

BASELINE INFORMATION ON 100 RANDOMLY SELECTED OFFICE BUILDINGS IN THE UNITED STATES (BASE): GROSS BUILDING CHARACTERISTICS

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ABSTRACT

The United States Environmental Protection Agency (EPA) has collected extensive indoor air quality data in 100 randomly selected office buildings following the standardized protocol developed for the Building Assessment Survey and Evaluation (BASE) study. These data were collected to provide normative data in typical office buildings so that policy makers would have sound scientific basis for decisions and guidance development and for researchers to have data for hypothesis development and testing. Summaries of building use, age, size, occupancy, and other gross building characteristics of the 100 BASE buildings are presented. Data demonstrate that typical office buildings are not all alike. The typical office building often houses more than offices. These other special-use spaces can greatly impact the types and levels of contaminants to which an occupant may be exposed.

KEYWORDS: air quality, commercial building, office buildings, office work

INTRODUCTION

The U.S. Environmental Protection Agency (U.S. EPA) recently completed the collection phase of a major cross-sectional study, the Building Assessment Survey and Evaluation study (BASE). The goal of the BASE study is to characterize key characteristics of IAQ and occupant perceptions and symptoms in public and commercial office buildings. This paper presents a summary of selected building characteristics data collected from 100 commercial and public office buildings across the U.S. Many people experience a range of persistent non-specific symptoms including headache, eye and throat irritation, and fatigue in certain buildings that improve when the individual leaves the building. This phenomena when not traced to any specific source in the 'complaint' building is referred to as 'sick building syndrome' (SBS). Many studies have been conducted in efforts to identify links between the building related symptoms and the characteristics of complaint buildings; however, there is little available information on the characteristics of non-complaint buildings for comparison. The building characteristic data were collected as part of the BASE study to help address this issue for office buildings.

METHOD

Between 1994 and 1998, data and samples were collected in each of 100 office buildings using a standardized protocol over a one-week period during either the summer or winter season [1]. These buildings were randomly selected from across the country in cities with populations over 100,000 without regard to indoor air quality concerns, except that buildings

with highly publicized indoor air quality problems were excluded. A test space was randomly selected within each building with a target population of no less than 50 occupants served by no more than two air-handling units. Table 1 contains a representative listing of the core parameters measured as part of the BASE protocol. Additional information on building and test space selection and measured parameters can be found in a previous paper [2].

Information on building characteristics was collected from building plans, interviews of building representatives, and field team observations.

Table 1. Core Parameters Measured in BASE Study

BASE Core Parameters			
Environmental Measures	Building Characteristics	HVAC Characteristics	Occupant Questionnaire
X Temperature	X Use	X Type	X Workplace Physical Information
X Relative Humidity	X Occupancy	X Specifications	X Health and Well-being
X Carbon Dioxide	X Geographical Location	S air handler	X Workplace Environmental Conditions
X Sound	X Ventilation equipment	S exhaust fans	X Job Characteristics
X Light	S operation schedule	X Filtration Systems	
X Carbon Monoxide	X Construction	X Air Cleaning Systems	
X Particles S PM ₁₀ , PM _{2.5}	X Outdoor Sources	X Air Washers	
X VOCs	X Smoking Policy	X Humidification Systems	
X Formaldehyde	X Water Damage	X Maintenance Schedule	
X Bioaerosols S air S visible growth	X Fire Damage	X Inspection Schedule	
X Radon	X Renovation	X Supply Air Flow Rate	
	X Pest Control	X Percent Outdoor Air	
	X Cleaning Practices	X Outdoor Air Intake Rate	
		X Supply Air temperature	
		S relative humidity	
		X Exhaust Fan Rates	
		X Local Ventilation Performance	
		X Natural Ventilation Measurements (if needed)	

RESULTS

The BASE study collected data from 100 randomly selected buildings in 37 cities in 25 States. This paper provides a summary of selected building characteristics found in these buildings in an effort to help better define the 'typical' office building. Fifty percent of BASE buildings were reported to be occupied 5 days a week. Twenty-six percent were reported to be occupied 6 days a week and 24%, 7 days. The buildings studied were primarily described as being located in urban surroundings (73%). Twenty-three percent were in suburban surroundings and 4% were in rural surroundings. Ninety-eight percent of the buildings had

mechanical ventilation. Forty-four buildings studied had operable windows. Of the 44 buildings with operable windows, an average 72% of the windows in a building were operable. Some additional general overview characteristics of the 100 BASE buildings are presented in Table 2.

Table 2. General Overview Characteristics of 100 BASE Buildings

Characteristic (unit)	Range	Average	Median
Construction Date (year)	1850 - 1996	1961	1972
Gross Floor Area (m ²)	1,665 - 134,195	24,756	13,964
Occupied Floor Area (m ²)	629 - 98,474	16,380	8,477
Number of Floors Above Grade	1 - 53	9	5
Number of Building Occupants (including visitors)	87 - 6500	1,020	705

Data were also collected on potential contaminant sources in and around BASE buildings. Volatile organic compound and particulate matter concentrations measured in the buildings may be related to some of these sources. The frequency of various sources in the 100 BASE buildings is represented in Figures 1 to 3. Information on interior renovations, such as painting, carpet replacement, and partition wall changes as well as information on cleaning materials used, and interior and exterior pesticide usage was collected as part of the BASE study. Sixty-one percent of the buildings reported having new carpeting in the past few years, 36% new furniture, and 56% partition/wall renovations. Varied categories and levels of usage for cleaning materials including window cleaners, furniture cleaners, bleach, and carpet cleaners were reported. Specific names of these materials were also collected as part of this study. The frequency of interior pesticide application varied with the two highest categories reported being monthly (34%) and as needed (31%). Focused analysis of the data on sources collected, including their association with simultaneously measured environmental parameters, will help determine the impact of these materials on the indoor environment and how use patterns affect that impact.

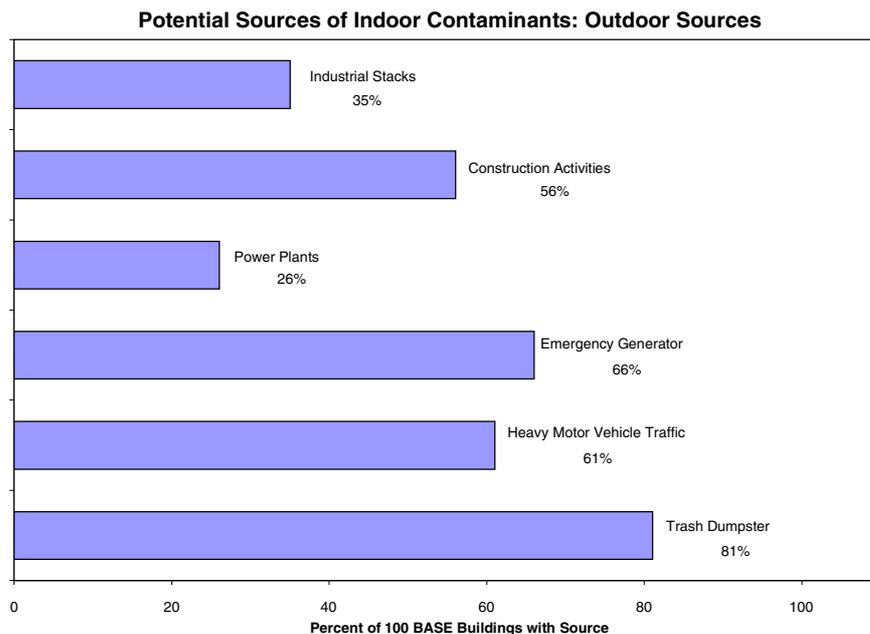


Figure 1. Potential Outdoor Contaminant Sources Reported in the BASE Study.

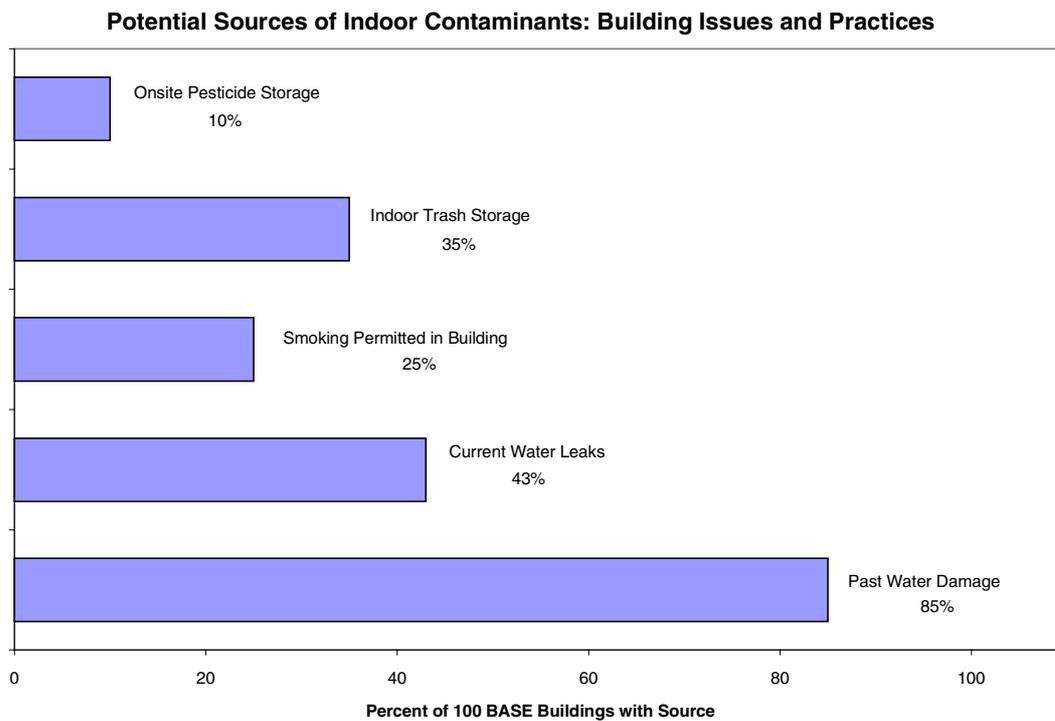


Figure 2. Potential Building Related Contaminant Sources Reported in the BASE Study

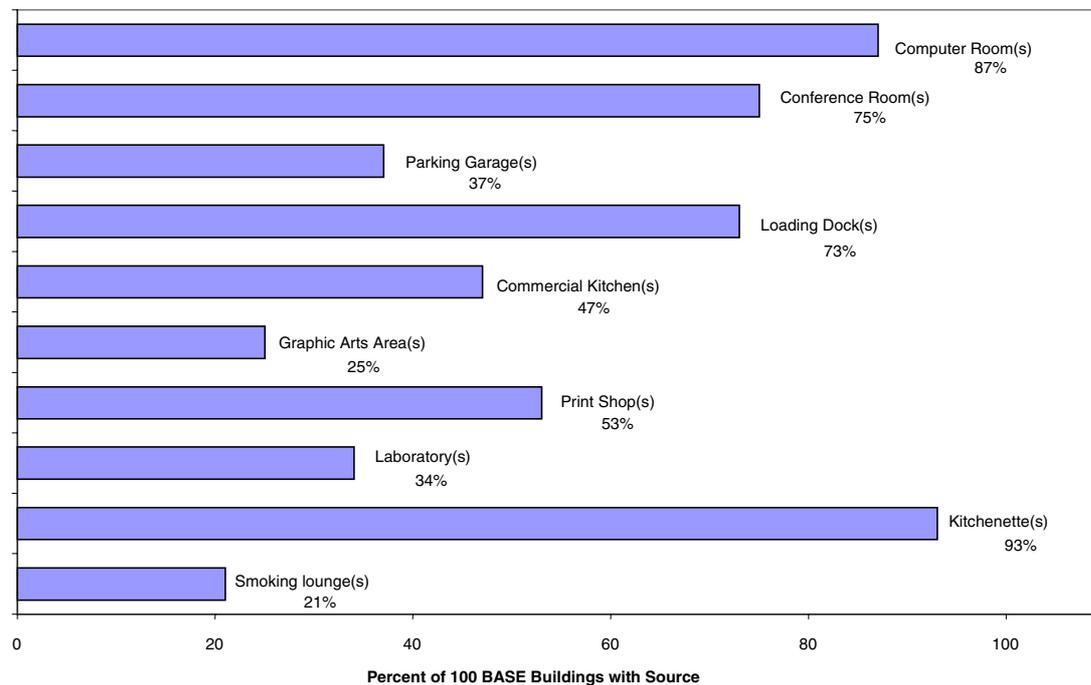


Figure 3. Special Use Spaces Reported in BASE Study

DISCUSSION

Many studies have been conducted in efforts to identify links between symptoms associated with buildings and the characteristics of complaint buildings. However, there is little available information on the characteristics of non-complaint buildings for comparison. The building characteristic data reported in this paper was collected as part of the BASE study to help address this issue for office buildings. The data presented indicate that 'non-complaint' or 'typical' office buildings can differ greatly with regards to size, year of construction, occupancy, location, and building management and maintenance practices. The 'typical' office building often houses more than offices. These other special-use spaces may greatly impact the types and levels of contaminants to which an occupant may be exposed. More analysis of the information presented in this paper, as well as the building characteristics, ventilation, and environmental parameter information collected as part of the BASE study will help clarify these exposures. The results from this study provide normative or baseline data on U.S. office buildings which can be used for comparisons to data from complaint buildings, for examining the relationships of building characteristics with other environmental and HVAC factors collected, for conducting risk assessments, and for designing more focused studies.

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REFERENCES

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