The California Portable Classroom Study and Its Impact on Classroom Ventilation

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Overview

There has been much interest and discussion by media and other agencies in the last few months surrounding the results of the recently released California Portable Classroom Study. This paper explores why the study was conducted and what the results mean with regard to the heating, cooling and ventilation of classrooms.

History

During the 2000 legislative session The California State Legislature passed AB 2872 ordering the California Air Resources Board and the Department of Health Services to conduct a comprehensive study of the indoor air quality in California portable classrooms. The study was prompted by concerns that California schools, especially portable classrooms, were not providing healthful learning environments for students and teachers.

The study included both permanent and portable classrooms, as well as a detailed analysis of Airborne Pollutant levels such as Aldehydes, Formaldehydes, non-carbonyl VOC's, Particulate Matter, Pollens and Spores, Floor Dust Contaminants, Pesticides, Metals, Allergens, and Polynuclear Aeromatic Hydrocarbons. It also examined Ventilation, Lighting, Noise, Temperature and Relative Humidity.

Findings

A key component of the study was to identify the age and number of portable classrooms in use throughout the state's K-12 school system. The findings revealed that at the end of school year 2001 nearly 30 percent (79,191) of the 268,030 classrooms in California were portables. Of those units, 22, 094 (27.9%) were more than 15 years old; 25,974 (32.8%) were between 6 and 16 years old; and 31,122 (39.3%) were less than 5 years old. In addition, 4,100 new units were expected to be added in the 2002 school year. The study does not reveal how many permanent classrooms were added in 2002.

As part of the study on portable classrooms, Field Technicians inspected the HVAC systems of typically two portable classrooms and one traditional classroom per selected school. Some of the most notable findings were:

- The difference in ventilation air, total supply air and age of the HVAC systems were not significantly different between portable and traditional classrooms.
- HVAC systems in portable classrooms typically had thermostats controlled by teachers.
- A high percentage of teachers (68%) in portables reported turning off their HVAC due to noise.
- The air filters in portable classroom HVAC systems were less likely to be changed than those in traditional classroom HVAC systems.
- Outside air intakes were shut off or otherwise blocked on the HVAC systems more often on portable classrooms than traditional classrooms (10.8% vs 2.7%).
- Both portable and traditional classrooms experienced school-day average concentrations of carbon dioxide (CO2) greater than 1000ppm and one-hour averages over 2000ppm. These results indicate insufficient ventilation in a substantial portion of California classrooms, both traditional and portable.

All classrooms exceeded the new ANSI acoustical standard for classroom noise levels (35dbA) and a substantial percentage of both traditional and portable classrooms exceeded outdoor noise limits, typically 55dbA.

Analysis

The findings of this report suggest that education facility managers and suppliers responsible for providing clean and comfortable classrooms need to rethink HVAC design and operation. Instead of focusing on heating and air conditioning systems that can also provide

ventilation and filtration, perhaps schools and suppliers should be thinking in terms of ventilation and filtration systems that can also heat and cool.

Justification for the need to think in these terms is found in the fact that users of portable and conventional classroom heating and cooling systems do not understand the importance of their systems' ventilation and filtration capabilities. Most of the HVAC systems examined in this study appeared to be capable of doing the job required of them according to Title 24 requirements, but many were being turned off by teachers who objected to the noise generated by them.

Title 24 code requirements for ventilation stipulate that a classroom be ventilated during all occupied times. It also provides several methods by which you can comply. Continuous ventilation during occupied times is the preferred method for classrooms.

Continuous Ventilation of a classroom requires that 15cfm of outside air per occupant be brought into the classroom. The typical expected occupancy of a classroom is 30 students and 1 teacher; 31 occupants times the 15cfm of outside air per occupant equals 465cfm of outside "ventilation" air. The classroom ventilation system

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must be set up to provide this level of ventilation during occupancy.

The code requires that the classroom be ventilated prior to expected occupancy in an amount equal to three complete air changes. That amount of ventilation air and time required is calculated by using the following formula:

Step 1: Classroom square footage x Classroom ceiling height
960 sqft x 8.5 ft = 8,160 cubic ft

Step 2: Multiply Classroom cubic feet x 3 (air changes)
8,160 x 3 = 24,480 cf

Step 3: Divide the sum of Step 2 x 465 cfm
24,480 cf / 465 cfm = 52

The answer calculated in Step 3 is how many minutes before expected occupancy we need to begin ventilating the classroom, 52 minutes.

Solutions

At least two companies have partnered with California schools to better understand the acoustic, ventilation and indoor air quality issues that prompted the Portable Classroom Study. These companies used feedback provided by facilities and teaching staff at the various school sites to enhance their product offering for classroom specific use. The following concepts are the direct result of this research:

Since 1992, most of the HVAC systems used on portable classrooms utilized a set-back type thermostat with a programmable fan setting, in order to meet the California Title 24 energy code requirement. The problem with this type of thermostat is that teachers frequently override the fan program, which turns off the ventilation system. Today there are new thermostats that have a programmable ventilation program and a key-pad lockout feature that prevents system from being shut-off by the occupant. While this product is a great improvement over previous models, teachers continue to complain about noise from the HVAC systems. Some of this noise is from the equipment itself, but primarily it is due to the excessive amount of air or CFM being blown into the classrooms.

As a result, the obvious question is: "How can ventilation system noise be reduced?" Results from the test classrooms reveal that teachers are happier when they do not hear the HVAC system operating. This suggests that upgrading to new, quieter and more energy-efficient equipment should be seriously considered by each school district. With budget concerns being what they are today, a school district might consider retrofitting existing HVAC systems to two-speed, continuous blower models, if new equipment purchasing is not a possibility. This type of modification can be administered to select brands of portable classroom HVAC systems, and in most cases will reduce air noise significantly. In addition, many of these HVAC systems can be retrofitted in the field with devices to provide the necessary ventilation for the classroom. These products have adjustable settings that are easily accessible and critical to assuring that the correct amount of fresh air passes into the classroom.

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Legislative Advisory Committee Seeking Nominations

The C.A.S.H. Board of Directors Nominating Committee is now accepting nominations for the Legislative Advisory Committee. The Committee has openings for four (4) **public sector** members.

The Board Policy for the Legislative Advisory Committee states that the C.A.S.H. Board of Directors Nominating Committee shall solicit names from the general C.A.S.H. membership and present a slate of candidates to the C.A.S.H. Board of Directors.

Nominees must possess the following qualifications:

- School District is a member of C.A.S.H. in good standing;
- Nominee is involved in school facility planning and/or management; and
- Nominee attends C.A.S.H. meetings, conferences and workshops on a regular basis.

C.A.S.H. makes every effort to keep a balance on the Legislative Advisory Committee reflecting different geographical locations, private-and-public sector interests, and other related factors.

Letters of interest or nomination should include the following:

- Name, position, address and phone number of the candidate;
- Nominee's experience and background in school facility planning or management;
- Any involvement in C.A.S.H. conferences, committees and activities; and
- Reasons this individual would make a good committee member and what contributions this candidate would make to C.A.S.H.

If you are a **public sector** member of C.A.S.H. and are interested in serving on the Legislative Advisory Committee or know someone who would make an excellent candidate for this Committee, please forward the requested information to:

Kathleen Moore
C.A.S.H. Nominating Committee
1130 K Street, Suite 210
Sacramento, CA 95814
Attention: Patti Herrera

Filing Deadline: **February 26, 2004**

LAUSD High Performance Schools

"We are about to experience an explosion in new school construction that is unprecedented," California State Architect and CHPS Board Member Stephan Castellanos said. "It is vital that these schools are resource efficient, healthy, well daylit community centers that will not only provide an excellent learning environment but also serve as a learning tool. Over the last 2 years, CHPS has developed a collection of proven best practices for school design and construction. The CHPS programs allow architects and school officials to learn how to integrate these concepts into their school project."

With 1/3 of school facilities requiring major renovations and the fact that schools spend $700 million on energy, California schools are in need. The Collaborative for High Performance Schools was established in response to the energy crisis and declining rate of student test scores. Incorporated as a 501 (c) 3 non-profit organization in 2002, CHPS further solidified its commitment to environmentally-sound design that enhances the educational environment for all school children. CHPS is a free informational resource made up of all of the major state agencies who are involved with building public schools, major state public utility companies, school district facility planners and designers.

Some of the Benefits of High Performance Schools include: improved student and teacher health, heightened student performance, decreased operating costs, lower absenteeism, enhanced indoor and outdoor environment. Not to mention financial incentive programs.

On January 29, 2004 CHPS formally recognized LAUSD for being the first school district to pass a resolution to adopt the CHPS Criteria for all future school buildings. This event will be in conjunction with a groundbreaking ceremony at the New Cahuenga ES#1, a CHPS Demonstration School. The LAUSD District Resolution, passed in 2002, requires that their schools "exceed by 30% the 28 point minimum CHPS qualifying level", and even goes so far as to mandate specific credits, including the "daylighting criteria as studies have shown that daylighting is a critical design element in successful learning." The district has successfully implemented CHPS by hiring an outside consultant, John Zinner to over see the process. LAUSD Board of Education had unanimously adopted a "Resolution on Sustainability & the Design & Construction of High Performance Schools" on October 28, 2003.

Cahuenga ES#1 is the first school in LAUSD to meet the CHPS Criteria and it is expected to earn 48 Credits upon completion. High Performance features include: Exceeding Title 24 by 30%; stormwater controls; clerestories on classroom windows; photo sensors and motion sensors integrated with all classroom electric lighting systems; recycled content acoustical ceiling tiles and wall panels; packaged rooftop gas-electric units on the 2nd and 3rd floors, including economizer cycles and premium high efficiency motors; split unit heat pump on the 1st floor with condenser on roof and fan coils at classrooms. This school will house over 1,000 students and help to relieve the extreme overcrowding conditions.

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Conclusion

There is definitely a correlation between learning environments and how well students and teachers function within them. Therefore, it makes good sense that everyone involved in specifying, operating and maintaining HVAC systems understand the importance of proper ventilation and noise reduction. The California Portable Classroom Study findings suggest that correct implementation and operation of these systems would dramatically improve the indoor environment for classroom occupants. In order to accomplish this, suppliers and end users will need to continue to partner, share information, innovate, improve and most importantly, educate those people responsible for controlling classroom environments.