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Trends in Brazilian building ventilation market and drivers for change

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1 Introduction

This paper presents an overview on building ventilation, indoor air quality and energy requirements in Brazil. Regulations, standards and market practices are reviewed.

Brazil is situated in South America (Figure 1) and is a large country (8.5 million square kilometres) with 184 million inhabitants (2007).

Brazil has tropical and sub tropical climates that are mild and allow reasonable comfort outside many hours of the year. Natural ventilation is very important for summer thermal comfort. Buildings normally are not insulated and leaky. Mechanical ventilation in houses is only used for bathrooms without windows to the outside.

Brazilian standard, NBR15220, from ABNT (Brazilian Standard Organization) show the division of Brazil in 8 bioclimatic zones (Figure 2) and recommends bioclimatic strategies for the adaptation of residential buildings in each bioclimatic zone. It is possible to see also in figure 2 that Brazil has latitudes varying from approximately 5N to 33S.

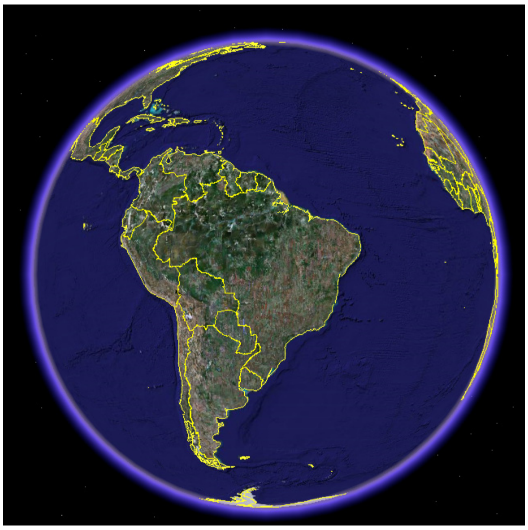

Figure 1: Brazil in South America

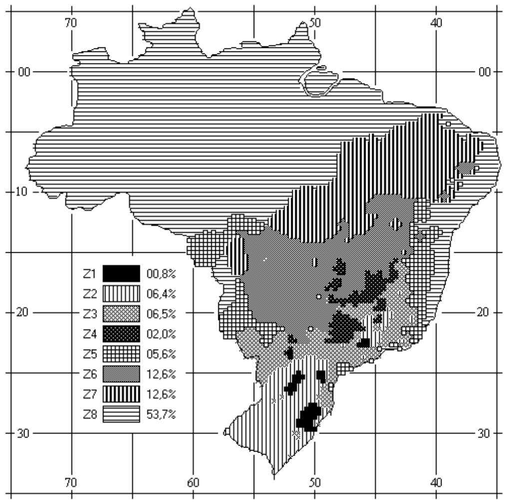

Figure 2: Brazilian bioclimatic zones from Brazilian standard NBR 15220

Brazil is a developing country and the Gross National Product (GNP) growth is still associated with energy consumption growth. Figure 3 shows the electric energy consumption for the residential, commercial and public sectors for years 1987 to 2005 and the GNP.

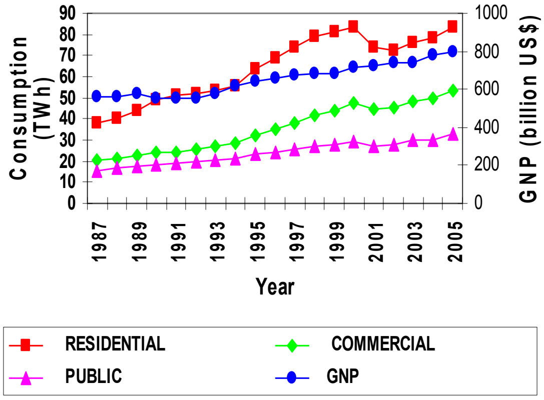

Figure 3: Brazilian Electric energy consumption per sector and GNP

2 National trends in IAQ requirements and market characteristics

Brazilian standard NBR 6401-1980 is the official reference for air conditioning design. It is somewhat outdated and based on air renovation established in ASHRAE Handbook of 1972. Good and conscious designers tend to use more recent ASHRAE standards and handbooks and do not follow NBR6401.

In 1996 the government forbade smoking in enclosed public spaces showing the first initiatives to improve IAQ in buildings.

In 1998 the Minister for Communications died by contamination of fungi from the central air conditioning system of the ministry building. This has helped to raise the attention of any IAQ problems in the sanitary agency ANVISA. Some standards and resolutions were established.

In 1998 the Ministry of health through ANVISA (National Sanitary Surveillance Agency) published order 3523 that has technical orientations to promoting better IAQ. It establishes guidelines for cleaning air conditioning systems and standards of air quality, identifying physical, chemical and biological pollutant sources and health risks. In 2000, resolution 176 established references for IAQ in air conditioned spaces. It was updated in 2003 by resolution number 9. This resolution establishes minimum parameters for good air quality, maximum microbiological contamination (fungi), and maximum chemical contamination (CO_2, aerosols, particulate matter, indoor temperature, humidity and velocity, air renovation, air filtering). It also presents sampling procedures.

Resolutions number 9 establishes:

- Maximum value for microbiological contamination is 750 ufc/m^3 for fungi and a relation of I/E less than 1.5 (I is the quantity of fungi in the interior air and E on the exterior air). When I/E is higher that 1.5 a diagnosis of the pollution sources has to be made and corrective measures implemented. No pathogenic or toxogenic fungi are allowed.
- Maximum values for chemical contamination are 1000 ppm for CO_2, and 80 μg/m^3 of particulate matter.
- Air temperature, humidity and velocity limits are taken from NBR 6401. Summer 23-26 °C and winter 20-22 °C. Humidity 35-65%. Velocity less than 0,25 m/s. Air renovation of 27 m^3/h/person for normal occupancy and 17 m^3/h/person for rooms with high fluctuation in its occupation. Regarding air renovation filtering, G1 for external air inlet and G3 for distribution.

At the moment NBR6401 is under revision and project 55:002.03-001 for Central and unitary air conditioning system installation should substitute it. Part 3 is dedicated to IAQ and establishes air renovation based on ASHRAE Standard 62.1:2004.

2.1 Requirements on ventilation of dwellings

Building codes require minimum window areas that can be opened to be 1/6 (long occupancy spaces) or 1/8 (short occupancy spaces) of the floor area and openings are normally only half of this area.

This is a very small area for natural ventilation and most of the dwellings around the country would benefit from larger areas.

Standard NBR15220 has recommendations for larger window areas that can be opened for natural ventilation in several bioclimatic regions but as it is only a recommendation, only a few buildings follow them. Table 1 presents the ventilation opening areas recommended in NBR15220. Each of the 8 bioclimatic regions has a different ventilation requirement.

Table 1: Ventilation Opening Area from Brazilian Standard NBR 15220

Ventilation Opening	Area (% of floor area)
Small	10%< A < 15%
Medium	15< A < 25%
Large	A>40%

It should be noted that the ventilation area must be shaded.

The energy labeling regulation under development for residential buildings will stimulate this bioclimatic adaptation in order to enhance natural ventilation and reduce energy consumption.

2.2 Requirements on ventilation of non residential buildings

Non residential buildings also follow the building code in relation to opening areas but many commercial buildings are highly glazed with large demands for air conditioning.

When central air conditioning systems are installed, generally good air renovation is guaranteed but with the high increase in split systems usage, without air renovation, indoor air quality is getting poor.

Even in centrally conditioned buildings problems are frequent. A study by INMETRO, the National Institute for Metrology, covering 78 buildings with central air conditioning systems (22 shopping centres, 37 cinema rooms and 19 supermarkets) in 6 cities from north to south of the country (Belem, Brasilia, Florianopolis, Recife, Rio de Janeiro and Sao Paulo) and using the resolution 176 and order 3523 of ANVISA, has presented some worrying results. Most of the buildings tend not to attend to requirements of maintenance and documentation to guaranty minimum IAQ requirements.

The results have shown that:

- Microbiological contamination: No pathogenic fungi and fungi bellow 750 ufc/m^3. Regarding the limit I/E less that 1.5 from the 78 buildings, 7 did not comply.
- Chemical contamination. CO_2 limit 33 out of the 78 did not comply and the limit varied from 1001 to 2284 ppm. Particulate matter, 80 μg/m^3 , all 78 complied.
- Indoor temperature, humidity and velocity, 52% did not comply temperature, 13% humidity and 4% velocity.

The complete evaluation has lead to 9% non compliance for microbiological contamination, 43% non compliance for chemical contamination, 56 % non compliance for indoor comfort parameters and only 32% total compliance

This study was performed in 2001 and in 2002. The results were shown to a large audience using television programs but we could say that little has changed so far.

3 National trends in energy requirements and market characteristics

In 2001 Brazil suffered an electric energy crisis. Lack of rain for the hydro electric plants and lack of investments in transmission lines and backup generation plants imposed the need to reduce 20% of the country's consumption. The management of the crisis and the cooperation of the population lea to high reductions in the country's energy consumption and some of these reductions became permanent. The important spin-off of this crisis was the signing by the government of the energy efficiency law that had been on the senate for 10 years.

Under this law a labelling scheme for commercial buildings was developed and is now in implementation (starting as voluntary)

by INMETRO and a labelling scheme for residential buildings is under development.
So far no minimum efficiency requirement for buildings was established.

4 National trends in air tightness requirements and markets

Basically there are no air tightness requirements in Brazilian buildings. There are some standards for specific window types (PVC, aluminium) but the verification is not a common practice. But new construction practices are increasing the air tightness in high quality buildings.
Laboratory infrastructure for testing whole building air tightness is not available in Brazil.

5 National trends in innovative systems and markets

There are no regulatory barriers for innovative systems but also very little innovation has been seen. There is a high potential for the use of natural and hybrid night time ventilation but no building component that provides the adequate ventilation with protection from rain and intrusion. In the residential market, some products that in the past were used and provided shade, darkness and ventilation are no longer available.

6 Conclusions

This paper has presented an overview on building ventilation, indoor air quality and energy requirements in Brazil. Regulations, standards and market practices were reviewed. It is clear that little attention is given to this subject in Brazil and that it took the death of a government minister for the sanitary agency to establish some recommendations but unfortunately not many people know they exist and an inspection program is needed to bring this subject into the agenda of building owners

7 References

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The Air Infiltration and Ventilation Centre provides technical support in air infiltration and ventilation research and application. The aim is to promote the understanding of the complex behaviour of the air flow in buildings and to advance the effective application of associated energy saving measures in the design of new buildings and the improvement of the existing building stock.