IDES-EDU

INTELLIGENT ENERGY EUROPE
FOR A SUSTAINABLE FUTURE

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Educational Package Ventilation

Lecture 1 :Typical ventilation design concepts and strategies

IEE/09/631/SI2.558225
28.10.2011

Summary

- Ventilation background
- Why ventilate?
- Two ways of building ventilation
- Ventilation and Air Quality
- Insulation, Air tightness and Ventilation
- The two natural mechanisms of ventilation
- Three-pronged recommended strategy for ventilation
- Energy impact of ventilation
- Evaluation of required ventilation rate

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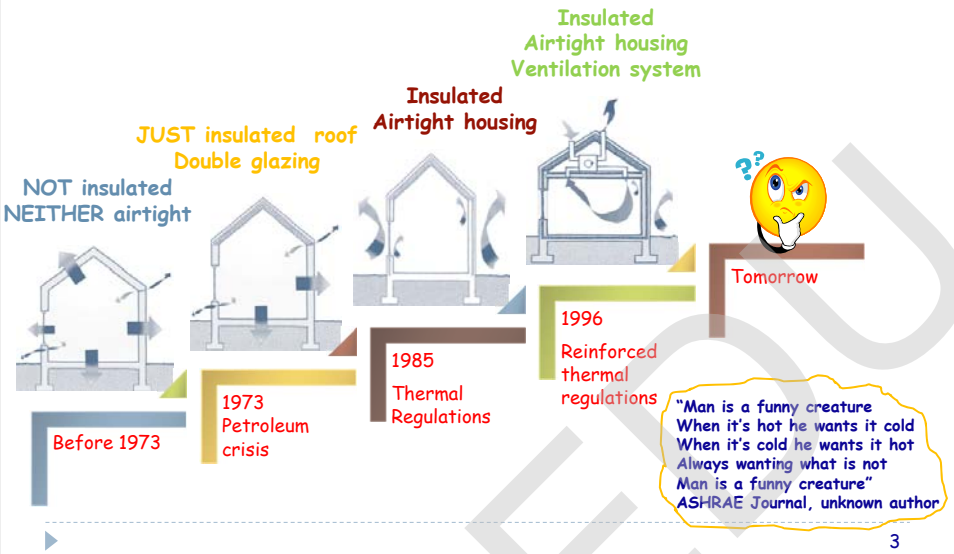
Ventilation background



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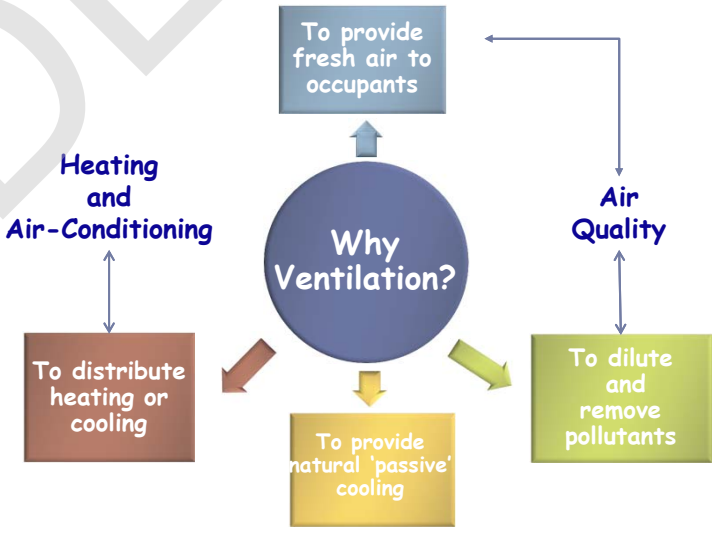
Why ventilate?



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TWO ways of building ventilation

Natural ventilation

Single sided ventilation

- supply and extraction through the same openings
- openings ~4% of floor area
- less efficient
- internal door remain closed

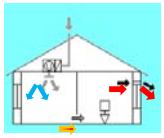
Cross ventilation

- supply and extraction at the same level in the building
- good result when wind exists
- internal doors opened or equipped with ventilation grilles

Stack ventilation

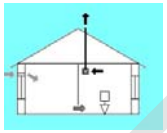
- air supply through louvers and extracted through chimneys
- wind not needed

Mechanical ventilation



Mechanical supply ventilation

- a fan supplies air to spaces
- ventilation openings in building's envelope are used for extraction
- usually used where high ventilation rates are needed and air has to be heated before entering the room



Mechanical extract ventilation

- a fan draws air from spaces
- fresh outdoor air enters into rooms either through the leakage routes of building envelope or through ventilation openings in the building envelope

Mechanical extract & supply ventilation

- a balanced ventilation system
- it must always include a supply and a return air fan
- an air heater is almost always installed in the supply air side

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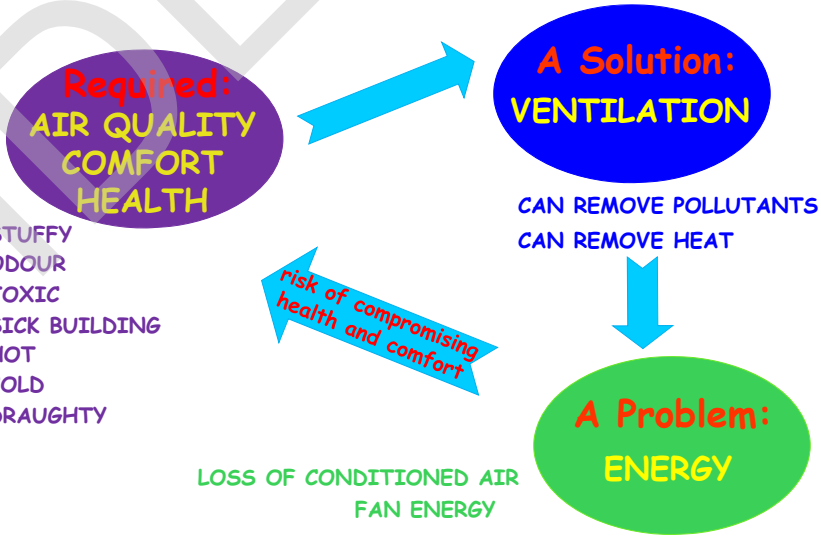
Ventilation and Air Quality



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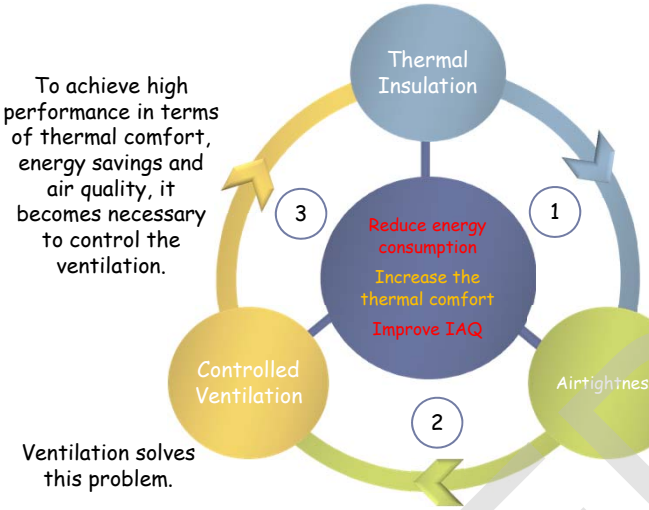
Insulation, Airtightness and Ventilation



To achieve high performance in terms of thermal comfort, energy savings and air quality, it becomes necessary to control the ventilation.

To reduce heat loss through the walls, in addition to the installation of insulation, delete air leakage through the building envelope. The airtightness solves this problem.

The realization of an airtight envelope -> no longer a sufficient air renewal.

Ventilation solves this problem.

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The two natural mechanisms of ventilation

Objectif

The objective of a good ventilation strategy is to ensure a balance between energy efficiency and indoor air quality.
"build tight – ventilate right"

- In other words:
  - Minimize the amount of air leakage through the building envelope
  - Install a controlled ventilation system to provide the necessary level of ventilation where and when necessary.

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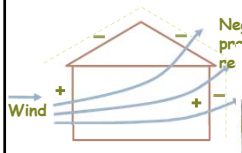
The two natural mechanisms of ventilation

1. Wind Driven Ventilation



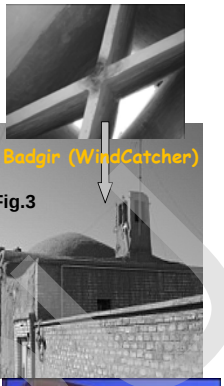
Wind driven flow

Wind tower

Fig.1 (a,b,c)

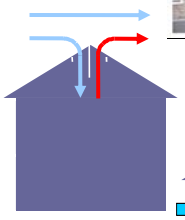
Fig.2

Yazd, Iran

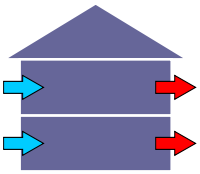


Badgir (WindCatcher)

Fig.3



Cross Flow Wind



$$p_w = C_p \rho v^2 / 2$$

IUT building La Réunion Island

Fig.4

Natural ventilation cross tropical climate

Fig.5

Natural ventilation system single sided type tropical climate

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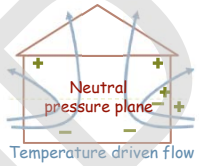
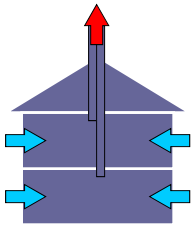
The two natural mechanisms of ventilation

2. Stack Driven Ventilation



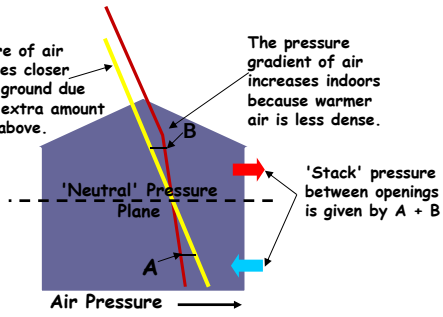
Temperature driven flow



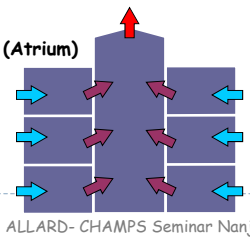
Stack (Flue)

Pressure of air increases closer to the ground due to the extra amount of air above.

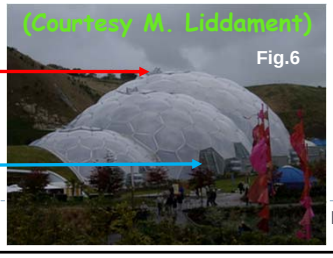
The pressure gradient of air increases indoors because warmer air is less dense.



Stack (Atrium)



Stack height



(Courtesy M. Liddament)

Fig.6

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Three-pronged recommended strategy for ventilation

Extract ventilation in 'wet' rooms	• **Remove** these pollutants directly to outside • **Minimize** their spread into the rest of the building
Whole building ventilation	• **Provide** a continuous supply of fresh air from outside • **Dilute** and **disperse** water vapor and pollutants that are either not removed by extract ventilation or are generated in other rooms from the building
Purge ventilation throughout the building	• **Aid** removal of high concentrations of pollutants and water vapor released from occasional activities such as painting and decorating • Opened windows

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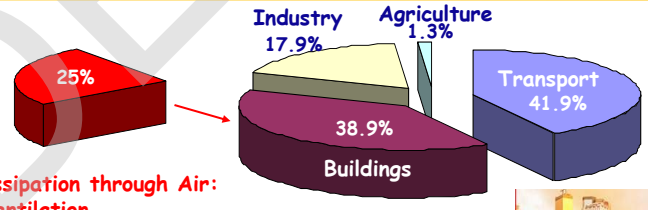
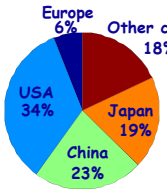
Energy impact of ventilation



Dissipation through Air:
-Ventilation
-Infiltration
-Venting

New York City, USA



Air-conditioner world market (in volume) in 2000

Honk Kong, China

Stockholm, Sweden

Huge demand to reduce the energy impact of ventilation!

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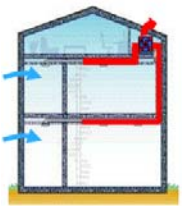
Energy impact of ventilation

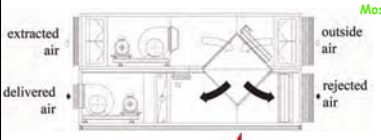
Power supply

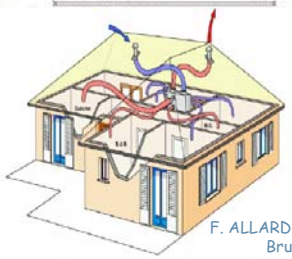
- Specific fan power
- Heat recovery units



Air exchange

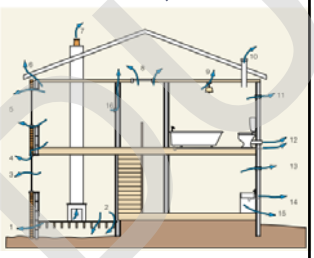
- Energy saving control devices
- Improving airtightness





Most common air leakage paths

1. Under-floor ventilator grilles.
2. Gaps in and around suspended timber floors.
3. Leaky windows or doors.
4. Pathways through floor/ceiling voids into cavity walls and then to the outside.
5. Gaps around windows.
6. Gaps at the ceiling-to-wall joint at the eaves.
7. Open chimneys.
8. Gaps around loft hatches.
9. Service penetrations through ceilings.
10. Vents penetrating the ceiling/roof.
11. Bathroom wall vent or extract fan.
12. Gaps around bathroom waste pipes.
13. Kitchen wall vent or extractor fan.
14. Gaps around kitchen waste pipes.
15. Gaps around floor-to-wall joints (particularly with timber frame).
16. Gaps in and around electrical fittings in hollow walls.



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Evaluation of required ventilation rate

for office spaces...

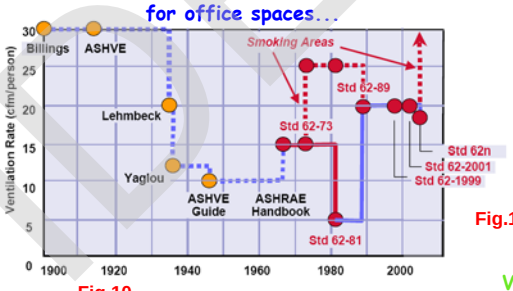

Fig.10

for residential buildings...

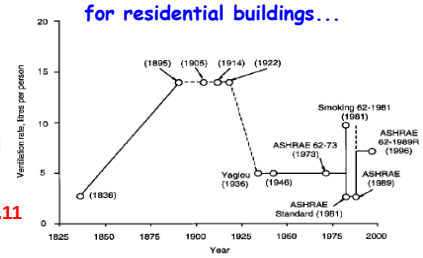

Fig.11

Brief Ventilation Rate History

Ventilation Rates 1955-2003 (cfm/person)

Space Type	Usual Practice 1955-1972 Min	Usual Practice 1955-1972 Rec	Std 62-73 Min	Std 62-73 Rec	Std 62-1981 Non-Smoking	Std 62-1981 Smoking	Std 62-1989 -1999 -2000	Addendum 62n
School Classroom	Local Codes		10	15 to 25	5	25	15	8 to 19 13 typ
Private Office	Non-Smoking 15	25	15	15 to 25	5	20	20	17
	Smoking 25	30						
Retail Shop	7½	10	7	10 to 15	5	25	15	16
Hotel Room	25	30	7	10 to 15	15 per room	30 per room	30 per room	11
Restaurant Dining Room	12	15	10	15 to 20	7	35	20	10
Absolute Minimum	Non-Smoking 5		5		5		15 or IAQ Procedure	5
	Smoking 25							

Fig.12

History And Background of Ventilation Rates, *Kansas City Seminar 4 June 29, 2003;* Fred Kohloss Consulting Engineer, Honolulu, Hawaii

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References

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HEALTHVENT HEALTH-BASED VENTILATION GUIDELINES FOR EUROPE, WORK PACKAGE 5, EXISTING BUILDINGS, BUILDING CODES, VENTILATION STANDARDS AND VENTILATION IN EUROPE FINAL DRAFT REPORT, Coordination of work: Olli Seppänen, Secretary General of REHVA, Project group: Nejc Brelih, Guillaume Goeders, Andrei Litiu

lecture F. Allard, "AERAULIQUE DES BATIMENTS"

F. ALLARD- CHAMPS Seminar Nanjing 20-22/03/2011

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History And Background of Ventilation Rates, *Kansas City Seminar 4, June 29, 2003;* Fred Kohloss Consulting Engineer, Honolulu, Hawaii

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