Definitions



ventilated

vented

Non-ventilated with air space and large number of joints

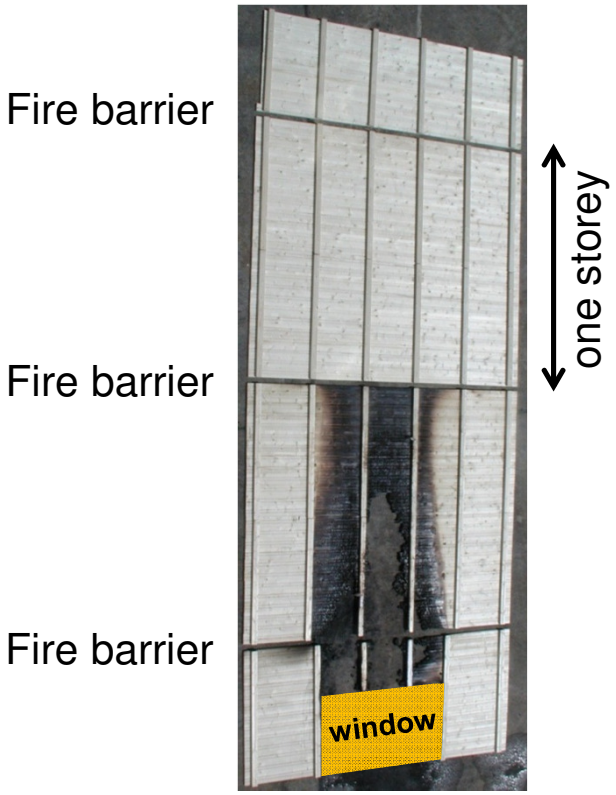
Non-ventilated without air space

Background

R+D Project: Fire safty of timber façades
→ fire tests of timber façades at the MFPA Leipzig (Germany)

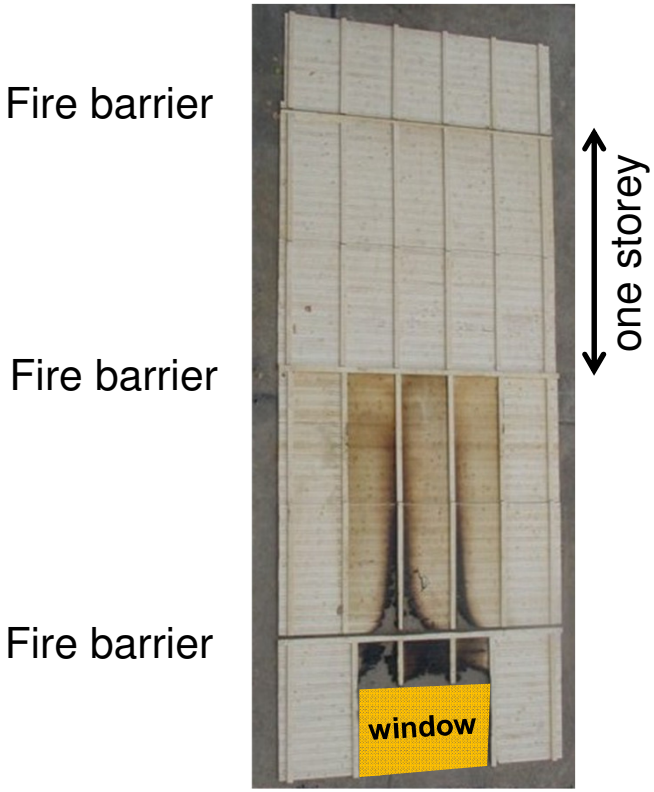
ventilated

Back side



vented

Back side

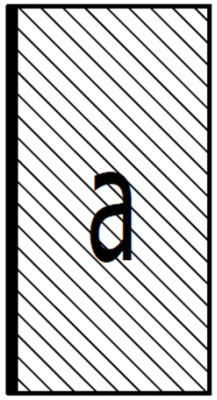


Does a vented façade work successfully?

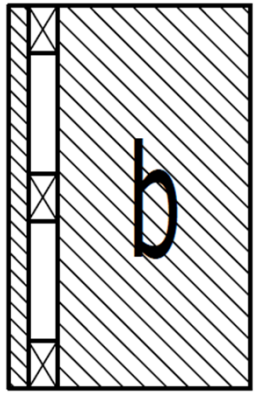
What is the air change in the ventilation space?

Old investigations (Helmut Künzel 1980)

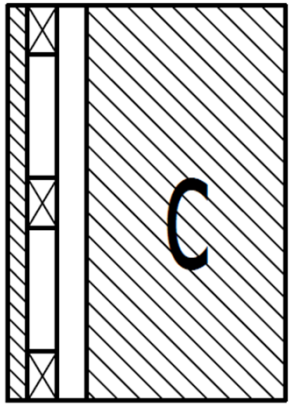
Field tests with very wet aerated concrete



glued fibrecementboard

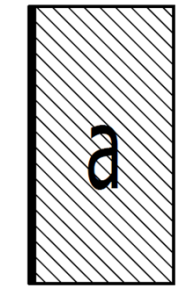


Non-ventilated with air space with large number of joints (tongue and groove)

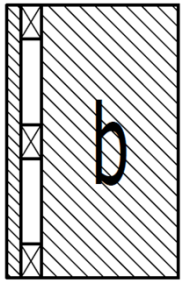


Ventilated (tongue and groove)

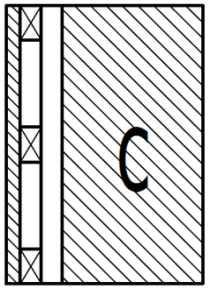
Validation with WUFI®



a)
Glued fibercement board

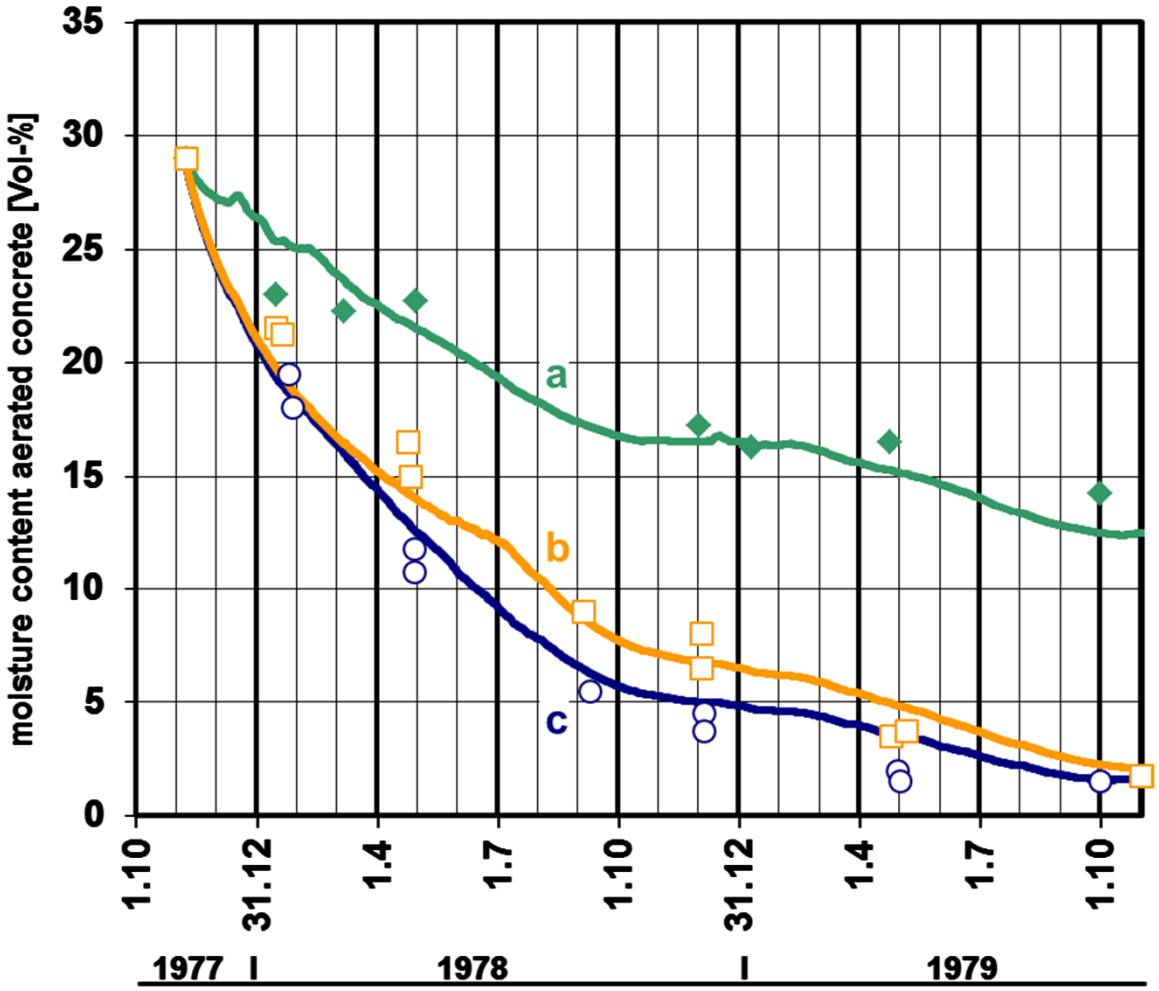


b)
Non-ventilated with air space tongue and groove



c)
ventilated tongue and groove

Drying out of the wall (aerated concrete)



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 conglomeration)
  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)

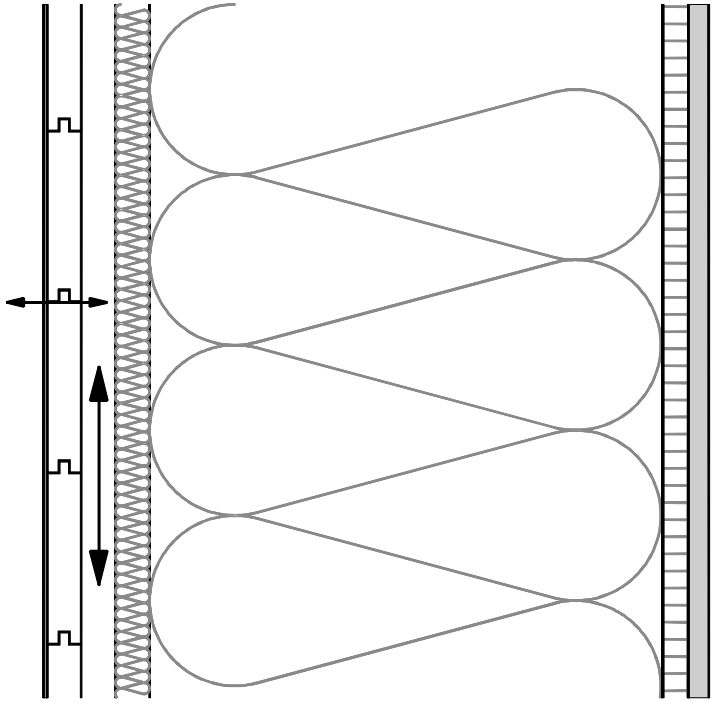
- The construction is not airtight
  (moisture source of 150 g/m^2 from inside)

Parameter study:

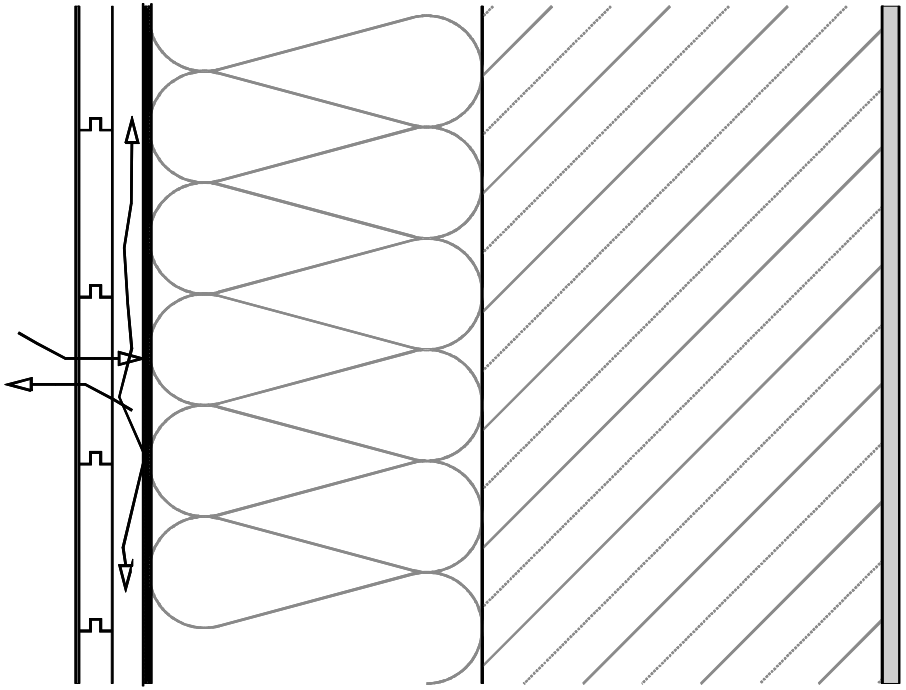
- Different kinds of coatings
  no coating / s_d-value: 1 and 2 m

Investigated building constructions

Timber frame construction



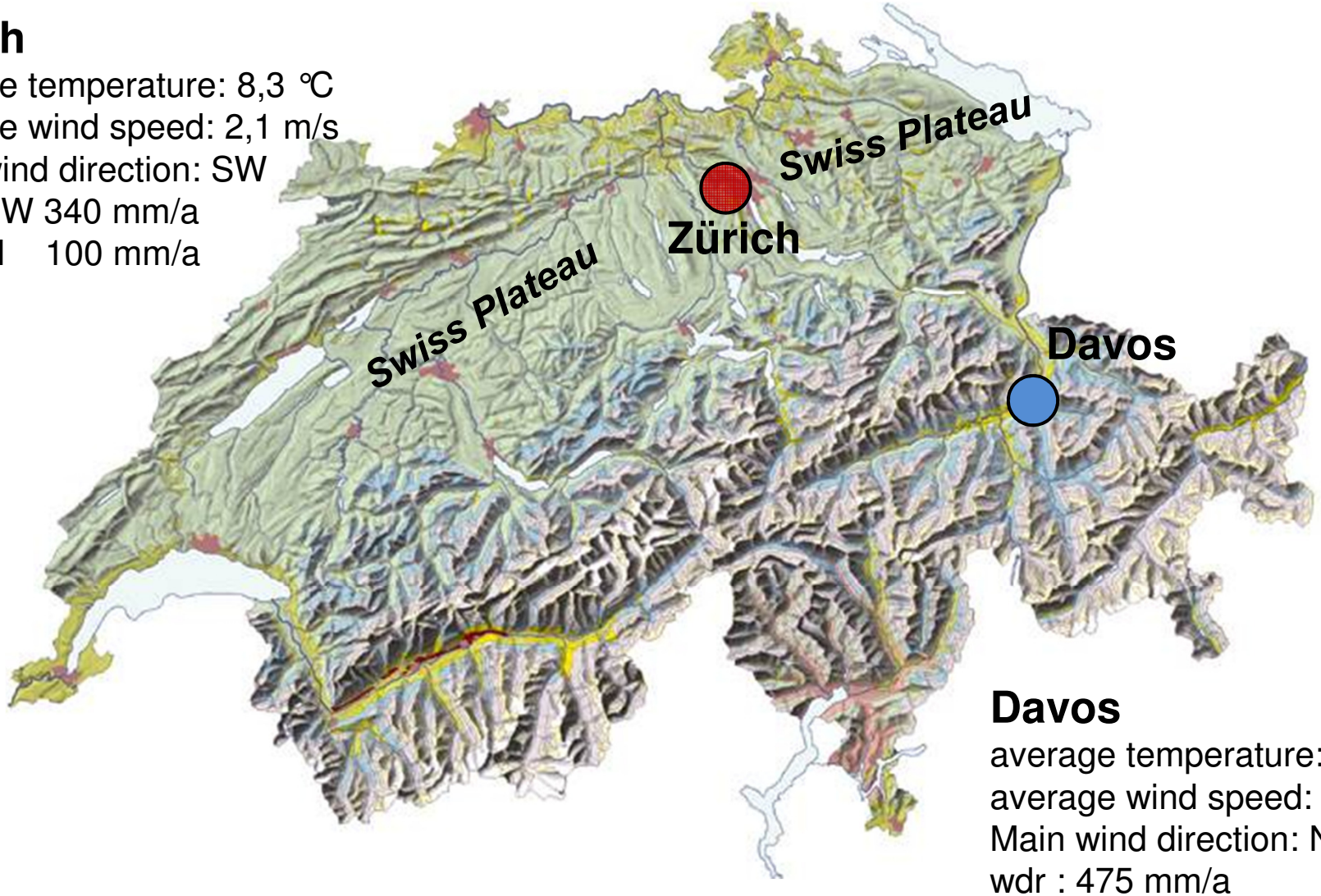
Brick construction



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

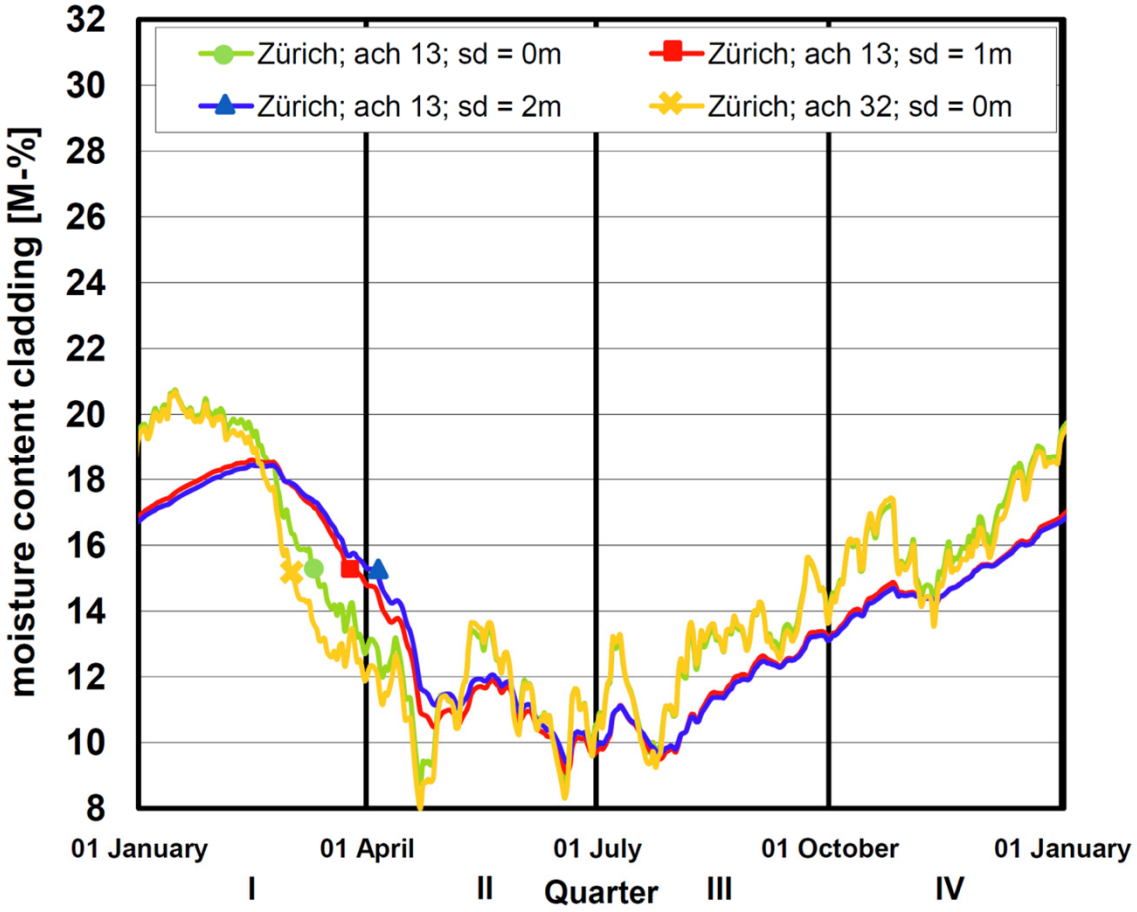


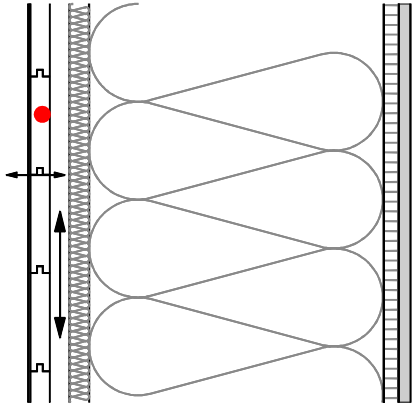
Davos
average temperature: 3,2 °C
average wind speed: 2,4 m/s
Main wind direction: NE
wdr : 475 mm/a

Parameter study timber construction

Zürich

Moisture content façade [M-%]





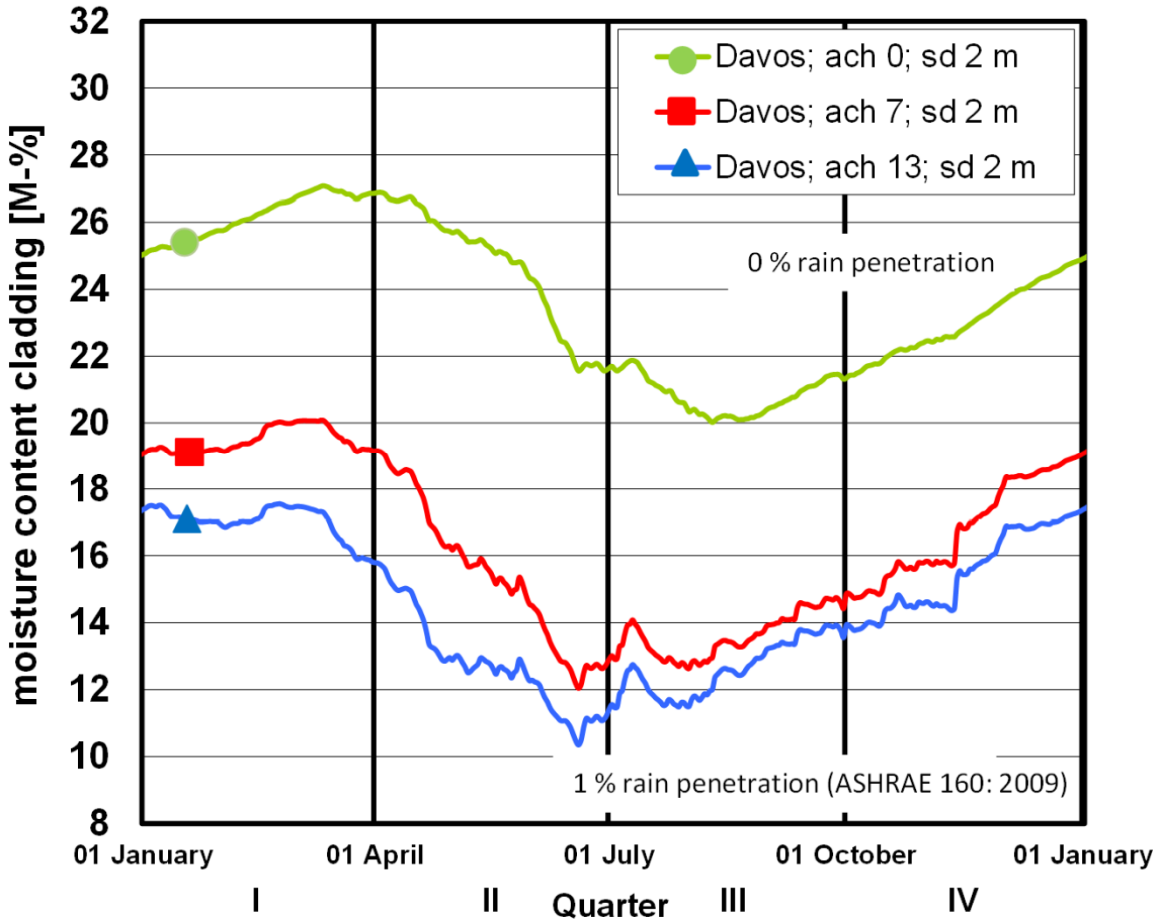
- **Orientation North**
- **Zürich**
- **13 and 32 ach**
- **1 % wdr back side**

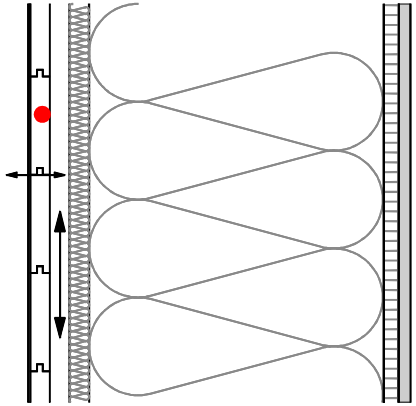
steady state

Parameter study timber construction

Davos

Moisture content façade [M-%]



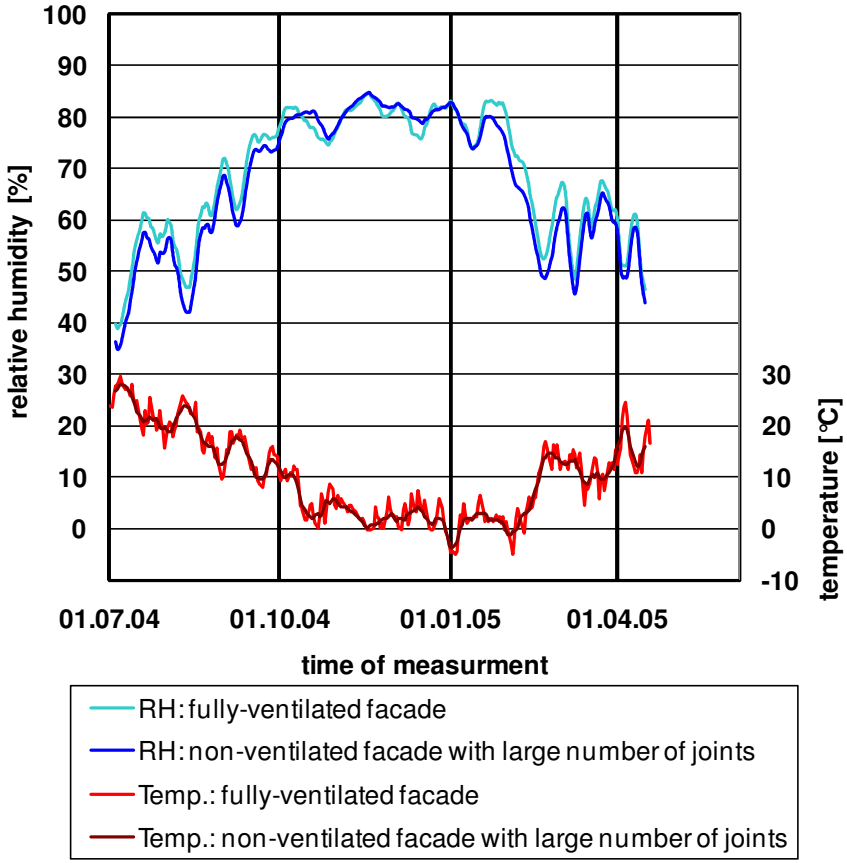


- **Orientation North**
- **Davos**
- **0, 7 and 13 ach**
- **0 and 1 % wdr back side**

steady state

Field test in Rain (CH)

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

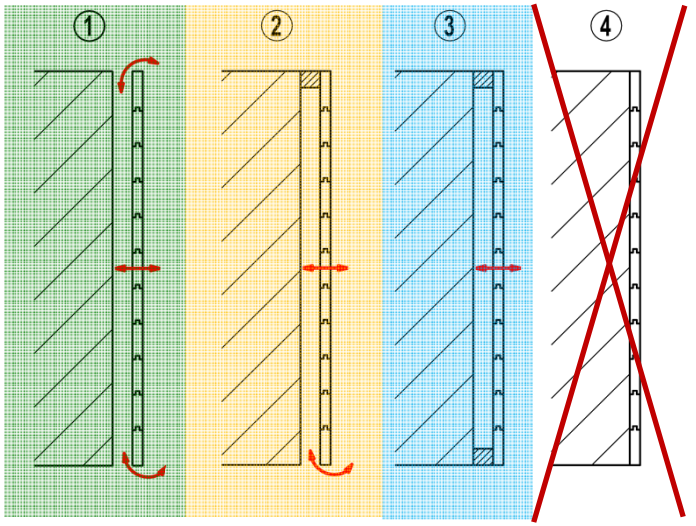


“Gewerbegebäude Grossweid“, Rain
Timber construction engineer: Pirmin Jung

Simple guideline

Construction behind the façade	Kind of ventilation	*Kind of façade*					
		large number of joints e.g. boards			*no joints e.g. panels*		
		coating					
		without	$s_d \leq 1$ m	1 m > $s_d \leq 2$ m	without	$s_d \leq 1$ m	*1 m > $s_d \leq 2$ m*
Timber construction with $s_{d,i} \geq 2{,}4$ m	ventilated	+	+	+	+	+	+
	vented	+	+	+	+	+	+
	non-ventilated with air space	+	+	+	O	O	O
	Non ventilated without airspace	-	-	-	-	-	-
Brick wall dry (retrofitting)	ventilated	+	+	+	+	+	+
	vented	+	+	+	+	+	+
	non-ventilated with air space	+	+	+	-	O	O
	Non ventilated without airspace	-	-	-	-	-	-
Brick wall wet (new building)	ventilated	+	+	+	+	+	+
	vented	+	+	+	O	O	O
	non-ventilated with air space	O	O	O	-	-	-
	Non ventilated without airspace	-	-	-	-	-	-

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



in style of HOLZ FORSCHUNG AUSTRIA


Thank you for your attention