AIR IS LIFE

Mankind is increasingly moving towards indoor environments with an artificial microclimate, which often deviates considerably from that outside, harming those present. This is known as “sick building syndrome” (Sumedha).

This problem has long been focused on and regulated at various levels (see WHO 1988). But now there is a progressive deterioration of the microclimate which can be attributed to architectural, environmental and social factors. This situation submits people to an increasing risk of exposure to infectious diseases, cancer etc.

The concentration of carbon dioxide (CO2) is considered as a parameter for the quality of the climate in indoor environments. This indicates the pollution of the microclimate in relation to the number of people present in a given volume of the indoor environment. The concentration of CO2 in indoor environments has long been associated with the risk of transmission of infectious diseases like influenza (Milton and Rudnig), but probably also by Coronavirus, as also the risk of the onset of lung cancer. Indeed the exposure to radon, a radioactive gas which derives from the decomposition of uranium and underground thorium, which is detected in well insulated buildings, is considered the second cause of lung cancer after smoking.

The concentration of CO2 in indoor environments depends on the one hand on the number of people, their physical activity and the volume of the environment, and on the other the air recycling through ventilation.

But what is the volume of air to be recycled in a given time frame (recycling rate m3/hour)?

For housing a ratio (recycling rate) of about once an hour is considered. This indicates that the whole

volume should be recycled every hour. In the following table recycling rates for different environments are

indicated: Table 1.

Offices	4-8
University lecture halls	6-8
School classrooms	5-8
Conference rooms	6-8
Photocopy shops	10-15
Private kitchens	15-25
Commercial kitchens	15-30
Public showers	15-25
Average for places normally frequented	4-8

Another approach to determining the air to be recycled is to calculate the volume to recycle per person present (on average 25-30m^3/hour) in relation to the volume of the total space.

This calculation method also indicates an overall recycling rate approximately between 4 and 8 m^3/hour.

With natural ventilation (not controlled mechanical ventilation = CMV) the following recycling rates are attained: Table 2.

Windows and doors closed	(according to the isolation degree)
Windows partially open	0.3-1.5
Windows intermittently open	0.3-4
Windows open continuously	9-15

This means for example, that for a school classroom, ventilation with all the windows open for about 10 minutes every hour is necessary.

At present ventilation of buildings contrasts with the energy requirements which require a reduction in energy leakage- Various laws, incentives etc. for the purpose of a renovated, eco-friendly house, have created renovation investments in buildings, which in Italy alone reach 50 billion euro per year (data from the Osservatorio Congiunturale ANCE 2019).

But unfortunately insufficient space is given to the aspects of ventilation, fundamental for wellbeing, even if there are various directives in this respect. The work to improve energy efficiency in already existing buildings, progressively reduces the recycling rate of the air with closed windows. This rate is reduced by a volume/hour in old houses (sufficient for a healthy climate in the habitat) to half in those with energy efficiency measures, to reach a value of a fifth volume/hour in zero emission houses. In the last two environments therefore a supplementary natural ventilation is needed (opening the windows for about ten minutes every hour) or else a forced mechanical ventilation**. "Ventilation mechanisms are only the consequence of a chain of construction errors which have been created by establishing standards for zero emission or low energy consumption housing"**.

Insufficient ventilation in indoor environments, has various other causes besides architectural ones:

1. External pollution reduces the opening of windows (cofactor for the high incidence of coronavirus in industrialized areas with high external pollution)
2. The internal/external temperature difference reduces ventilation frequency (cofactor for the high incidence of coronavirus in countries with a cold climate)
3. Impossibility to keep windows open as in e.g. care homes, banks etc. (cofactor for the high incidence in

these places)

4. Change in lifestyle: members of a household spend less and less time in the home due to more time spent in the workplace.

All the above factors, concomitantly with the new construction standards lead to an increasingly dangerous management of indoor environments with multiple repercussions on people's health. In fact so many people staying for a long time in environments without an adequate air exchange worldwide **has led to and still leads** to a high number of human victims (see the coronavirus pandemic).

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