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INFLUENCE OF BUILDING AIR TIGHTNESS ON VENTILATION LOSSES

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SYNOPSIS

The Building Air Tightness is an important parameter on ventilation systems performance and energy losses.
Yet, the total amount of leakage is as important on performances as their effective position in the room.
Some calculations have been run according to prEN 13465 from TC156 WG2 for different buildings (single house, dwellings and commercial buildings) varying air tightness, value and repartition for different ventilation systems (natural, mechanical exhaust, mechanical exhaust and supply).

All these calculations have been compared focusing on ventilation losses during heating season in Paris.
Some double zone calculations on the commercial building (offices and stock area) have also been run to be compared to uniform single zone repartition.

Calculations confirm the importance of air tightness on ventilation losses and show variations due to repartition hypothesis which must therefore be chosen carefully. Very often, air-tigthness value and its repartition are unknown and the hypothesis made on calculations are most important on results.

KEYWORDS

Air-tightness - Ventilation loss – Ventilation Performance

MAIN TEXT

The Building Air Tightness is an important parameter on ventilation systems performance and energy losses.
Some calculations have been run according to prEN 13465 from TC156 WG2 for different buildings (single house, dwellings and commercial buildings) varying air tightness, value and repartition for different ventilation systems (natural, mechanical exhaust, mechanical exhaust and supply).

All these calculations have been compared focusing on ventilation losses during heating season in Paris.

1- Influence of air tightness with mechanical exhaust ventilation system in dwellings

Table 1 shows the influence of air tightness for two different dwellings and various shielding. Both ventilation systems of the dwellings (3 and 4 floors) have been dimensioned according to French regulation and are situated in Paris.

Table 1 : influence of air tightness

Dwelling # 2 - mechanical exhaust

airflow 180 m3/h	air tightness under 4 Pa		shielding	qv (m3/h)	ventilation loss (kwh)	ǀ	%
	m3/h/ext.m²	vol/h/ach/dwell				airflow	vtl loss
220	1.2	0.48	No shielding	238	5720		
220	1.6	0.64		244	5858	2.5	2.4
220	0.8	0.32		234	5628	-1.7	-1.6
220	0.4	0.16		232	5580	-2.5	-2.4
180	1.2	0.48	No shielding	200	4810		
180	0.8	0.32		195	4676	-2.5	-2.8
180	0.4	0.16		192	4600	-4.0	-4.4
220	1.2	0.48	shielding	232	5564		
220	0.4	0.16		232	5555	0.0	-0.2

Dwelling # 1 - mechanical exhaust

airflow 245 m3/h	air tightness	under 4 Pa	shielding	qv (m3/h)	ventilation loss (kwh)	ǀ	%
	m3/h/ext.m²	vol/h/ach/dwell				airflow	vtl loss
220	1.2	0.27	No shielding	338	8046		
220	1.6	0.37		347	8258	2.8	2.6
220	0.8	0.18		330	7876	-2.3	-2.1
220	0.4	0.009		325	7767	-3.8	-3.5
220	1.2	0.274	shielding	324	7757		
220	0.4	0.001		323	7722	-0.3	-0.5

Dwellings #1 – natural ventilation

air tightness	under 4 Pa	shielding	qv (m3/h)	ventilation loss (kwh)	ǀ	%
m3/h/ext.m²	vol/h/ach/dwell				airflow	vtl loss
1.2	0.27	half shielding	438	11178		
0.8	0.18		398	10145	-9.1	-9.2
0.4	0.009		338	8608	-22.8	-23

- When the air tightness varies, airflow varies exponentially according to the law given in figure 1 :
- When the ventilation airflow increases, the "slope" of the curve decreases. In fact, the total airflow increase, but the mechanical ventilation protects the building against cross ventilation.
- On building #1, natural ventilation is more sensible to air tightness (up to 23 %).

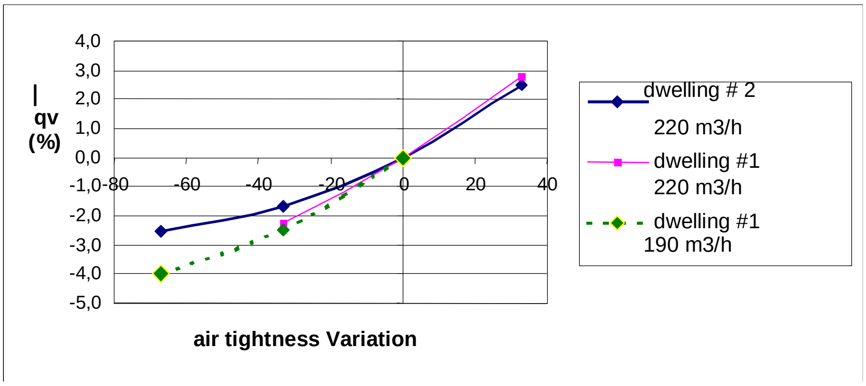


Figure 1 : air tightness variation

2- <u>Influence of building shielding</u>

Table 2 shows how results vary with shielding for the same buildings described in §1.

<u>Table 2</u> : influence of shielding

Dwelling # 2 - mechanical exhaust

airflow.	cross ventilation % qv.mec	air tightness ǀ	under 4 Pa	shielding	qv (m3/h)	ventilation loss (kwh)	ǀ	%
		m3/h/ext.m²	vol/h/ach/dwell				Qv	vtl loss
230	2.8%	1.2	0.48	No	238	5720	2.6	2.8
230	1.0%	1.2	0.48	Half	234	5617	0.9	1.0
230	0.11%	1.2	0.48	Full	232	5564		
230	0.38%	0.4	0.16	No	233	5680	0.4	0.5
230	0.01%	0.4	0.16	Full	232	5555		

Dwelling # 1 – mechanical exhaust

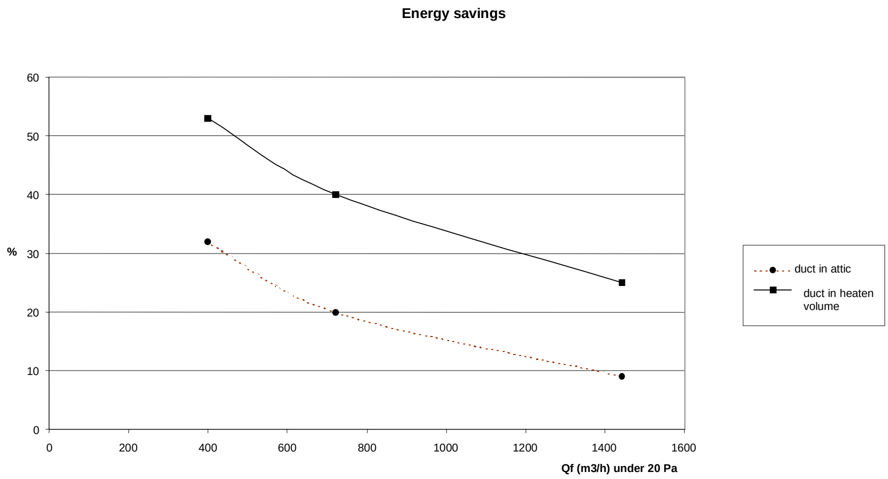
airflow	cross ventilation % qv.mec	air tightness ǀ	under 4 Pa	Shielding	qv (m3/h)	ventilation loss (kwh)	ǀ	%
		m3/h/ext.m²	vol/h/ach/dwell				Qv	vtl loss
323	5%	1.2	0.27	No	338	8046	4.3	3.7
323	2%	1.2	0.27	Half	330	7872	1.9	1.5
323	0.3%	1.2	0.27	Full	324	7757		
323	1%	0.4	0.09	No	325	7767	0.6	0.6
323	0%	0.4	0.09	Full	323	7722		

When the building shielding is correct, cross ventilation effect is not significant in ventilation losses compared to the mechanical airflow.

3- <u>Influence of air-tightness on balanced exhaust and supply ventilation systems in single houses</u>

Calculations have been run on a standard single-house of 100 m², ground floor, near Paris.
A balanced supply and exhaust mechanical ventilation system is compared to a single mechanical exhaust. Heat recovery efficiency is 67 %, average airflow is 112 m3/h. Figure 2 shows the decrease of energy savings when the house becomes more leaky.

Figure 2 : energy savings balanced system / mechanical exhaust



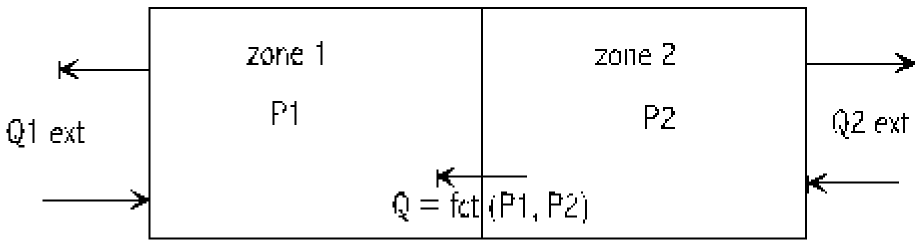
4- Influence of air tightness repartition on a multizone office building

An office building has been modelled with :

- **ground floor : stock area** — - Ventilation system : None
  - Air tightness : 0.7 ach under 4 Pa or 1.6 ach under 4 Pa
- **first floor : offices** — - Ventilation system : mechanical exhaust
  - Air tightness : 0.7 ach under 4 Pa

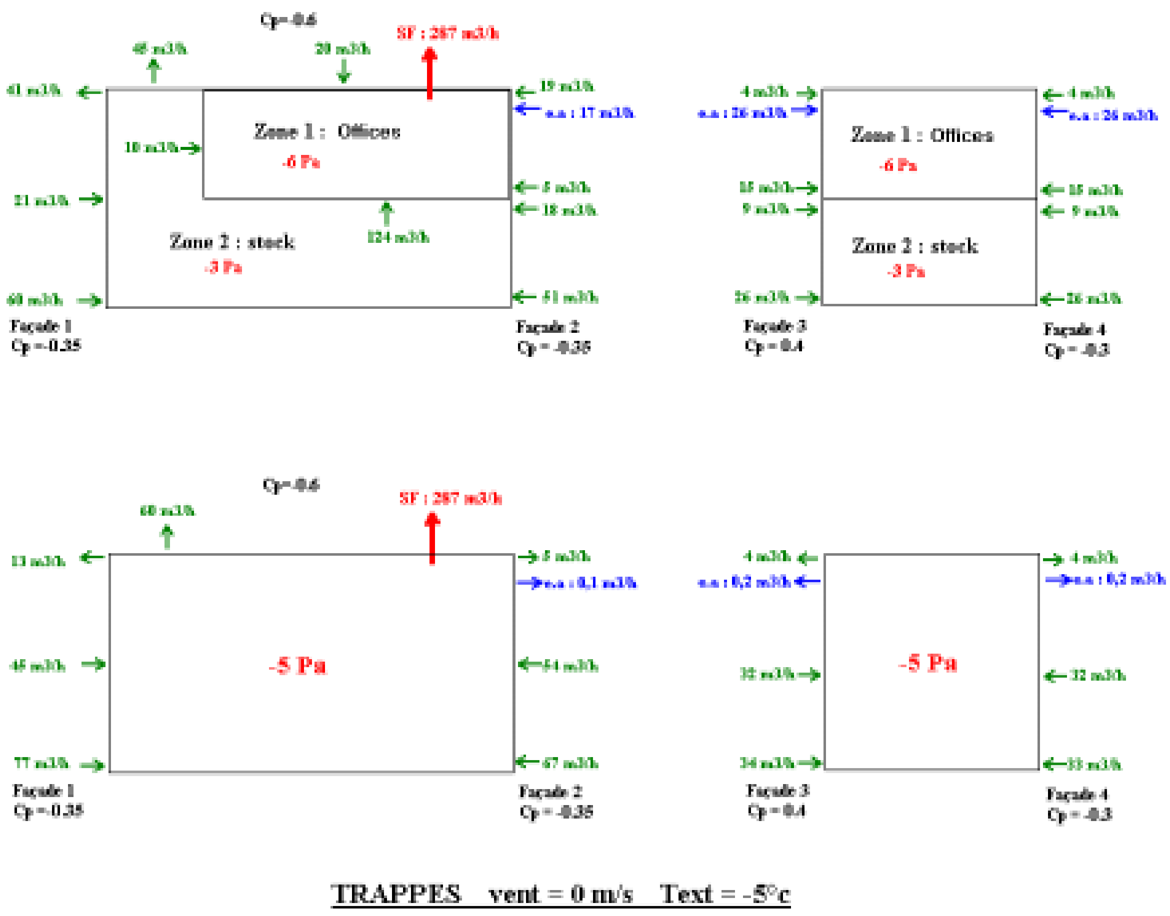
The total air tightness is distributed on all façades and the building is modelled with a two zones model according to figure 3.

Figure 3 : multizone model



First calculations have been run with the multizone model and compared to a monozone model of the full building. The monozone model increased ventilation loss by 30 %. This effect was due to the fact that the monozone model tended to increase stack effect flow between both floors (see figure 4).

Figure 4 : Multizone/monozone models flow repartition
Example for outdoor temperature : -5°C, no wind



CONCLUSION

The Building Air Tightness is an important parameter on ventilation systems performance and energy losses.
Yet, the total amount of leakage is as important on performances as their effective position in the room.
The repartition of air tightness as well as the number of zone considered in the model must therefore be chosen carefully. Very often, air-tigthness value and its repartition are unknown and the hypothesis made on calculations are most important on results.

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