ESBG 2015

EUROPEAN STRAWBALE GATHERING MONTARGIS | PARIS

STRAW, THERMAL CONCEPTION and PASSIVE HOUSE

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Introduction

Speaker

- Franck JANIN, coming from Lyon, France
  - Physics engineer
  - Self-builder of a straw bale passive house
- Owner and creator of the small company HELIASOL
  - Thermal and energy engineering
  - Mainly involved in passive or nearly passive houses/building
    - 40 projects with straw bale
    - - among therm 5 are passive
    - 50 passive projects,
    - - 6 already certified by PHI, Passiv Haus institut
    - - 10 in progress for certification

Introduction

Plan

- My experience in thermal engineering
  - Building passive with straw bales
- Summer comfort : monitoring of 2 houses during this really hot summer, this year
- Heating with wood stove

  - These results and experiences are valid in Lyon/ France area
  - Climate : “semi continental, medium cold 70 kKh (kilo Kelvin hour / year), 1100 hours equivalent fully sunny per year

Thermal engineering

Passive house

- Passive house definition
  - Well insulated house with so low heat demand that you can fulfil it by heating the air supplied by ventilation (hygienic ventilation rate)
- A passive house of 100 m² will need per year (for heating)
  - 150 liter of fuel
  - 1500 kWh of electricity
  - 1 stere of wood
    - 1 m^3 of stacked wood (length 1 m)
    - 0.6 m^3 stacked wood (length 33 cm)

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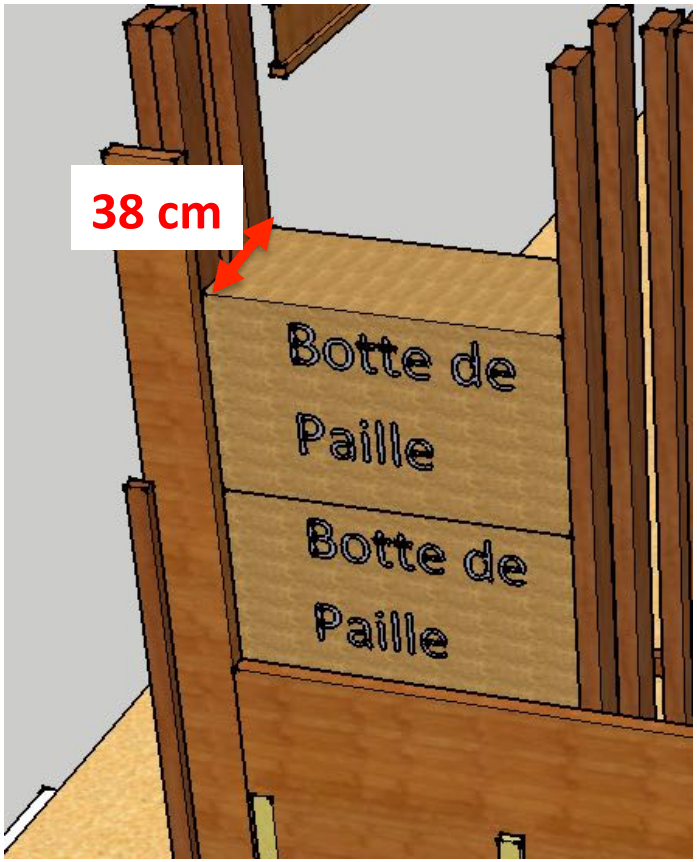
Thermal engineering

Straw insulation

- 38 cm of straw : U = 0.052/0.38 = 0.13 W/m².K
- With integrated thermal bridge (up to 10%) (wood skeleton), U < 0.15 W/m².K
- Passive House recommendation U < 0.15 W/m².K

- Straw bale Ok for passive house in France and most Europe



Thermal engineering

Straw insulation

- Wall : Straw
- Roof : Straw
- Basement : Straw or anything else

- Is this enough to achieve very low consumption ?
  No !

Thermal engineering

hd2

Low consumption
50 kWh / m² year
(Heating demand)

Passive House
15 kWh / m² year
(Heating demand)

- Orientation
- Bioclimatic
- Compactness (of the heated area)
- Windows triple glazing welcome with solar factor > 0.6
- No thermal bridges
- And …

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Thermal engineering

hd2

Low consumption
50 kWh / m² year
(Heating demand)

Passive House
15 kWh / m² year
(Heating demand)

- Double flow ventilation with heat recovery
- Air tightness
  - n50 < 0.6 volume / hour
  - 4 x better than french regulation RT 2012

Thermal engineering

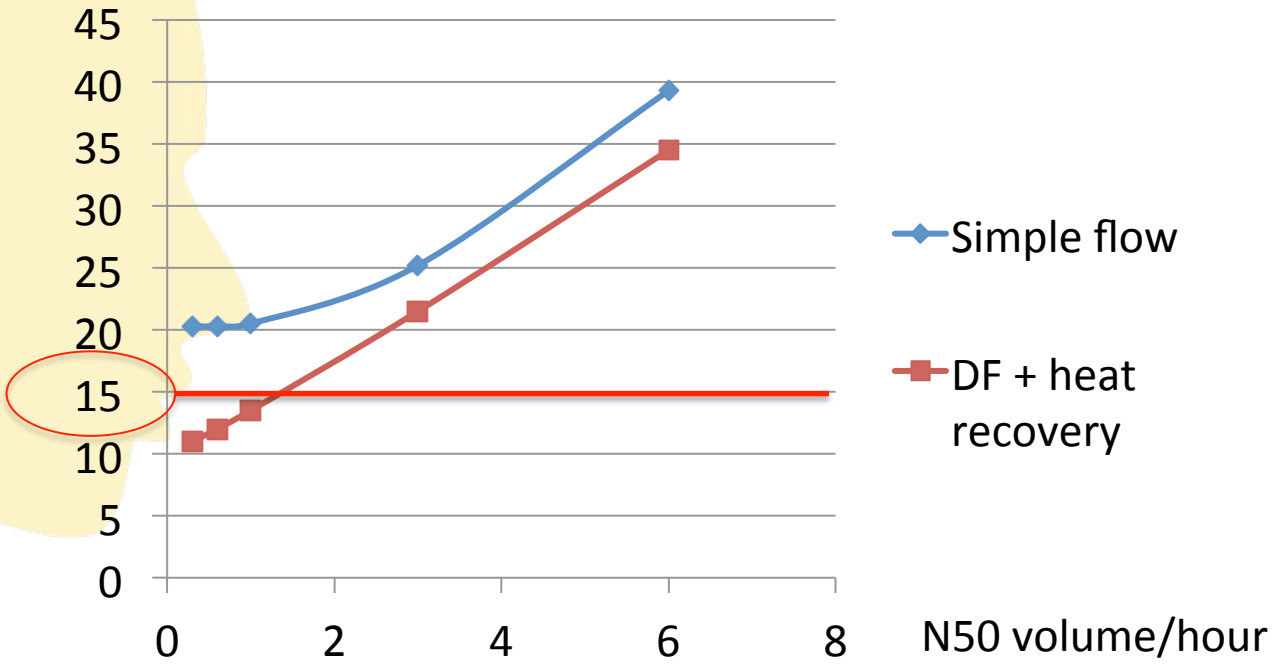
Ventilation / air tightness

- As straw walls usually do not block vapour, do we need some ventilation ?
  - Ventilation is not only used for vapour control : CO_2, VOC (volatile organic compounds), Oxygen and more
  - Sweat wall and roof are not enough to evacuate vapour in a standard house
- What about natural ventilation ?
  - Windows opening or grids are really difficult to control (depending on the wind)
  - Heating demand will increase and air quality will decrease
    - Problem of bedroom during night

Thermal engineering

Ventilation / air tightness

- Is air tightness mandatory ?
- Heating demand kWh / m² per year

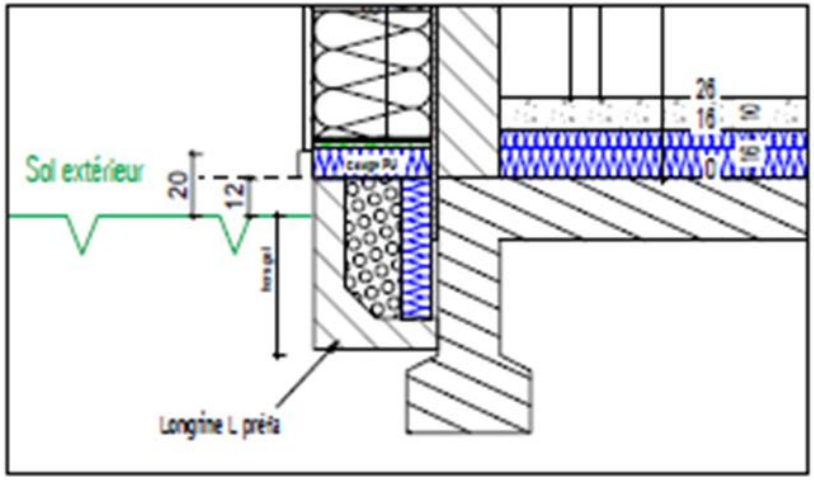


Example based on values of the passive refurbishment in Valence / France

Thermal engineering

Some details

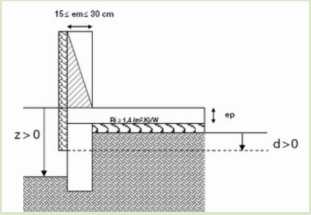
- It's difficult to do something really bad with straw bale insulation and wood, but take care of basement :



Psi = 0.25 W/m.K
Heating demand : 11 kWh/m²

New passive house
Psi = 0 W/m.K
Heating demand : 8 kWh/m²

Bad thermal bridge
Psi = 0.6 W/m.K
Heating demand : 18 kWh/m²



Thermal engineering

Our good practices

- Involve in the design team, a thermal / energy specialist as soon as possible
  - Could be the architect (if he has the skills)
- With our climate “semi continental, medium cold 70 kKh (kilo Kelvin hour / year), 1100 hours equivalent fully sunny per year
  - Taking care of air tightness
  - Using mechanical ventilation during winter and heatwave, with heat recovery if possible

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Summer comfort

Monitoring

- In a straw (and therefore well insulated) house, winter comfort is not anymore a problem
- This year, July in Rhone Alps region, heatwave nearly like in 2003

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Summer comfort

Monitoring

- 2 straw passive houses and a standard house (1990)

- Passive refurbishment
- Location 100 km south Lyon
- Elevation 164 m
- One floor
- Flat roof (straw)
- Usage : family 4 person
- No window shutter

- New Passive
- 100 km north Lyon
- Elevation 403 m
- One floor
- Attic (ventilated)
- Not used in July
- Wood shutter (70%)

- Standard
- Lyon suburb
- Elevation 210 m
- Two floors
- Attic
- Family 4 p
- Wood shutters

Summer comfort

Monitoring : passive refurbishment

- House of 1978, concrete block
- Passive refurbishment with exterior straw insulation
- No window shutter
- Valence, 100 km south of Lyon
- Family of 4, living and home work for one person
- Triple glazing
- Ventilation with heat receovery
- No earth tube nor brine pipe

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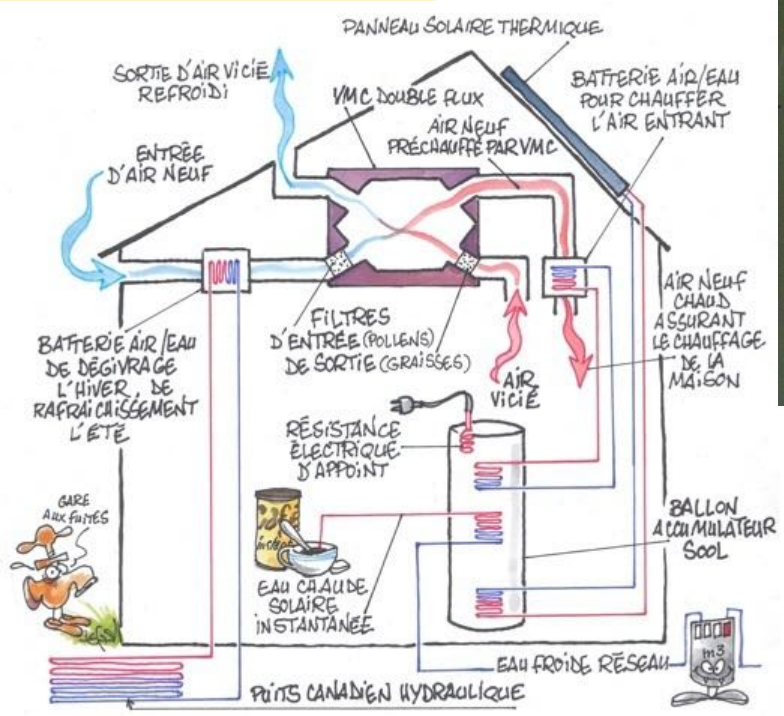
Summer comfort

Monitoring : New house, 100 km north Lyon

Summer comfort

Monitoring : New house, 100 km north Lyon



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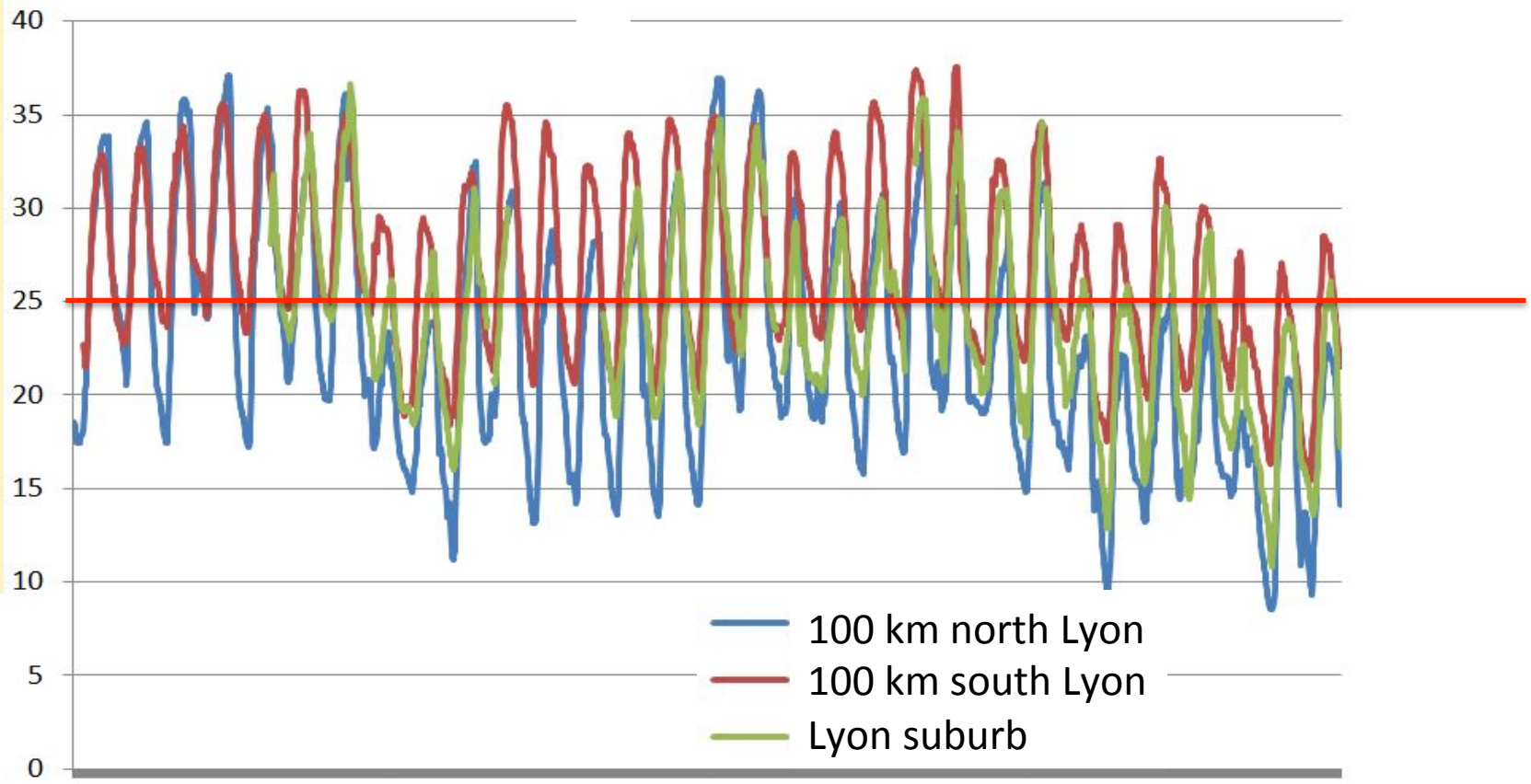
Summer comfort

Results

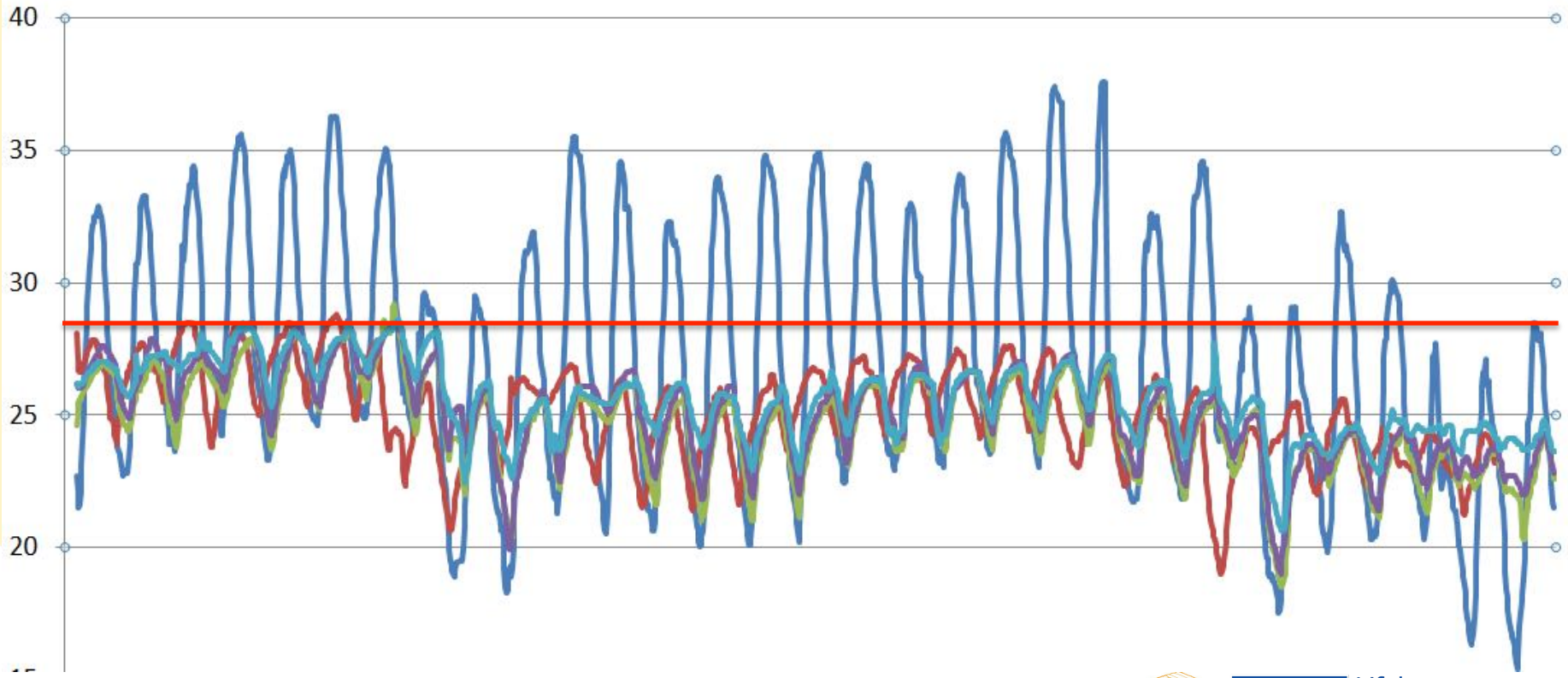
External temperature in July



Summer comfort

Results

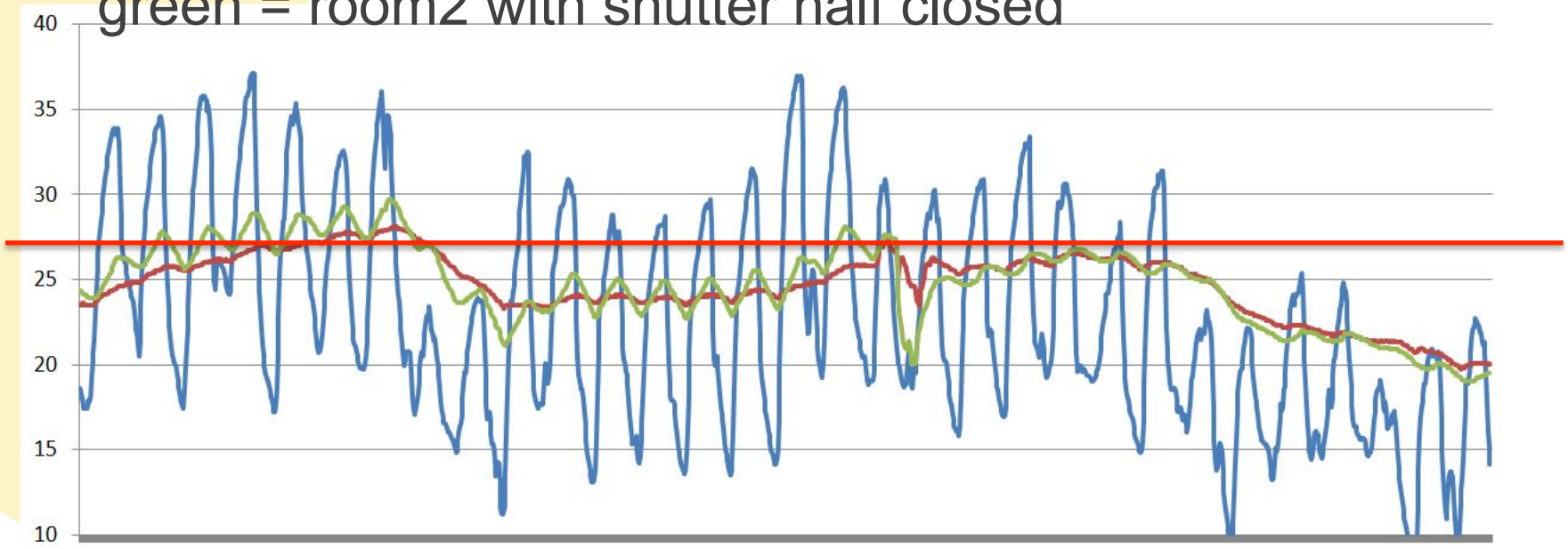
- Passive refurbishment, July temperatures
- Blue = outside



Summer comfort

Results

- New passive (not used, no night over ventilation, no inertia), July temperatures
- Blue = outside, red = living room with shutter closed, green = room2 with shutter half closed

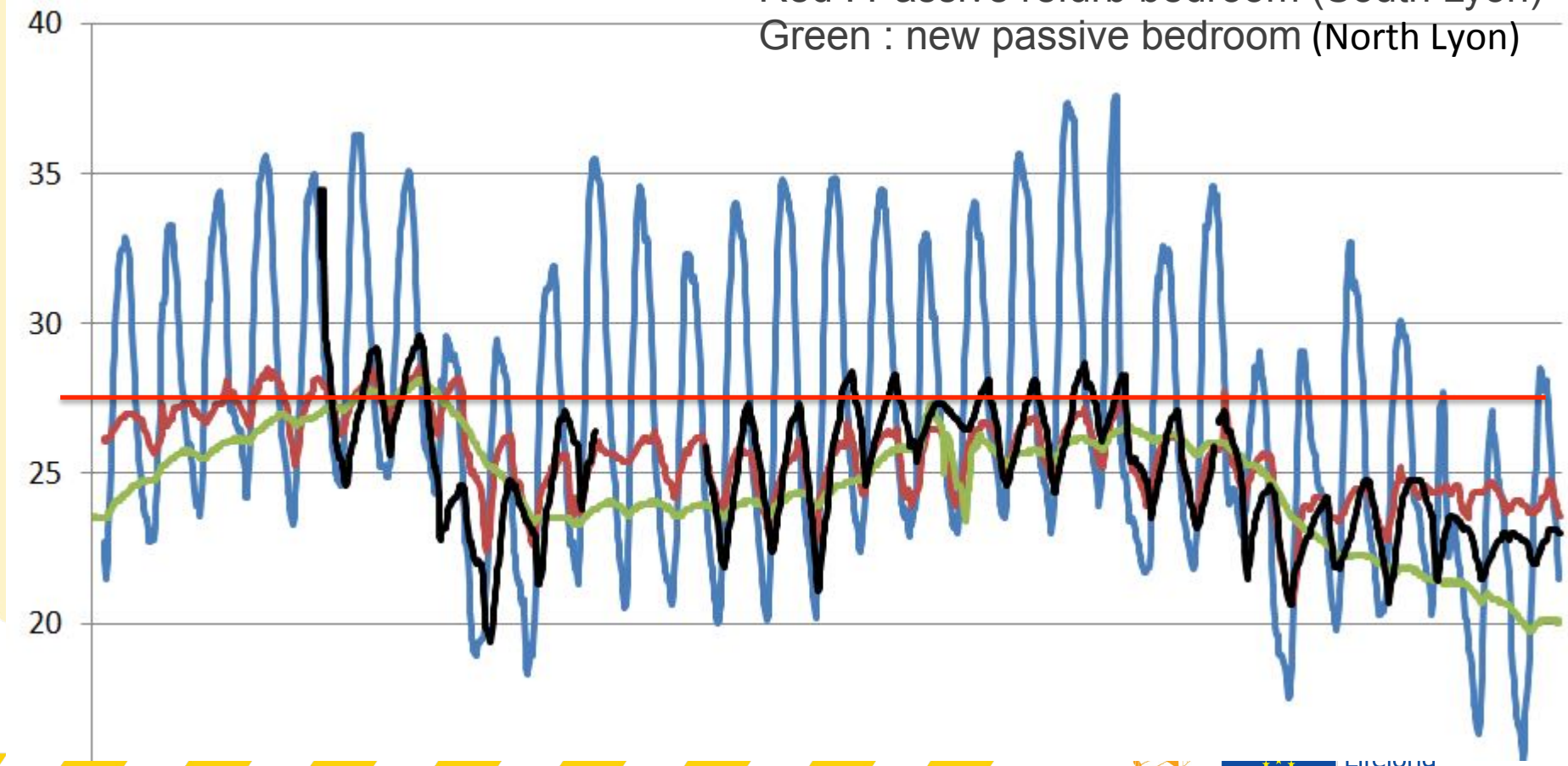


Summer comfort

Results

- July temperatures

Blue = outside,
Black : standard house bedroom Lyon
Red : Passive refurb bedroom (South Lyon)
Green : new passive bedroom (North Lyon)



Summer comfort

Conclusion

- Passive houses, straw insulated are providing a good level of comfort, even during heatvawes in this region
- Needed
  - Protect windows from solar radiations
  - Open windows at night when outside temperature is lower
  - Take care of internal heat sources : PC's light, owen, …
- Some inertia may help

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Heating

Supplied air or radiation / convection

Only possible in really passive houses

Heat retaining stove

Wood stove

Heating

Wood

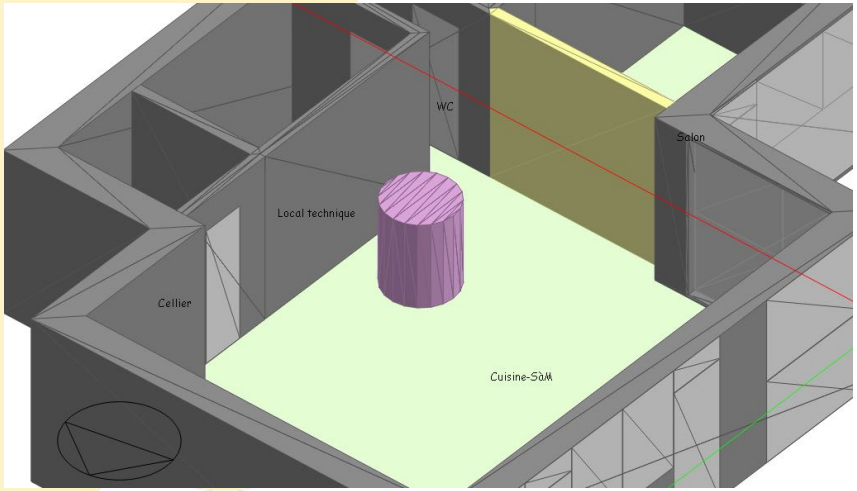
- Wood heating is usually providing a good level of comfort and satisfaction
- You may spend 60 € to 180 € of wood per year and 60 € for the annual chimney sweeping (cleaning)

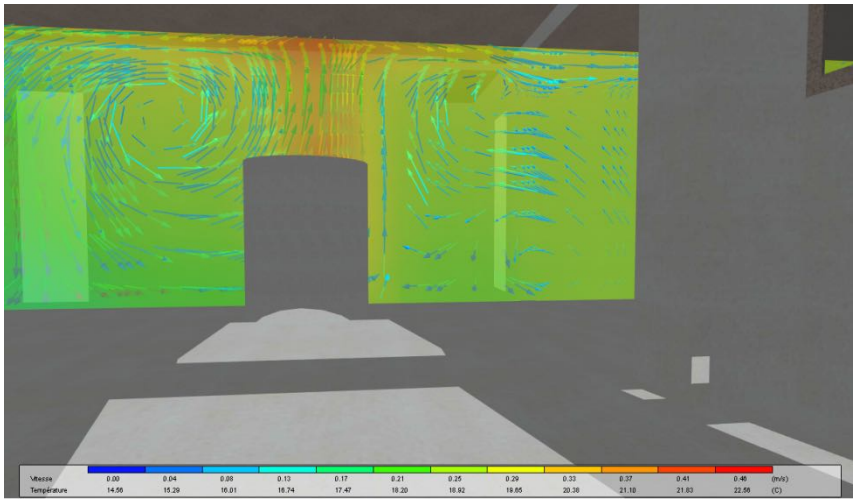
- The main problems we have seen were related to heat diffusion
  - Living room is too hot, and bedroom too cold

Heating

CFD

- We can simulate heat flow via CFD (computed flow dynamic)
  - But not human behaviour



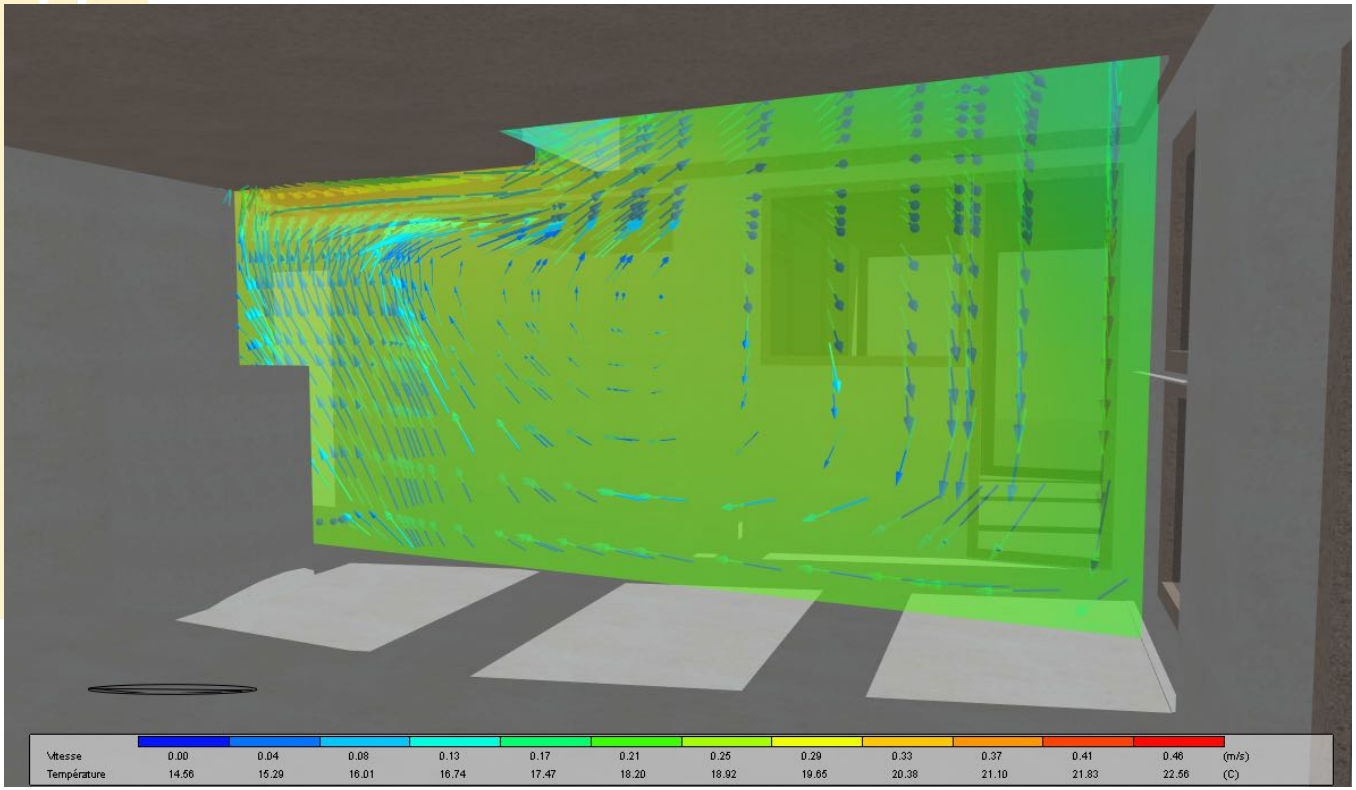


Colors : Blue = 16° Green = 18° Red = 22°
Arrows : blue (0 m/s) à red (0.5 m/s)

Heating

CFD

- And a cross section, with the staircase



Heating

Wood

- Good practices
  - 2 floors better than one floor
  - Minimum insulation between rooms and floors
  - Stove close to the staircase
  - Double flow ventilation with heat recovery will increase the comfort in the rooms
  - Opening/closing doors to do temperature regulation
  - The house must have heat storage capacity (time constant higher than 200 hours)
    - To avoid temperature moving up and down too fast
  - If not, you may need a “heat retaining stove”
    - Either the house or the stove must retain the heat

Thanks for your attention

THE END

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