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INDOOR AIR QUALITY STANDARDS AND CODES IN THE UNITED STATES

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Abstract

This paper covers some of the policy options used in the U.S. concerning regulation of building construction. The extensive code system is discussed, and the voluntary standards upon which the codes are usually based. While the codes set out the mandatory requirements, the standards are voluntary only. Some of the important background, research and philosophy of the standards are covered, as well as other information which has been offerred to users to promote the voluntary use of energy conserving strategies which are compatable with acceptable indoor air quality.

Introduction

Because indoor air quality has been recognized as a serious, or possibly serious, problem in the U.S. in recent years, there has been increased activity by many groups and government agencies, which has been designed to protect the public from unnecessary exposure to airborne contaminants. These activities have involved research by government agencies, private organizations and companies. The results have been used to provide bases for standards and codes, and to provide information for improved product development and system design and operation. In this brief paper, only an overview of this subject can be covered. For a more complete summary of codes, standards and other technical data pertaining to indoor air quality, see reference (1).

Addressing Indoor Air Quality Issues

To do an adequate job of assessing the extent of the problem and arriving at decisions on action, the various organizations need information concerning: (1) the various indoor contaminant sources; (2) the range of indoor contaminant levels and the environmental factors affecting these levels; (3) the relationship between indoor air quality and energy conservation; (4) the potential health effects from exposure to indoor air pollutants; (5) the acceptable range of indoor contaminant levels as determined by objective or subjective evaluations; and (6) the effectiveness and economics of the various indoor air quality control techniques. Then the results can be used to promulgate the various options, --regulation, recommendation, education, etc.

It should be emphasized that buildings are continually being built and that decisions must be made with incomplete information. However, insofar as possible, all the above factors are taken into account. It should also be stressed that inadequate ventilation is not a source of indoor contamination, but allows indoor contaminant levels from existing pollutant sources to be elevated.

Regulatory Activities

In the U.S. no one federal agency has jurisdiction over the quality of indoor air in non-industrial buildings. Although the Environmental Protection Agency (EPA) is the lead agency within the federal government for the control of air pollution, deriving its authority from the Clean Air Act, this legislation covers "ambient air", which has been interpreted to mean that air external to buildings. EPA has done an admirable job in improving the U.S. ambient air quality. The Occupational Safety and Health Administration (OSHA) is responsible for safeguarding worker's health in the workplace. However, the "workplace" has been considered to be the industrial workplace, and so to date, most of their activities have been there. Therefore, with the exceptions listed below, the responsibilities for indoor air quality in homes, schools, offices, etc. have resided with the various state and local governments and with the private sector. Those excepted provisions are: EPA requirements for the removal of asbestos in schools, the General Services Administration (GSA) regulations to restrict smoking within federal buildings, and the Department of Housing and Urban Development (HUD) regulations specifying formaldehyde emission limitations from partical board and plywood for use in mobile homes. (The EPA also has jurisdiction over pesticides, such as chlordane, wherever they are used.)

State and local governments have been very active in dealing with indoor air quality issues. For example, Massachusetts has banned the use of urea-formaldehyde foam insulation (UFFI), and both Minnesota and Wisconsin have promulgated formaldehyde standards for new mobile homes. California has banned the sale of unvented combustion space heaters. Many states and municipalities have instituted anti-smoking ordinances. Finally, many states have prepared informational documents to inform their populations about indoor air quality.

These state and local governments also promulgate building codes. These are legal requirements to be followed to protect the health and safety of their citizens. There are approximately 5000 such codes which cover most of the U.S, although there are some areas which have no building codes at all. These codes are the responsibility of the area issuing them, and they differ widely in their content. For ventilation and energy conservation, which is the subject of this paper, these codes are almost always based upon voluntary consensus documents, such as the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) ventilation standard and energy conservation standard. However, there is much autonomy in the code bodies. Some refer to such ASHRAE standards in total. Others modify them, and still others write their own provisions. It is impossible here to cover the wide variations found in these codes. In order to try for more standardization, there are three "model" code groups covering the geographic areas of the U.S. These groups publish model codes for the various jurisdictions to use. Progress is being made to harmonize these codes, but the autonomous nature of the U.S. political process is complex. However, it can be seen that codes do rely on a body of adequate, research-based information to guide them. It has evolved that ASHRAE has assumed that role for ventilation and energy conservation.

Voluntary Consensus Standards Activities

ASHRAE has had a long history of developing technical information and standards on ventilation. ASHRAE's main purpose is to "advance the arts and sciences of heating, refrigeration, air-conditioning and ventilation for the benefit of the general public". One of ASHRAE's predicessor societies was established in 1894, and was the American Society of Heating and Ventilating Engineers (ASHVE). "Ventilation" was in the name of the society, and it has been involved in ventilation technology ever since. Ventilation provisions were publicized from the beginning.

Figure 1 shows the milestones of recommended ventilating requirements over the past and current times. In 1836 Tredgold determined that 4 cubic feet of outside air per minute per person, 4 cfm/person (2 L/s/person) was adequate to permit Welsh underground miners to work. It turns out that this was very close to the recent minimum requirement for ventilating for a person who is sedentary and not polluting the environment except with his own effluent. When ASHVE was organized, the work of Billings and Flugge recommended 35 cfm/person (17.5 L/s/person). This was based on the conditions of the times, which included much indoor pollution from gaslights, cooking, etc. and with personal hygiene habits less rigorous than now. In addition, energy was not a problem then. In the 1920's many of the states promulgated standards based on whatever information was available to them. In 1936 Yaglou, a famous ASHVE member, determined that 10 cfm/person (5 L/s/person) was adequate for situations where people were the main pollutant source. About that time the American Standards Association (ASA) was the organization which developed and promulgated consensus voluntary standards. They developed the first consensus ventilation standard known to the authors. It covered windows and other openings for natural ventilation, and included an appendix on mechanical ventilation. Several ASHVE members were on the committee which wrote it. This then became the basis for many building codes, and because codes are difficult and time-consuming to change, this Standard, ASA A53.1 1946, (2) may still be in some codes.

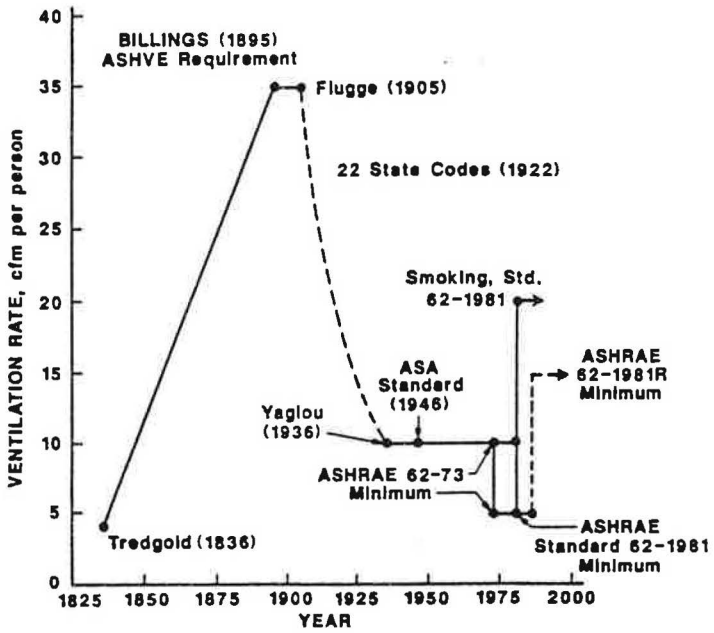

Fig. 1. History of recommended and minimum ventilation rates in the U.S.

Subsequently, the ASA was superceded by the American National Standards Institute, (ANSI). ANSI acts as an umbrella organization to avoid duplication and to oversee and approve the procedures of the various standard-writing organizations. ASHRAE is an approved standard-writing organization, and therefore operates under a prescribed consensus procedure. As such, ASHRAE is the organization which develops consensus standards for building ventilation and energy conservation requirements.

These standards are written by a committee of 10-20 experts, chosen by ASHRAE to be balanced in their views and expertise. (For the last two revisions, a European member has been appointed, bringing that expertise to ASHRAE.) This committee is a sub-committee of ASHRAE's Standards Committee, which is a standing committee whose members are elected by the Board of Directors. The sub-committee is called the Standards Project Committee (SPC), and there is one such committee for each standard under development. The SPC meets 2-4 times per year, and drafts the standard. Upon initial completion, the standard is submited for an open review period of 60-90 days, and comments are invited from all interested parties. The comments are resolved insofar as possible, and when consensus is reached, approval is recommended by the SPC, the Standards Committee and the Board of Directors. Consensus is defined as "substantial agreement, but not necessarily unanimity". If there are substantial objections which cannot be resolved, another public review period may take place.

Under these procedures, ASHRAE revised ASA A53.1-1946, and reissued it as ASHRAE Standard 62-73 (3),"Standards for Natural and Mechanical Ventilation". For the first time, mechanical ventilation was stressed. This Standard 62-73 was the basis for most building codes, as they were revised under their often deliberate procedures. Standard 62-73 was prescriptive in its contents, but it did recognize the coming energy crisis by including two columns of cfm/person (L/s/person) for the various types of spaces listed. There was a "minimum" column and a "recommended" column. The minimum column was approximately one-half the recommended, recognizing quality of the application. In addition, to save energy, it provided a method for cleaning return air with filters, to be re-used in the space,

Under the usual revision procedures, ASHRAE again revised Standard 62-73, and reissued it as Standard 62-1981 (4) "Ventilatioon for Acceptable Indoor Air Quality". This standard introduced a two-path approach involving the usual prescriptive method, as well as a performance method. The prescriptive method had two columns, one for "smoking permitted" and another for "smoking prohibited". There was a large difference between the values, recognizing the annoyance of tobacco smoke. As before, the minimum value was 5 cfm/person (2.5 L/s/person) which reflected the research at the time, when environments were "polluted" only with people performing light activity. The performance method allowed for inovation in future developments, whereby a designer could meet the standard if he could show that no pollutant level exeeded those set out in a rather extensive table. In addition, he would have to show that 80% or more of occupants would express satisfaction with the environment from a subjective asessment. It was known that few, if any, designers would use this method. It was further intended that the two approaches were not to be mixed. In other words, once a method was chosen, the other method would not apply.

The Formaldehyde Institute formally objected to the formaldehyde limit given in the performance method table (0.1 ppm) and they appealed to ANSI that consensus had not been reached. Although ASHRAE refuted the charge, ANSI upheld the appeal, and did not approve Standard 62-1981, even though ASHRAE approved and issued it. Although it is now the current standard, code-writing bodies were reluctant to include this standard in code revisions, so that currently, ASHRAE Standard 62-73 is still widely used.

ASHRAE recognized this controversy, and the rapid pace of research in the field, and immediately started revision. By now the U.S. was sensitized to the importance of this standard in future codes. Seven years later, the standard has not reached consensus within the SPC.

The current draft of Standard 62-1981R (5) ("R" for being revised), is the best current thinking on the subject. Although it has several differences from Standard 62-1981, it does retain the two-path approach. Because of the controversy, it moves the table of suggested contaminant levels to the appendix, where it is not part of the standard. Of additional importance, it revises the minimum ventilation rate to 15 cfm/person (7.5 L/s/person) because of new research. Also it contains only one column of ventilation rates, so that there is no "no smoking" column. It is more explicit on methods to treat recirculated air through filters, and it recognizes VAV system problems, and suggests some solutions. In addition, it mentions ventilation effectiveness and includes cautions about bio-organisms. It also contains a requirement for documentation of the designers' solutions. Several other minor differences are also proposed.

It is impossible to predict when, or what the final approved draft will contain, but this draft represents the most uptodate ASHRAE thinking, and its provisions should be used now, with engineering judgement.

Conclusions

It can be seen that the U.S. regulatory system is very diverse and complicated, with much individual autonomy. Codes are changed very slowly. Currently ASHRAE Standard 62-1981 is not well accepted by code bodies, due to its rejection by ANSI. It is hoped that many codes will use the teachings of ASHRAE's new information, but that cannot be controlled under the current conditions.

ASHRAE will continue to refine Standard 62-1981R to the best of its ability, both because it is the only U.S. consensus document available, and many of the ventilation standards provisions in codes are in need of revision to protect the public health in buildings insofar as possible.

References

(1) Standards, regulations and other technical criteria related to indoor air quality. Report by the National Institute of Building Sciences, Washington, DC, U.S.A, 1986.

(2) Light and ventilation. Standard A53.1, American Standards Association, New York, NY, U.S.A, 1946.

(3) Standards for natural and mechanical ventilation. Standard 62-73, The American Society of Heating, Refrigerating and Air-Conditioning Engineers, Atlanta, GA, U.S.A, 1973.

(4) Ventilation for Acceptable Indoor Air Quality. Standard 62-1981, The American Society of Heating, Refrigerating and Air-Conditioning Engineers, Atlanta, GA, U.S.A, 1981.

(5) Ventilation for Acceptable Indoor Air Quality. Standard 62-1981R, (currently in revision). The American Society of Heating, Refri-- gerating and Air-Conditioning Engineers, Atlanta, GA, U.S.A, 1988.