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PREDICTING THE CONTRIBUTING EFFECTS OF OCCUPANTS ON THE TOTAL AIR CHANGE IN HOUSES

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ABSTRACT

In order for designers, builders and regulatory agencies to be able to ensure adequate indoor air quality, quantify heat loss and evaluate the economic benefits of house airtightening, they must know what that total air change is. The occupants' habits contribute to this total air change. To date, very little has been published relating to models that predict the impact the occupants have on house air change rates.

This paper describes a method to predict the occupants' effects on the total air change rate in houses in winter. It was developed by taking a survey of over 40 families in a 6000 DDB.65F climate of various ages and lifestyles. These families, in three age groups, were asked to keep track of the number of times that they entered or exited their house on a daily basis for at least 7 days. They also kept track of the number of times guests came to the door and the number of times doors were left open accidently. Questions were asked regarding bath, kitchen and dryer exhaust fan use and window-opening habits.

A compilation of the survey data resulted in a correlation between the number of occupants and the number of door openings per day, as well as to bath fan and clothes dryer use. Studies were made predicting the air change due to the door openings and fan and dryer use. It was found that the clothes dryer was the most significant contributor to occupant air change under most circumstances. Those families who opened windows regularly, impacted the air change rate significantly. However, any window opening at all was very rare among those surveyed. Entry vestibules were also analyzed and found to be fairly ineffective.

A formula was developed to approximate the effects that occupants have on the total air change rate. Applications and limitations of the formula are outlined and suggestions and needs for further research are given.

ABBREVIATIONS

AC/H	Air Change per Hour, the total exchange of all interior air with outside air in 1 hour.
C	Centigrade, degrees
CFM	Cubic Feet per Minute
DDB.65F	Degree Days Base 65 degrees Fahrenheit
F	Fahrenheit, degrees
FT2	Feet Squared, square feet
FT3	Feet Cubed, cubic feet
HR	Hour
l/s	Liters per Second
M2	Meters Squared, square meters
M3	Meters Cubed, cubic meters
MPH	Miles per Hour
M/s	Meters per Second
M3/s	Meters Cubed per Second

MATH OPERATORS:

+	Addition
-	Subtraction
*	Multiplication
/	Division

1. INTRODUCTION

The regular activities of occupants contribute to the total air change in dwellings. It is important to be able to calculate what these occupant effects are, since the accuracy of heat loss calculations, energy savings from airtightening and indoor air quality predictions are dependent on knowing the total air change. Also the timing of mechanical ventilation can be optimized if it is known when and how much "background" air change is occurring.

The subject of this paper is to evaluate the activities of occupants that cause air change and then to develop a method to quantify what this contribution is.

The objectives of this paper are to:

1. Describe a survey and its results that was performed to obtain more information about the habits of occupants as it relates to air change.

2. Quantify the air change associated with occupants' habits.

3. Develop a model to predict the air change caused by occupants that will be useful to the practitioner.

4. Outline the applications of the model.

2. OCCUPANT HABIT SURVEY

2.1 General Description

A survey of 45 families, totalling 253 individuals, was completed during January. All lived in single family detached dwellings in Utah (western USA) in a climate of 6000 DDB.65F. They were provided with forms and instructions for compiling data for 7 days. The occupants, identified by 3 age groups, kept track on a daily basis of how many times they passed through exterior doors. They also recorded how many times visitors came to the door requiring the door to be open a few seconds while the visitor was queried. The times per day and duration that doors were accidently left ajar were also recorded. Weather data, whether school was in session, the day of the week and how many times doors were opened for pets, were factors also tracked. The occupants were also asked how often they opened windows for any reason; this question was asked regarding their habits during the entire winter, and not just for the week of the survey. Finally, the occupants were asked for the amount of time that they used their clothes dryer and kitchen and bath exhaust fans.

2.2 SURVEY RESULTS--HABITS OF OCCUPANTS

TERMINOLOGY: The following are definitions of new terms used in this text.

Airlock: An entry with a inner door about 6 FT. (2.1 M) from the the exterior door, intended to reduce the amount of air change when the exterior door is opened.

Doors Left Ajar: Doors inadvertently left open.

Openings for Guests: Openings of doors to greet guests where the door is held open for a period of time.

Passage Openings: Openings caused by occupants passing through doors.

SURVEY FINDINGS:

1. There was a correlation between the number of occupants in a family and the average number of passage and guest openings for the family for that day. That is, if there are more occupants in a dwelling, there will be a corresponding increase in the number of openings per day. This is portrayed in Figure 1.

2. There was little difference between age groups and the average number of openings. The average number of passage openings per day per occupant for 4-to-12 year olds was 7.2; for 13-to-18 year olds, 7.6; and for those over 18 years-old, 7.8. Figure 2 shows that the average number of openings per day within each age group varied considerably, typical of differences in human habits.

3. Parents that both worked outside the home averaged 7.8 passage openings per day each which was slightly less than the 9.4 average for couples who had only one working outside the home. Retired couples averaged about the same as the "both working" couples.

4. The number of openings per day per occupant varied only slightly from weekdays to weekends, with Sunday showing less outdoor activity. The difference was not large enough to be statistically important. Subsequently week averages are given in all the data.

5. Doors being left ajar every day occurred in 76% of the families. The Mean time that doors were left ajar was .4 minutes per day per occupant.

6. Bath fan use varied considerably among those surveyed. The Mean time per day per occupant was 1.2 minutes, with a standard deviation of 2.4 which was one of the weaker correlations in the survey data.

7. Clothes dryers were reported to be used an average of 2.1 hours per week per occupant which reduces to 18 minutes per day per occupant.

8. Opening of windows at night for sleeping or at other times during the day for "air freshening" was very sporadic and rare among those surveyed. 8% of the families surveyed opened a window slightly at night for sleeping, 14% opened a window daily for less than 1 hour duration, 8% reported opening a window for once a week for less than an hour, and 70% reported that they never open their windows during winter.

9. The use of kitchen exhaust fans was also very rare. Conventional construction in the area is to put recirculating filtered fans in the kitchen range hoods. 33% of the families used an outside venting kitchen exhaust fan on the average of 5 minutes per day per family.

3. AIR CHANGE ASSOCIATED WITH OCCUPANTS' HABITS

In this paper it is assumed that the occupants' effects on the total air change do not include the air draws associated with the flues of combustion appliances such as wood burning stoves and fireplaces, water heaters and furnaces. The purpose of this paper is primarily for the optimization of the design of new dwellings. In new dwellings, where airtightness is a design feature, it is assumed for safety and energy considerations, that all combustion appliances will be uncoupled from the interior conditioned space. This will eliminate any significant contribution to the air change of the conditioned space from combustion appliances.

3.1 METHOD TO PREDICT FLOWS THROUGH OPEN DOORS

A mathematical model was recently developed and tested which predicts the flow of air through an open door (Ref. 1). The parameters required as input for the model are the inside and outside temperatures, the width and height of the door opening, the dimensions of the inside entry-way or room, the time for the door to open, its duration at fully open and the time to close the door. Wind conditions of 11 MPH (5 M/s) or less are assumed.

This model was used with the survey data to calculate how much air was being exchanged by the Passage Openings, by the Openings for Guests and by the Doors Left Ajar. These evaluations were made for average winter temperatures in 6000, 8000 and 10,000 DDB.65F locations. The variations were minimal so the 8000 DDB.65F average winter temperature of 30F (-1C) was used as the ambient temperature in all cases.

3.2 QUANTIFYING OTHER SOURCES OF AIRCHANGE

Figure 3 portrays how the total air change caused by occupants is distributed among the five sources common to all of the surveyed families. This graph is for the most common case where windows are not opened during winter and where kitchen fans are not vented outside. Table 1 lists these five sources and the respective volume of air associated with them. The isolated cases of window openings, opening doors for pets and kitchen exhaust fans are treated in Section 4.

3.3 RESULTS

It can be clearly seen that the clothes dryer contributes by far the most of any of the occupant sources of air change. The domination of the clothes dryer makes the variation in the other sources less critical. It is noted that some families may vent the clothes dryer inside, or may vent it through an air-to-air heat exchanger or an air-to-water heat pump. These cases are treated in Section 4.

Entry airlocks or vestibules were evaluated using the mathematical model (Ref. 1). It was found that the airlock made no difference in the volume of air flow for Passage Openings, but it did reduce the volume of air exchange in the Openings for Guests by 35%. This is due to the difference in the time the the door is held open. In practice it is assumed that even in a house with one airlock/vestibule there will be openings of doors other than through the vestibule door. Table 1 shows the effect of 1/2 of the openings going through the vestibule and 1/2 going through normal doors. The data indicates that generally airlock/vestibules do not significantly reduce the total air change associated with door openings in dwellings.

4. PREDICTIVE MODEL FOR OCCUPANTS' EFFECTS

4.1 MODEL DERIVATION

From the Survey explained in Section 2, a correlation was found between the number of occupants and the number of the various types of door openings and the use of bath fans and clothes dryers. That is, if the number of occupants are known then it can be predicted how many Passage Openings, Openings for Guests, and Doors Left Ajar there will be per day. As well, the average duration that the clothes dryer and bath fans will be used per day can also be predicted.

The survey showed that little improvement in accuracy was achieved by differentiating between the opening frequencies of the three age groups surveyed. Therefore, in this simplified model all occupants are grouped together regardless of age or life-style.

Section 3 described how these occupant sources of air change were quantified into a volume of air flow. This Section combines the information from Sections 2 and 3 to develop a method to predict the effect the occupants have on the total air change of the house.

It is recognized that the occupants activities causing air change occur primarily during the day and peak during the early afternoon hours (Ref. 2). Even though the air change due to the occupants is not evenly distributed during every hour of a 24 hour period, it is convenient to reduce the daily total flow to an average flow per hour for the entire day. This is then reduced to an average total house air change per hour rate, which can be used readily in heat loss and ventilation assessment calculations.

The derivation of the predictive model follows.

1. The flows of the five Common Sources or components of occupant air change itemized in Table 1 under the heading of "No Airlock" were summed. This resulted in an average total volume of air change per day due to one occupant. "Common" sources refers to those sources which are common to most homes. See Table 1. The minute increase in overall accuracy achieved by formulating separate equations for cases with airlocks was not considered worth the effort.

2. Then, this resulting value is multiplied by the number of occupants in the dwelling to get a total daily dwelling air volume change.

3. Finally, using the floor area of the dwelling (assuming an 8 FT. [2.4 M] ceiling height), an air change per hour value is found. This represents the average air change per hour (ac/h) over a 24 hour period that is being caused by the occupants and the five common sources of air change. An ac/h is the total interior volume of air inside being exchanged with the outside in one hour.

4. There are some sources of air change which are not common to most families. These are itemized with their own formulas and used as required to give an air change per hour value.

5. The ac/h value from the common sources is added to the ac/h values from any special sources, resulting in the total ac/h for occupants effects.

4.2 MODEL SPECIFICS

Table 2 should be used to determine the ac/h value for occupants' effects. The basis for each item in Table 2 is included below including the equations and procedure for determining an ac/h value for each contributing area of occupant-caused air change.

1. **AC/H DUE TO COMMON SOURCES:**
   (See Table 1 for a list of the "Common Sources")

   Equation 1: AC/H =

   $$(15.3 * OCCUP) / AREA$$
   (If in FT2)

   -OR-

   $$(1.42 * OCCUP) / AREA$$
   (If in M2

   Where:

   AC/H = daily average air change per hour from Common Sources (Table 1).
   OCCUP = number of occupants in dwelling. If this is not known figure 2 occupants for the first bedroom and 1 occupant for every bedroom thereafter.
   AREA = inside floor area of the dwelling in square feet (FT2) and meters (M2).

   (8 FT. (2.44M) Ceiling height is assumed)

2. **AC/H FROM OTHER SOURCES:**

   A. If one window is opened slightly every night or day (10 hrs), the flow converted to a 24 hr. average ac/h can be approximated by:

   Equation 2: $$AC/H = 112 / AREA$$
   (If in FT2)

   - OR-

   $$AC/H = 11 / AREA$$
   (If in M2)

   B. If one window is opened slightly every other night or day (10 hrs), the flow converted to a 24 hr. average ac/h can be approximated by:

   Equation 3: $$AC/H = 56 / AREA$$
   (If in FT2)

   -OR-

   $$AC/H = 6 / AREA$$
   (If in M2)

C. If a window is opened once per week for 10 hours, the flow converted to a 24 hr. average ac/h can be approximated by:

Equation 4: AC/H = 16 / AREA
(If in FT2)

-OR-

AC/H = 1.5 / AREA
(If in M2)

Equations 2 through 4 are based on a window that is 3.3 FT (1 M) tall and opened 2 inches (50mm) for 10 hours per night. Flows were obtained from basic flow correlation equations as well as empirically based equations for typical winter conditions in urban areas where average wind speed is less than 11 MPH (5 M/s). (Ref. 3; 4). The model is weighted towards single sided ventilation with little cross ventilation. If more than one widow was opened and configured to allow cross ventilation the flow for the same total open window area could easily double. The actual equation used (Ref. 4, p. 30) is:
Q = .33 * A where 'A' is the area of all opened windows in M2 and 'Q' is the air flow in M3/s. .33 is a factor that can range from .1 to .25 for single sided flow and from .4 to .8 for cross ventilation and less shielded conditions.

Interpolate the results for cases which do not fit the given situations. Obviously these equations will give at best only very rough approximations of ac/h rates, due to the variation in size and width of each actual window opening and varying site conditions (temperature, wind, shielding, etc.)

D. If the occupants use a kitchen exhaust fan that vents to the outside each day, then the daily average ac/h caused by 15 minutes per day of a 150 CFM (71 l/s) exhaust fan is found by:

Equation 5: AC/H = 12 / AREA
(If in FT2)

-OR-

AC/H = 1.13 / AREA
(If in M2)

E. If a pet is let in or out of the house 6 to 10 times per day, the associated daily 24 hr. average ac/h contribution is found by:

Equation 6: AC/H = 18 / AREA
(If in FT2)

-OR-

AC/H = 1.7 / AREA
(If in M2)

F. If the clothes dryer is vented inside and/or if it is run through an air-to-air heat exchanger or air-to-water heat pump, then its flow is taken into account in the mechanical ac/h calculations. The Common Sources ac/h value from Equation 1 assumes the dryer is vented outside. If the dryer is not a contributor, the ac/h figure that should be **subtracted** from the Common Sources ac/h value is found by:

Equation 7: AC/H = (9.4 * OCCUP) / AREA
(If in FT2)

-OR-

AC/H = (.87 * OCCUP) / AREA
(If in M2)

G. If storm doors are on all of the exterior doors then the effective width and duration of the door openings are decreased. It is estimated to reduce Passage Opening airfow by 50% and Openings for Guests airflow by 33%. This reduction in ac/h should be subtracted from the Common Source ac/h, and can be found by:

Equation 8: AC/H = (2.2 * OCCUP) / AREA
(If in FT2)

-OR-

AC/H = (.2 * OCCUP) / AREA
(If in M2)

Reduce the value in half if storm doors are only on half of the exterior doors.

H. If the house has an airlock/vestibule that is not larger than 7 FT (2.13M) square on one of the prime exterior doors then the airflow will be reduced from the values obtained in Equation 1. This amount which should be subtracted from the Common Source ac/h value is found by:

Equation 9:

$$AC/H = (.53 * OCCUP) / AREA \quad \text{(If in FT2)}$$

-OR-

$$AC/H = (.051 * OCCUP) / AREA \quad \text{(If in M2)}$$

3. SAMPLE CALCULATION:

For example, a 2000 FT2 (186 M2) house has five occupants. The occupants have a pet they let in and out of the house approximately 6 times per day. Their clothes dryer is vented outside and they use their outside-vented kitchen exhaust fan regularly. They crack open a window for part of the day about once a week.

From Equation 1 the Common Sources ac/h value is found to be .038. From Equation 4 the contribution due to the window opening is approximated at .008 ac/h. Equation 5 gives us .004 ac/h for the exhaust fan contribution. From Equation 6 the pet contribution is calculated at .009 ac/h. From summing all of those values, the Total Occupant Effects is found to be .059 ac/h. The procedure may be simplified by using Table 2. Also, Figure 4 has been prepared for houses with only Common Sources as air leakage contributors.

5. APPLICATIONS OF THE MODEL

The Occupants Effects ac/h value obtained from the method in Section 4, or Table 2 can be added to the natural and mechanical ac/h values to arrive at a more accurate Total air change per hour rate for the dwelling.

This more accurate Total ac/h value will help obtain more realistic results when calculating the heat loss associated with air change in houses. Most current personal computer energy analysis programs in the USA and Canada do not take Occupant's Effects into account which will yield heat loss due to air change errors of up to 30%, especially in airtightened houses. Users should add the Occupant's Effects ac/h value to the natural ac/h figure before inputting into the computer.

To determine the required amount of added ventilation in airtightened homes, the "background" ac/h rate is subtracted from the total dwelling design ac/h rate. The background ventilation is normally the natural ac/h rate. However, a certain amount, if not all, of the Occupants Effects ac/h rate can also be considered as background ventilation. It can be used, then, to add to the natural ac/h rate to determine the total background rate, which is then subtracted from the dwelling Total design rate to determine the amount of mechanical ventilation needed.

The timing and/or flow rate of the mechanical ventilation system may also be adjusted down during the day (or night if windows are open) when there is more background ventilation due to Occupants Effects.

6. SUMMARY

A survey of occupants' habits regarding activities that contribute to the air change in houses has been completed and evaluated. A good correlation was found between the number of occupants and the number of door openings as well as the duration and frequency of bath fan and clothes dryer use. The volume of air change associated with the bath fan and clothes dryer use as well as from door openings was determined using flow models. In addition to these sources of occupant caused air change, other special sources were evaluated for their flow contribution.

A model was then developed that predicts the dwelling daily average air change per hour rate caused by occupants in winter for climates colder than 5000 DD.B65F.

The applications for using an Occupants Effects ac/h rate in calculations of heat loss and mechanical ventilation rates and timing were explained.

It is apparent from other research (Ref. 2; 4), that occupant habits with regards to the opening of windows and the use of clothes dryers and kitchen exhaust fans in winter may be very regional in nature. Among those participating in this survey, window opening during winter was extremely rare. Random questioning of a small sampling of people in other parts of the Northern USA and Canada yielded similar habits. As occupants become more energy conscious and as controlled mechanical ventilation systems become more prevalent amd sophisticated, opening of windows during winter will basically cease, which will eliminate that large varying factor. However, the last cited work shows regular window opening by Europeans to be very common. Europeans should used the algorithm in Ref. 4 to estimate Occupant's Effects. North Americans using the European model will generally be over-predicting the actual occupants effects. To verify and further develop the accuracy of this model, additional research and tests are needed to correlate predictions with actual monitored results.

This predictive model is based on a large number of assumptions, many of which can never be verified due to the variable nature of human behavior. Its accuracy is obviously rough. But until more accurate models are developed, this one should aid the North American designer, builder and researcher in more accurately determining the total air change in dwellings.

REFERENCES

1) Kiel, D.E. and D.J. Wilson. "Gravity Driven Flows Through Open Doors." 7th Air Infiltration Center Conference, Stratford-upon-Avon, UK, October, 1986.

2) Kvisgaard, B. and P.F. Collet. "Occupants' Influence on Air Change in Dwellings." 7th Air Infiltration Center Conference, Stratford-upon-Avon, UK, October, 1986.

3) Liddament, M.W. Air Infiltration Calculation Techniques-An Applications Guide, Air Infiltration and Ventilation Centre, Great Britain, 1986.

4) J.C. Phaff in "Inhabitant Behavior with Respect to Ventilation--A Summary Report", AIVC Technical Note 23, p. 30-31, March 1988.

FIGURE 1

TOTAL OPENINGS VS FAMILY SIZE

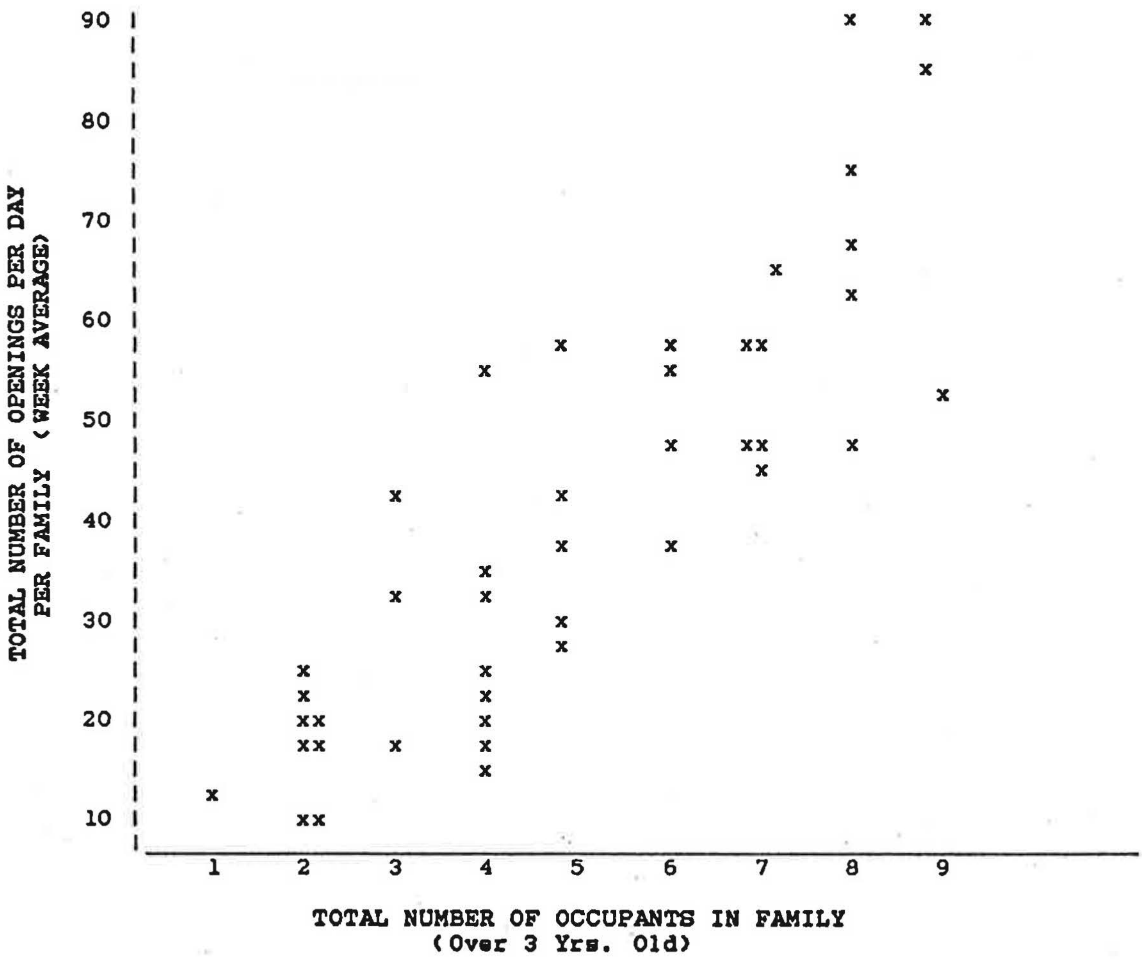
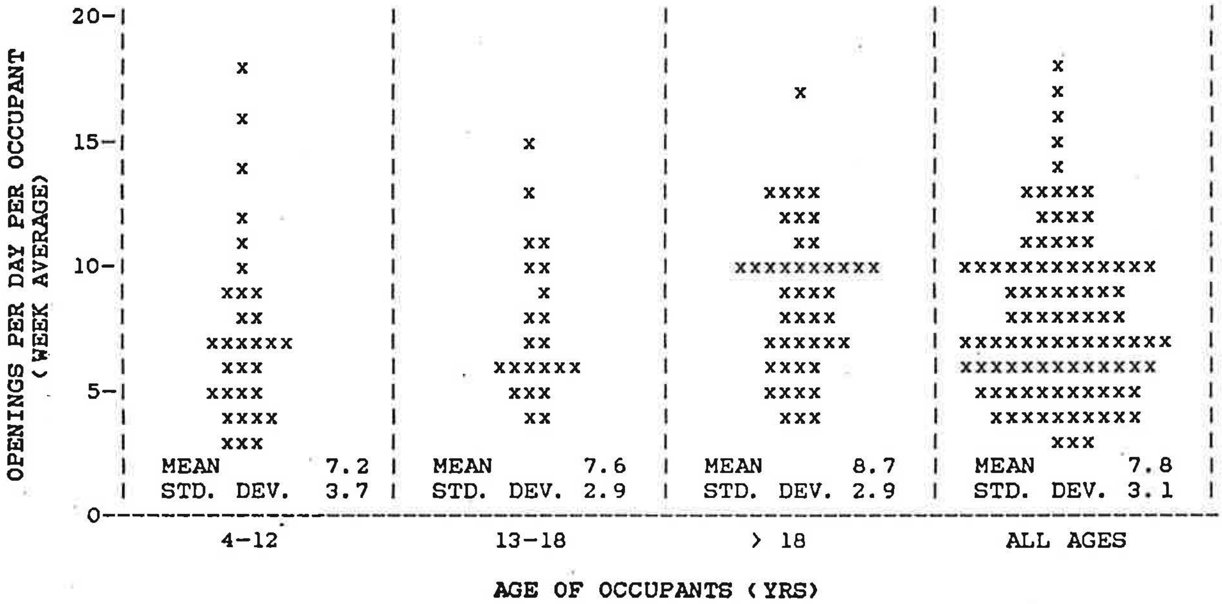


FIGURE 2

NUMBER OF PASSAGE OPENINGS
(By Age Group)



NOTES:

1. Passage Openings refer to openings caused by occupants going through a door, rather than for just opening the door to speak to a guest, etc.

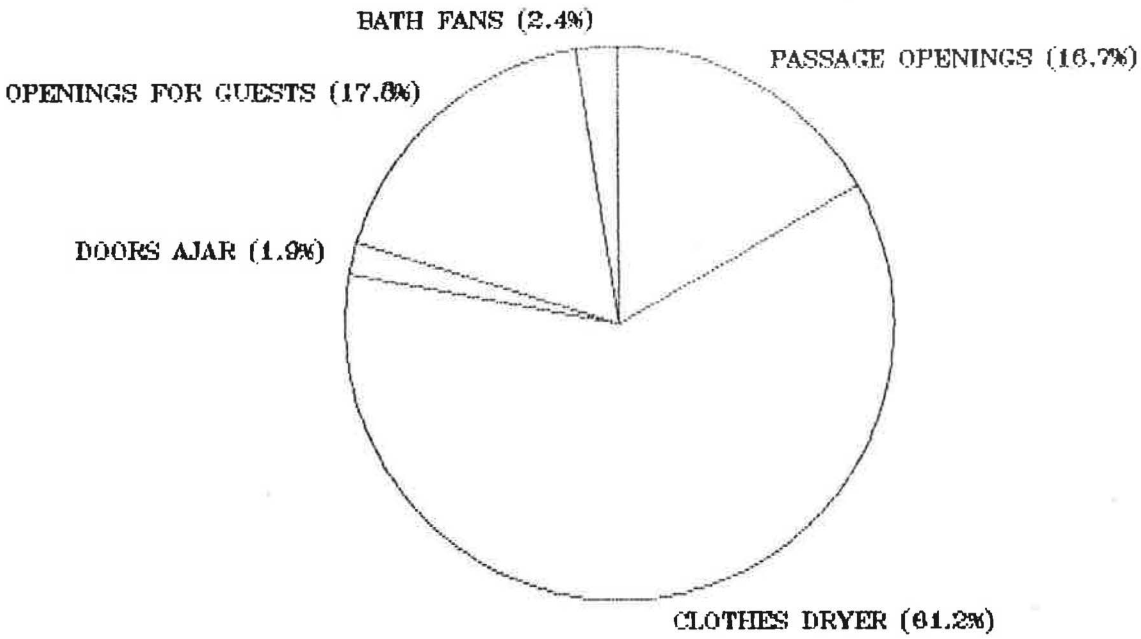
2. Each "x" represents all of the occupants of the given age group in a specific family.

3. STD. DEV. is the Standard Deviation

FIGURE 3

COMPONENTS OF OCCUPANT AIR CHANGE

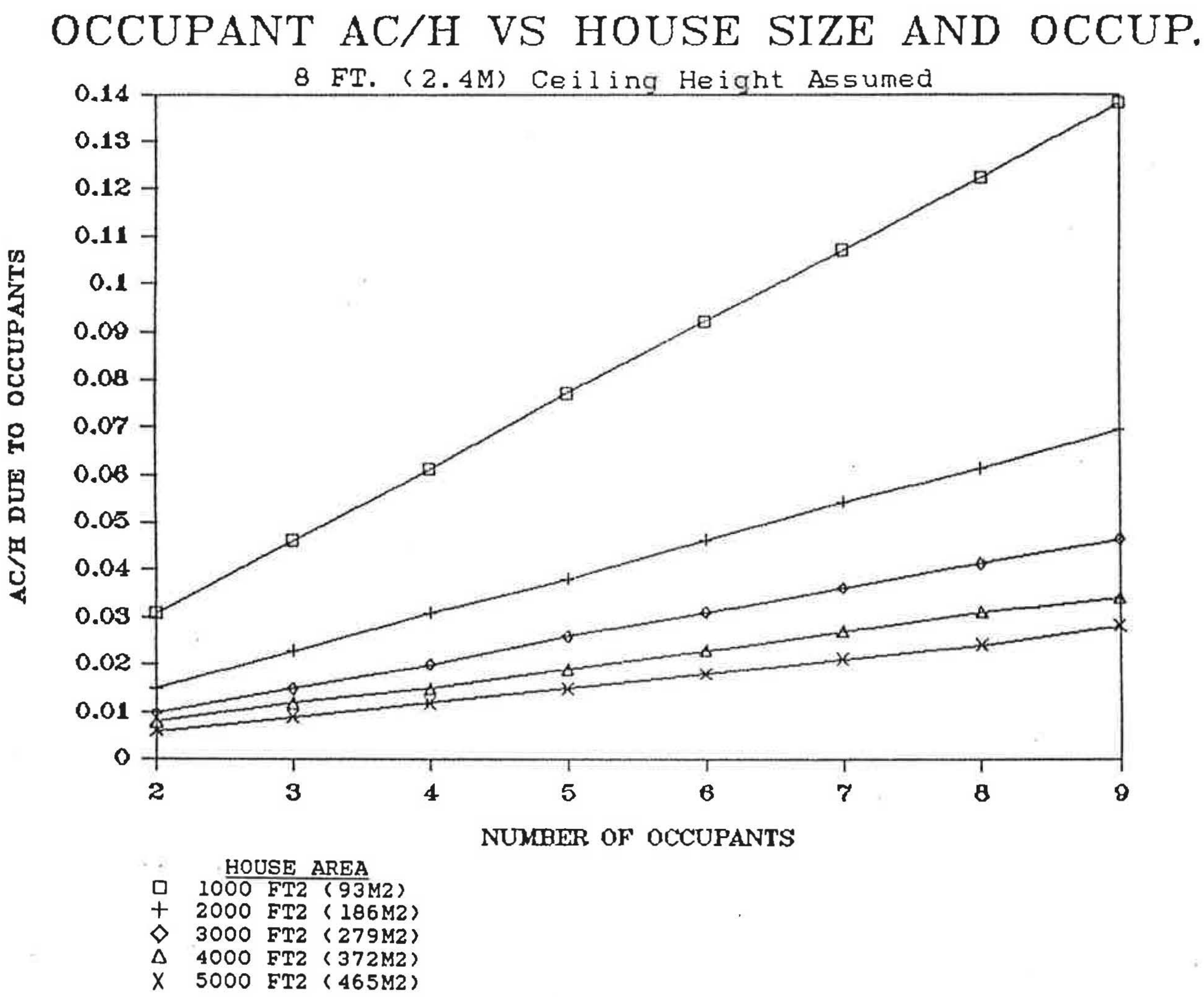
FROM COMMON SOURCES



OTHER FACTORS AFFECTING OCCUPANT AIR CHANGE
NOT COMMON AND/OR NOT RELATED TO THE NUMBER OF OCCUPANTS

* OPENING WINDOWS FOR AIR FRESHENING
* USING AN OUTSIDE VENTED KITCHEN EXHAUST FAN
* PETS THAT REQUIRE LEAVING THE HOUSE FREQUENTLY
* CLOTHES DRYER NOT VENTED DIRECTLY OUTDOORS
* STORM DOORS
* VESTIBULE AIRLOCK ENTRY

FIGURE 4



BASED ON THE COMMON SOURCES (TABLE 1)

TABLE 1

VOLUME OF AIR CHANGED PER DAY PER OCCUPANT
(From Common Sources)

[In Cubic Feet and (Cubic Meters)]

SOURCE	NO AIR LOCK	AIRLOCK	1/2 AIRLOCK
PASSAGE OPENINGS	491 (14)	491 (14)	491 (14)
OPENINGS FOR GUESTS	522 (14.8)	317 (9)	420 (11.9)
DOORS LEFT AJAR	55 (1.6)	55 (1.6)	55 (1.6)
CLOTHES DRYER	1800 (51)	1800 (51)	1800 (51)
BATH FANS	72 (2)	72 (2)	72 (2)
TOTAL	2940 (83)	2735 (77)	2838 (80)

Notes:

1. Based on 8000 DDB.65F average winter temperature of 30F (-1C).
2. **Airlock:** Calculations were made for a 6FT x 7FT (2.1 M x 2 M) closed entry.
3. **1/2 Airlock:** Flow calculations were made for 1/2 of the Passage and Greeting Openings being through the Airlock.
4. **Passage Openings** were openings caused by occupants passing through doors. Survey Mean was 7.8 Openings per day per occupant. Opening through closing time was assumed to be 6 seconds.
5. **Openings for Guests** were the number of openings to greet guests. Survey Mean was 1.2 Openings per day per occupant. It was assumed that the door was held open an average of 29 seconds per greeting.
6. **Doors Left Ajar** refers to doors inadvertently left open. Survey Mean time per occupant per day that doors were left ajar was .4 minutes. Flow calculations were based on an assumed opening of .5 FT (.15 M).
7. **Clothes Dryer** flow was based on a Survey Mean of 18 minutes per day per occupant and a measured typical flow of 100 CFM (47 l/s).
8. **Bath Fan** use in the Survey averaged 1.2 minutes per day per occupant. Assumed typical flow of 60 CFM (29 l/s) was used for the flow calculations.

TABLE 2

FORMULA FOR PREDICTING OCCUPANT EFFECTS

AIR CHANGE SOURCES	AC/H FACTOR [AREA in FT2]	AC/H FACTOR [AREA in M2]	EQUATION BASIS
COMMON SOURCES (TABLE 1)	+(15.3 * OCCUP)	+(1.42 * OCCUP)	1
1 WINDOW CRACKED EA. NIGHT*	+112	+11	2
1 WINDOW CRACKED EVERY OTHER NIGHT*	+56	+6	3
1 WINDOW CRACKED ONCE/WEEK*	+16	+1.5	4
KITCHEN EXHAUST FAN USED 10 MIN./DAY	+7.8	+.77	5
PETS EXIT 6-10 TIMES/DAY	+18	+1.7	6
CLOTHES DRYER NOT VENTED DIRECTLY TO OUTDOORS	-(9.4 * OCCUP)	-(.87 * OCCUP)	7
STORM DOORS ON ALL DOORS	-(2.2 * OCCUP)	-(.20 * OCCUP)	8
1 VESTIBULE/AIRLOCK	-(.53 * OCCUP)	-(.051 * OCCUP)	9

* Open 2 in. (50mm) by 3.3 ft. (1 M) for 10 hours.

TO PREDICT THE TOTAL AC/H CAUSED BY OCCUPANTS, TOTAL THE APPLICABLE AC/H FACTORS (COL. 2 OR 3) AND USE WITH:

EQUATION 10:

TOTAL DWELLING AC/H DUE TO OCCUPANTS EFFECTS = FACTORS / AREA

WHERE:
AC/H = The 24 Hour Average Air Change per Hour
FACTORS = The Sum of All Applicable AC/H FACTORS
AREA = Inside Floor AREA of Dwelling in FT2 or M2
OCCUP = Number of OCCUPANTS (See Equation 1)

EXAMPLE: A 2000 FT2 (186 M2) house with one entry vestibule is being designed with an anticipated occupant load of 5. The occupants typically use the kitchen exhaust fan once a day, they have a pet that is let out regularly and they rarely open windows during winter.

From Column 1:			AC/H FACTORS
Common Sources:	+15.3 * 5 occupants	=	+76.5
Kitchen Exhaust Fan:		=	+ 7.8
Pets:		=	+18
Vestibule:	-.53 * 5 occupants	=	- 2.65
SUM OF FACTORS:			99.65

OCCUPANTS EFFECTS = 99.65 / 2000 FT2 = .05 AC/H