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A STUDY OF MOISTURE MOVEMENT IN BUILDINGS

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Summary

This report is concerned with the development of simplified models for moisture movement between two and three zones. We discuss the effect of interzone air movement on the relative humidity in each zone.

The models indicate that airflow through doorways would have a significant effect on moisture movement in houses and is therefore an important parameter to be included in condensation models.

Introduction

To improve energy efficiency in houses, attempts are made to reduce heat losses which result from poor thermal insulation and high air infiltration rates. The use of wall insulation, draught-proofing and replacement of open fires by flue gas heaters is now common practice and as a result the concentration of indoor air contaminants, particularly water vapour, is increased. The detrimental effects of condensation, including deterioration of building fabric, peeling of wallpaper and mould growth, have become serious and widespread problems affecting buildings in many countries [1].

In winter, many people, especially those of low income, do not heat their homes as a whole, but only those rooms in use by the occupants. Air movement carries water vapour produced in the kitchen and living room, which are usually heated to 22°C, to other parts of the house, such as the unheated bedrooms, where condensation occurs. Condensation problems cannot be solved by zone heating alone as house insulation, ventilation and air movement are significant factors [2]. It is therefore important to study ventilation and air movement within the house under a range of test conditions.

A number of mathematical models [3] has been developed to study energy and moisture transfers in buildings. Some of these models assume fixed values for the infiltration rate and interzone heat-transfer coefficient, while others regard the building as a single uniformly mixed zone. There is an urgent need to perform experimental studies on moisture and energy transfer so that a unified and accurate model describing these parameters may be developed.

This report describes two moisture transfer models based upon infiltration and interzone airflow algorithms which have been derived experimentally.

DERIVATION OF A TWO-ZONE MOISTURE TRANSFER MODEL

The internal vapour pressure is estimated from this steady-state moisture transfer model. The model treats the house as two separate zones as shown in Fig 12E. Moisture is released in Zone 1 (M_{g1}) and Zone 2 (M_{g2}) respectively. The amount of moisture transfer in each zone can be calculated by applying equations describing the conservation of mass of water.

The flow rates are determined as follows :

$$F_{01} = F_{12} + F_{10} - F_{21} \quad (1)$$

$$F_{02} = F_{20} + F_{21} - F_{12} \quad (2)$$

The rate of moisture increase in Zone 1 is given by

$$d(d_{v1})/dt = F_{01}d_{vO} + F_{21}d_{v2} - F_{10}d_{v1} - F_{12}d_{v1} + M_{g1} \quad (3)$$

Similarly, the rate of moisture increase in Zone 2 is given by

$$d(d_{v2})/dt = F_{02}d_{vo} + F_{12}d_{v1} - F_{20}d_{v2} - F_{21}d_{v2} + M_{g2} \quad (4)$$

Assuming a steady-state moisture transfer in the two zones, eqn (3) and (4) become respectively

$$F_{01}d_{v0} + F_{21}d_{v2} - F_{10}d_{v1} - F_{12}d_{v1} + M_{g1} = 0 \qquad (5)$$

$$F_{02}d_{v0} + F_{12}d_{v1} - F_{20}d_{v2} - F_{21}d_{v2} + M_{g2} = 0 \qquad (6)$$

Rearranging eqns (5) and (6) for d_{v1} and d_{v2}, substituting for d_{v2} from eqn (5) into eqn (6) and substituting for dv1 from eqn (6) into eqn (5), the following equations are obtained :

$$d_{v1} = \frac{[F_{01}(F_{20} + F_{21}) + F_{02}F_{21}]}{(F_{10} + F_{12})(F_{20} + F_{21}) - F_{12}F_{21}} d_{v0} + \frac{F_{21} M_{g2}(F_{20} + F_{21}) M_{g1}}{(F_{10} + F_{12})(F_{20} + F_{21}) - F_{12}F_{21}} \qquad (7)$$

$$d_{v2} = \frac{[F_{02}(F_{10} + F_{12}) + F_{01}F_{12}]}{(F_{10} + F_{12})(F_{20} + F_{21}) - F_{12}F_{21}} d_{v0} + \frac{F_{12} M_{g1} + (F_{10} + F_{12}) M_{g2}}{(F_{10} + F_{12})(F_{20} + F_{21}) - F_{12}F_{21}} \qquad (8)$$

The air infiltration rates from outside the house in each zones are given by eqns (1) and (2)

The air change rates in Zone 1 and 2 are respectively

$$A_1 = (F_{10} + F_{12})/V_1$$

$$A_2 = (F_{20} + F_{21})/V_2$$

The derivation of F_{10}, F_{20} and F_{12} or F_{21} are as follows :

Case 1 (F_{10})

$$F_{10} = \frac{(0.242\sqrt{\Delta T})\,V1}{3600}$$

where,

ΔT = Temperature Difference between T1 and ExternalTemperature

CASE 2 (F_{20})

It is similar to the above case except that the ΔT is the temperature difference between Zone 2 and the External Temperature.

Case 3 (F_{12} or F_{21})

$$F_{12} = F_{21} = (CdW/3)\ [gH^3\ \Delta T/T]^{0.5}$$

where,

Discharge Coefficient (Cd) = $0.0835\ (\Delta T/T)^{-0.313}$

Substituting from eqn (1), (2), (9) and (10) into eqns (7) and (8), and simplifying, gives :

$$d_{v1} = d_{v0} + \frac{F_{21}M_{g2} + A_2V_2M_{g1}}{(A_1V_1A_2V_2 - F_{12}F_{21})} \qquad (11)$$

$$d_{v2} = d_{v0} + \frac{F_{12}M_{g1} + A_1V_1M_{g2}}{(A_1V_1A_2V_2 - F_{12}F_{21})} \qquad (12)$$

The absolute humidities, d_{v1} and d_{v2}, are given by :

$$d_{v0} = 2.17\ P_{v0}/T_0 \qquad (13)$$

$$d_{v1} = 2.17\ P_{v1}/T_1 \qquad (14)$$

$$d_{v2} = 2.17\ P_{v2}/T_2 \qquad (15)$$

It is also assumed that ;

$$K_1 = \frac{F_{21}M_{g2} + A_2V_2M_{g1}}{(A_1V_1A_2V_2 - F_{12}F_{21})}$$

$$K_2 = \frac{F_{12}M_{g1} + A_1V_1M_{g2}}{(A_1V_1A_2V_2 - F_{12}F_{21})}$$

Substituting from eqn (14) and (15) into eqns (11) and (12), respectively and using K_1 and K_2 as defined above, eqns(11) and (12) become :

$$P_{v1} = (T_1/T_0)\, P_{v0} + 0.461\ K_1T_1 \qquad (16)$$

$$P_{v2} = (T_2/T_0)\, P_{v0} + 0.461\ K_2T_2 \qquad (17)$$

MOISTURE MOVEMENTS BETWEEN UPSTAIRS AND DOWNSTAIRS

The moisture transfer model derived above is used to calculate the mean internal vapour pressures for the lower and upper floors of the house.

Moisture generation and distribution between the two zones are important in estimating the internal vapour pressure. The moisture generated within the house each day is estimated to be between 4 and 12 kg [3]. The moisture release rates depend on the building occupants and appliances use. A typical moisture generation rates for various heating appliances and occupant activities are given by CIBSE [4].

The following assumptions are made for the purpose of the theoretical analysis.

1 a) Volume of Lower Floor $(V_1) = 60\ m^3$

b) Volume of Upper Floor $(V_2) = 100\ m^3$

2. Levels of moisture release rates (M) and distributed between the two floors.

   a) 4 kg/day

   b) 8 kg/day

   c) 10 kg/day

3. The proportional rate of moisture generated in :

   a) the lower floor (Mg1) $= \frac{2}{3} \times M$

   b) the Upper Floor (Mg2) $= \frac{1}{3} \times M$

4. External vapour pressure (P_{v0}) extracted from BS 5250 [Ref 5] at 5 °C and 95% is 0.83 KPa.

5. In this theoretical analysis, two cases were considered.

   a) The lower and upper floors of the house were heated to different temperatures. They were stated below :

Set No.	1	2	3	4	5	6	7	8	9
Mean Internal Temp. of Lower Floor (T1)	12.5	14.5	16.5	18.5	20.5	22.5	24.5	26.5	28.5
Mean Internal Temp. of Upper Floor (T2)	12.0	13.5	15.0	16.5	18.0	19.5	21.0	22.5	24.0
Temp. Diff. between the two Floors	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5

b) The upper floor was kept at 12 °C while the lower floor was heated to mean temperature of 10.5, 12.5, 14.5, 16.5, 18.5, 20.5, 22.5, 24.5 and 26.5 °C.

SAMPLE CALCULATION

This is a sample calculation for the Relative Humidity (%) of the Lower Floor and Upper Floor at a total moisture release rate of 4kg/day and at a temperature of 12.5 °C and 12 °C respectively. (Refer to Fig 1B and 2B)

The mean internal vapour pressures for the Lower and Upper Floor were calculated using the above established moisture transfer model.

For 4 kg/day of moisture release in the house:

The moisture release at the lower floor (M_{g1})

$$= \frac{2}{3} \times 4 = 2.68 \text{kg/day}$$

$$\text{Moisture release rate in g/s} = \frac{2.68 \times 1000}{3600 \times 24} = 0.031$$

The moisture release at the upper floor (M_{g2})

$$= \frac{1}{3} \times 4 = 1.32 \text{ kg/day}$$

$$\text{Moisture release rate in g/s} = \frac{1.32 \times 1000}{3600 \times 24} = 0.01528$$

TO CALCULATE THE RELATIVE HUMIDITY OF THE LOWER FLOOR

Data :

T_1	=	12.5 °C (285.5K)	V_1	=	60 m^3
T_2	=	12.0 °C (285 K)	V^2	=	100 m^3
T_0	=	5 °C (278K)	W	=	0.7 m
T	=	12.25 °C (285.25K)	H	=	2.1 m
ΔT	=	0.5K	P_{v0}	=	0.83 X 10^3 Pa
M_{g1}	=	0.031 g/s			
M_{g2}	=	0.01528 g/s			

(i) To evaluate the Coefficient of Discharge for the doorway using

$$Cd = 0.0835\ (\Delta T/T)^{-0.313}$$

$$= 0.0835\ (0.5/285.25)^{-0.313}$$

$$= 0.6087$$

(ii) To evaluate the interzonal air movement through the doorway

$$F_{12} = F_{21} = (CdW/3)[gH^3\ \Delta T/T]^{0.5}$$

$$= (0.6087\ X\ 0.7/3)[\ 9.81\ X\ 2.1\text{^}3\ X\ 0.5/285.25)^{0.5}$$

$$F_{12} = F_{21} = 0.0567 \ m^3/s$$

(iii) To evaluate the infiltration rate (F_{10} and F_{20})

$$F_{10} = \frac{(0.242 \sqrt{T1-T0}) \times V1}{3600}$$

$$= \frac{(0.242 \sqrt{285.5-278}) \times 60}{3600}$$

$$= 0.0110 \ m^3/s$$

$$F20 = \frac{(0.242 \sqrt{285-278}) \times 100}{3600}$$

$$= 0.01779 \ m^3/s$$

(v) To evaluate the Air Change Rate (A)

$$A_1 = (F_{10} + F_{12})/V_1$$

$$= (0.0110 + 0.0567)/60$$

$$= 1.129 \times 10^{-3} \text{ air change per second}$$

$$A_2 = (F_{20} + F_{21})/V_2$$

$$= (0.01779 + 0.0567)/100$$

$$= 7.449 \times 10^{-4} \text{ air change per second}$$

(vi) Evaluate for the internal vapour pressure of lower floor

$$K_1 = \frac{F_{21}M_{g2} + A_2V_2M_{g1}}{(A_1V_1A_1V_2 - F_{12}F_{21})}$$

$$= \frac{0.0567 \times 0.01528 + 7.449 \times 10\text{^}4 \times 100 \times 0.031}{1.129 \times 10\text{^}-3 \times 60 \times 7.449 \times 10\text{^}-4 \times 100\text{-}(0.0567)^2}$$

$$= 1.734 \text{ g/m}^3$$

$$P_{v1} = (T_1/T_0)P_{v0} + 0.461K_1T_1$$

$$= (285.5/278)\ 0.83 \times 10\text{^}3 + 0.461\ (1.734)(285.5)$$

$$= 1080.65 \text{ Pa} = 0.01081 \text{ bar}$$

From the steam table,

At 285.5K , Pss (Saturation Pressure) = 0.01449 bar

$$\text{Since RH} = \frac{P_{v1} \times 100}{Pss}$$

$$= \frac{0.01081}{0.01449} \times 100 = 74.5\ \%$$

TO CALCULATE THE RELATIVE HUMIDITY OF THE UPPER FLOOR

The data is same as the Lower Floor.

Using,

$$K_2 = \frac{F_{12}Mg_1 + A_1V_1M_{g2}}{(A_1V_1A_2V_2 - F_{12}F_{21})}$$

$$= \frac{0.0567 \times 0.031 + 1.129 \times 10\text{^}-3 \times 60 \times 0.01528}{(1.129 \times 10\text{^}-3 \times 60 \times 7.449 \times 10\text{^}-4 \times 100 - (0.0567)^2}$$

$$= 1.525 \text{ g/m}^3$$

$$P_{v2} = (T_2/T_0)Pv0 + 0.461K_1T^1$$

$$P_{v2} = (285/278)0.83 \times 10\text{^}3 + 0.461 \times 1.525 \times 285$$

$$= 1051.26 \text{ Pa} = 0.0105 \text{ bar}$$

From steam table,

At 285k, Pss = 0.01401 bar

Therefore,

$$RH. = \frac{0.0105}{0.01401} \times 100$$

= 74.9 %

A spreadsheet package called Microsoft Excel was used to calculate the rest of the values. They are listed below :

a) Calculation for RH of the Lower Floor at a moisture release rate of 4kg/day (Table 7B).

b) Calculation for RH of the Lower Floor at a moisture release rate of 8kg/day (Table 8B).

c) Calculation for RH of the Lower Floor at a moisture release rate of 10kg/day (Table 9B).

d) Calculation for RH of the Upper Floor at a moisture release rate of 4kg/day (Table 10B).

e) Calculation for RH of the Upper Floor at a moisture release rate of 8kg/day (Table 11B).

f) Calculation for RH of the Upper Floor at a moisture release rate of 10kg/day (Table 12B).

ANALYSIS OF RESULTS

The data which are used to plot the graphs are listed below :

a) Data for Graph of RH Vs Temp at Lower Floor (Table 1B)

b) Data for Graph of RH Vs Temp at Upper Floor (Table 2B)

c) Data for RH Diff Vs Temp Diff (Table 3B)

d) Data for the Effect of Interflow in Lower Floor (Table 4B)

e) Data for the Effect of interflow in Upper Floor (Table 5B)

f) Data for Graph of Variation in RH Vs Variation in Temp (Case B) (Table 6B)

CASE A

Fig 1B and 2B show the variation of the relative humidity with temperature for the lower and upper floor of the house, respectively. The effects of variations in moisture release rate are clearly shown in these figures. Relative humidities in the range of 75 - 100% are obtained in the lower floor, for an infiltration rate of 0.66 air change per hour and an air change inclusive of interzonal air movement of 4 per hour at a temperature of about 12.5 Degree Celcius. The recommended [6] relative humidity should be less than 70% to prevent mould growth, which implies temperatures in the range 14.5 - 18.0 Degree Celcius are required. This is similar to the upper

floor where the relative humidity is found to be high when the temperature is low and moisture release rate is large.

Fig. 3B shows the relative humidity difference between the upper and lower floor Vs the temperature difference between the two floors. The relative humidity difference (RH2 - RH1) is found to increase from about 0.5 % to about 8% (depending on the moisture release rate) as the temperature difference is increased from 0.5 to 4.5 Degree Celcius.

In Fig. 4B and 5B, they show the effect of interzone air flows on the relative humidity in the lower and upper floor. These figures show that for the lower floor, under the condition of no interzone air flow results in a relative humidity about 20% higher than that with interzone air flow at a temperature of 12.5 Degree Celcius. However this percentage difference of relative humidity gets smaller as the temperature increases (about 5% difference at 28.5 Degree Celcius). In the case of upper floor, the relative humidity under the condition with no interzone air flow is about 18% lower than that with interzone air flow at a temperature Of 12.5 Degree Celcius. Similar to the lower floor, the percentage difference in relative humidity gets smaller as the temperature increases.

As you compare the graph of the upper and lower floor, they are opposite. For the lower floor, the relative humidity with

interzone air flow is lower than the relative humidity with no interzone air flow. However for the upper floor, the relative humidity with interzone air flow is higher than the relative humidity with no interzone air flow. This is probably due to the moisture release rate in the lower floor is much higher and together with the interzone air flow in the upper floor, the moisture will move to the upper floor.

CASE B

This assumption is valid only when the lower floor is provided with heating. The estimated relative humidity for the upper floor is about 90% for a mean internal temperature of 12 Degree Celcius and a moisture release rate of 2.64 kg/day. At this high relative humidity, condensation and mould growth will occur.

In Fig. 6B, it shows the variation of RH2 - RH1 with temperature difference. The relative humidity difference in the range of 15% - 60% may be reached for a temperature difference of 16.5 Degree Celcius. If you refer to the graph, the rate of relative humidity difference increased rapidly at first with temperature difference and then slow down . This situation will occur when the lower floor is the kitchen which reaches high temperature during cooking periods.

DERIVATION OF A THREE-ZONE MOISTURE TRANSFER MODEL

This is similar to the two-zone transfer model whereby it is used to estimate the internal vapour pressure. The models treats the house as three separate zones, as presented in fig 13E. It is assumed that the moisture release rate in zone 1,zone 2 and zone 3 is M_{g1}, M_{g2} and M_{g3} respectively. The amount of moisture transfer in each zone can be calculated by applying equations describing the conservation of mass of water.

The flow rates are determined as follows :

$$F_{01} = F_{10} + F_{12} + F_{13} - F_{21} - F_{31} \quad (1)$$

$$F_{02} = F_{20} + F_{21} + F_{23} - F_{12} - F_{32} \quad (2)$$

$$F_{03} = F_{30} + F_{31} + F_{32} - F_{23} - F_{13} \quad (3)$$

The rate of moisture increase in Zone 1 is given by

$$d(dv)/dt = F_{01}d_{v0} + F_{21}d_{v2} + F_{31}d_{v3} - F_{10}d_{v1} - F_{12}d_{v1} - F_{13}d_{v1} + M_{g1} \quad (4)$$

The rate of moisture increase in Zone 2 is given by

$$d(dv)/dt = F_{02}d_{v0} + F_{12}d_{v1} + F_{32}d_{v3} + F_{20}d_{v2} - F_{21}d_{v2} - F_{23}d_{v2} + M_{g2} \quad (5)$$

The rate of moisture increase in Zone 3 is given by

$$d(dv)/dt = F_{03}d_{v0} + F_{23}d_{v2} + F_{13}d_{v1} - F_{30}d_{v3} - F_{31}d_{v3} - F_{32}d_{v3} + M_{g3} \quad (6)$$

Assume Steady-State, $d(d_{vx})/dt = 0$

$$F_{01}d_{v0} + F_{21}d_{v2} + F_{31}d_{v3} - F_{10}d_{v1} - F_{12}d_{v1} - F_{13}d_{v1} + M_{g1} = 0 \quad (7)$$

$$F_{02}d_{v0} + F_{12}d_{v1} + F_{32}d_{v3} - F_{20}d_{v2} - F_{21}d_{v2} - F_{23}d_{v2} + M_{g2} = 0 \quad (8)$$

$$F_{03}d_{vo} + F_{13}d_{v1} + F_{23}d_{v2} - F_{30}d_{v3} - F_{31}d_{v3} - F_{32}d_{v3} + M_{g3} = 0 \quad (9)$$

Rearrange Eqn (7),

$$d_{v1} = (F_{01}d_{v0} + F_{21}d_{v2} + F_{31}d_{v3} + M_{g1})/(F_{10} + F_{12} + F_{13}) \quad (10)$$

Rearrange Eqn (8),

$$d_{v2} = (F_{02}d_{v0} + F_{12}d_{v1} + F_{32}d_{v3} + M_{g2})/(F_{20} + F_{21} + F_{23}) \quad (11)$$

Rearrange Eqn (9),

$$d_{v3} = (F_{03}d_{v0} + F_{13}d_{v1} + F_{23}d_{v2} + M_{g3})/(F_{30} + F_{31} + F_{32}) \quad (12)$$

The air change rates in Zone 1, 2 and 3 are respectively,

$$A_1 = (F_{10} + F_{12} + F_{13}) / V_1 \quad (13)$$

$$A_2 = (F_{20} + F_{21} + F_{23}) / V_2 \quad (14)$$

$$A_3 = (F_{30} + F_{31} + F_{32}) / V_3 \quad (15)$$

Substituting A_1V_1 into Eqn (10),

$$d_{v1} = (F_{01}d_{v0} + F_{21}d_{v2} + F_{31}d_{v3} + M_{g1}) / A_1V_1 \quad (16)$$

Substituting A_2V_2 into Eqn (11),

$$d_{v2} = (F_{02}d_{v0} + F_{12}d_{v1} + F_{32}d_{v3} + M_{g2}) / A_2V_2 \quad (17)$$

Substituting A_3V_3 into Eqn (12),

$$d_{v3} = (F_{03}d_{v0} + F_{13}d_{v1} + F_{23}d_{v2} + M_{g3}) / A_3V_3 \quad (18)$$

Rearrange,

$$d_{v1} = F_{01}d_{v0}/A_1V_1 + F_{21}d_{v2}/A_1V_1 + F_{31}d_{v3}/A_1V_1 + M_{g1}/A_1V_1 \quad (19)$$

$$d_{v2} = F_{02}d_{v0}/A_2V_2 + F_{12}d_{v1}/A_2V_2 + F_{32}d_{v3}/A_2V_2 + M_{g2}/A_2V_2 \quad (20)$$

$$d_{v3} = F_{03}d_{v0}/A_3V_3 + F_{13}d_{v1}/A_3V_3 + F_{23}d_{v2}/A_3V_3 + M_{g3}/A_3V_3 \quad (21)$$

Let $K_1 = F_{01}/A_1V_1$; $K_2 = F_{21}/A_1V_1$;

$K_3 = F_{31}/A_1V_1$; $K_4 = Mg_1/A_1V_1$

$$d_{v1} = K_1d_{v0} + K_2d_{v2} + K_3d_{v3} + K_4 \quad (22)$$

Let $M_1 = F_{02}/A_2V_2$; $M_2 = F_{12}/A_2V_2$;

$M_3 = F_{32}/A_2V_2$; $M4 = M_{g2}/A_2V_2$

$$d_{v2} = M_1d_{v0} + M_2d_{v1} + M_3d_{v3} + M_4 \quad (23)$$

Let $N_1 = F_{03}/A_3V_3$; $N_2 = F_{13}/A_3V_3$;

$N_3 = F_{23}/A_3V_3$; $N4 = M_{g3}/A_3V_3$

$$d_{v3} = N_1d_{v0} + N_2d_{v1} + N_3d_{v2} + N_4 \quad (24)$$

Rearrange Eqn,

$$K1dv0 - dv1 + K2dv2 + K3dv3 + K4 = 0 \quad (25)$$

$$M1dv0 + M2dv1 - dv2 + M3dv3 + M4 = 0 \quad (26)$$

$$N1dv0 + N2dv1 + N3dv2 - dv3 + N4 = 0 \quad (27)$$

Eqn(25) x M_2,

$$M_2K_1d_{v0} - M_2d_{v1} + M_2K_2d_{v2} + M_2K_3d_{v3} + M_2K_4 = 0 \quad (28)$$

Eqn (26) + (28),

$$M_1d_{v0} + M_2K_1d_{v0} - d_{v2} + M_2K_2d_{v2} + M_3d_{v3} + M_2K_3d_{v3} + M_4 + M_2K_4 = 0 \quad (29)$$

$$d_{v0}(M_1 + M_2K_1) - d_{v2}(1 - M_2K_2) + d_{v3}(M_3 + M_2K_3) + M_4 + M_2K_4 = 0 \quad (30)$$

Eqn(26) x N_2,

$$M_1N_2d_{v0} + M_2N_2d_{v1} - N_2d_{v2} + M_3N_2d_{v3} + M_4N_2 = 0 \quad (31)$$

Eqn(27) x M_2,

$$M_2N^1d_{v0} + M_2N_2d_{v1} + M_2N_3d_{v2} - M_2d_{v3} + M_2N_4 = 0 \quad (32)$$

Eqn(31)-(32),

$$d_{v0}(M_1N_2 - M_2N_1) - d_{v2}(N_2 + M_2N_3) + d_{v3}(M_3N_2 + M_2) + M_4N_2 - M_2N_4 = 0 \quad (33)$$

Eqn(30) x $(M_3N_2 + M_2)$,

$$d_{v0}(M_1 + M_2K^1)(M_3N_2 + M_2) - d_{v2}(1 - M_2K_2)(M_3N_2 + M_2) + d_{v3}(M_3 + M_2K_3)(M_3N_2 + M_2) + (M_4 + M_2K_4)(M_3N_2 + M_2) = 0 \quad (34)$$

Eqn(33) x $(M_3 + M_2K_3)$,

$$d_{v0}(M_1N_2 - M_2N_1)(M_3 + M_2K_3) - d_{v2}(N_2 + M_2N_3)(M_3 + M_2K_3) + d_{v3}(M_3N_2 + M_2)(M_3 + M_2K_3) + (M_4N_2 - M_2N_4)(M_3 + M_2K_3) = 0 \quad (35)$$

Eqn (34) - (35),

$$d_{v0}[(M_1 + M_2K_1)(M_3N_2 + M_2) - (M_1N_2 - M_2N_1)(M_3 + M_2K_3)] - d_{v2}[(1 - M_2K_2)(M_3N_2 + M_2) - (N_2 + M_2N_3)(M_3 + M_2K_3)] + [(M_4 + M_2K_4)(M_3N_2 + M_2) - (M_4N_2 - M_2N_4)(M_3 + M_2K_3)] = 0 \quad (36)$$

Rearrange,

$$d_{v2} = [(M_1 + M_2K_1)(M_3N_2 + M_2) - (M_1N_2 - M_2N_1)$$
$$(M_3 + M_2K_3)]d_{v0} + [(M_4 + M_2K_4)(M_3N_2 + M_2) -$$
$$(M_4N_2 - M_2N_4)(M_3 + M_2K_3)] \;/$$
$$[(1 - M_2K_2)(M_3N_2 + M_2) - (N_2 + M_2N_3)(M_3 + M_2K_3)] \qquad (37)$$

Let $X_1 = [(M_1 + M_2K_1)(M_3N_2 + M_2) - (M_1N_2 - M_2N_1)(M_3 +$
$M_2K_3)] /$
$[(1 - M_2K_2)(M_3N_2 + M_2) - (N_2 + M_2N_3)(M_3 + M_2K_3)]$

$X_2 = [(M_4 + M_2K_4)(M_3N_2 + M_2) - (M_4N_2 - M_2N_4)(M_3 +$
$M_2K_3)] /$
$[(1 - M_2K_2)(M_3N_2 + M_2) - (N_2 + M_2N_3)(M_3 + M_2K_3)]$

Therefore,

$$d_{v2} = X_1d_{v0} + X_2 \qquad (38)$$

Eqn(30) x $(N_2 + M_2N_3)$,

$$d_{v0}(M_1 + M_2K_1)(N_2 + M_2N_3) - d_{v2}(1 - M_2k_2)(N_2 + M_2N_3) +$$
$$d_{v3}(M_3 + M_2K_3)(N_2 + M_2N_3) + (M_4 + M_2K_4)(N_2 + M_2N_3) = 0$$
(39)

Eqn(33) x $(1 - M_2K_2)$,

$$d_{v0}(M_1N_2 - M_2N_1)(1 - M_2K_2) - dv_2(N_2 + M_2N_3)(1 - M_2K_2)$$
$$+ d_{v3}(M_3N_2 + M_2)(1 - M_2K_2) + (M_4N_2 - M_2N_4)(1 - M_2K_2) = 0 \quad (40)$$

Eqn(39) -(40),

$$d_{v0}[(M_1 + M_2K_1)(N_2 + M_2N_3) - (M_1N_2 - M_2N_1)(1 - M_2K_2)]$$
$$+ d_{v3}[(M_3 + M_2K_3)(N_2 + M_2N_3) - (M_3N_2 + M_2)(1 - M_2K_2)] +$$
$$[(M_4 + M_2K_4)(N_2 + M_2N_3) - (M_4N_2 - M_2N_4)(1 - M_2K_2)] = 0 \quad (41)$$

Rearrange,

$$d_{v3} = -[(M_1 + M_2K_1)(N_2 + M_2N_3) - (M_1N_2 - M_2N_1)$$
$$(1 - M_2K_2)]d_{v0} -$$
$$[(M_4 + M_2K_4)(N_2 + M_2N_3) - (M_4N_2 - M_2N_4)(1 - M_2K_2)] /$$
$$[(M_3 + M_2K_3)(N_2 + M_2N_3) - (M_3N_2 + M_2)(1 - M_2K_2)] \quad (42)$$

Rearrange,

$$d_{v3} = [(M_1N_2 - M_2N_1)(1 - M_2K_2) - (M_1 + M_2K_1)$$
$$(N_2 + M_2N_2)]d_{v0} +$$
$$[(M_4N_2 - M_2N_4)(1 - M_2K_2) - (M_4 + M_2K_4)(N_2 + M_2N_3)] /$$
$$[(M_3 + M_2K_3)(N_2 + M_2N_3) - (M_3N_2 + M_2)(1 - M_2K_2)] \qquad (43)$$

Let $Y_1 = [(M_1N_2 - M_2N_1)(1 - M_2K_2) - (M_1 + M_2K_1)$
$(N_2 + M_2N_3))] /$
$[(M_3 + M_2K_3)(N_2 + M_3N_3) - (M_3N_2 + M_2)(1 - M_2K_2)]$

Let $Y_2 = [(M_4N_2 - M_2N_4)(1 - M_2K_2) - (M_4 + M_2K_4)(N_2 +$
$M_2N_3)] /$
$[(M_3 + M_2K_3)(N_2 + M_3N_3) - (M_3N_2 + M_2)(1 - M_2K_2)]$

Therefore,

$$d_{v3} = Y_1d_{v0} + Y_2 \qquad (44)$$

Eqn(25),

$$K_1d_{v0} - d_{v1} + K_2d_{v2} + K_3d_{v3} + K_4 = 0 \qquad (25)$$

Substitute Eqn(38) & (44) into (25),

$$K_1 d_{v0} - d_{v1} + K_2(X_1 d_{v0} + X_2) + K_3(Y_1 d_{v0} + Y_2) + K_4 = 0 \quad (45)$$

$$K_1 d_{v0} - d_{v1} + K_2 X_1 d_{v0} + K_2 X_2 + K_3 Y_1 d_{v0} + K_3 Y_2 + K_4 = 0 \quad (46)$$

Rearrange,

$$d_{v0}(K_1 + K_2 X_1 + K_3 Y_1) - d_{v1} + (K_2 X_2 + K_3 Y_3 + K_4) = 0 \quad (47)$$

$$d_{v1} = d_{v0}(K_1 + K_2 X_1 + K_3 Y_1) + (K_2 X_2 + K_3 Y_2 + K_4) = 0 \quad (48)$$

Let $Z_1 = K_1 + K_2 X_1 + K_3 Y_1$; $Z_2 = (K_2 X_2 + K_3 Y_2 + K_4)$

$$d_{v1} = Z_1 d_{v0} + Z_2 \quad (49)$$

$$d_{v2} = X_1 d_{v0} + X_2 \quad (38)$$

$$dv_3 = Y_1 d_{v0} + Y_2 \quad (44)$$

The absolute d_{v0}, d_{v1}, d_{v3} and d_{v4} are given by :

$$d_{v0} = 2.17\ P_{v0}/T_0$$

$$d_{v1} = 2.17\ P_{v1}/T_1$$

$$d_{v2} = 2.17\ P_{v2}/T_2$$

$$d_{v3} = 2.17\ P_{v3}/T_3$$

Eqn(49),

$$2.17(P_{v1}/T_1) = Z_1(2.17)(P_{v0}/T_0) + Z_2$$

$$P_{v1} = (T_1/T_0)P_{v0}Z_1 + (0.461)T_1Z_2 \qquad (50)$$

Eqn(38),

$$2.17(P_{v2}/T_2) = X_1(2.17)(P_{v0}/T_0) + X_2$$

$$Pv_2 = (T_2/T_0)P_{v0}X_1 + (0.461)T_2X_2 \qquad (51)$$

Eqn(44),

$$2.17(P_{v3}/T_3) = Y_1(2.17)(P_{v0}/T_0) + Y_2$$

$$P_{v3} = (T_3/T_0)P_{v0}Y_1 + (0.461)T_3Y_2 \qquad (52)$$

MOISTURE MOVEMENT BETWEEN THE THREE ZONES

Similar to the two zones, the moisture transfer model derived above is used to calculate the mean internal vapour pressures. This model is a much better representation of a house as compared to the two zone model. Zone 1 can be the kitchen; Zone 2 can be the living room and Zone 3 can be the bedroom. The assumptions made for this theoretical analysis have been taken into consideration for all the possible factors which will affect an actual house.

They are :

1 a) Volume of Zone 1 = $60m^3$

b) Volume of Zone 2 = $120m^3$

c) Volume of Zone 3 = $60\ m^3$

2 Levels of moisture release rate (M) and the amount distributed between the 3 zones were :

a) 4Kg/day

b) 8Kg/day

c) 10Kg/day

3. The proportional rate of moisture generated in

a) Zone 1 (Mg1) = $\frac{1}{2}$ X M

b) Zone 2 (Mg2) = $\frac{1}{3}$ X M

c) Zone 3 (Mg3) = $\frac{1}{6}$ X M

4. External vapour pressure (P_{v0}) extracted from BS 5250(Ref 5) at 5 Degree Celcius and 95% RH is 0.83 KPa.

5. In this theoretical analysis, two cases were considered.

a)

SET NO	1	2	3	4	5	6	7	8	9
MEAN INTERNAL TEMP OF ZONE 1 (T1)	12.5	14.5	16.5	18.5	20.5	22.5	24.5	26.5	28.5
MEAN INTERNAL TEMP OF ZONE 2 (T2)	12	13	14	15	16	17	18	19	20
MEAN INTERNAL TEMP OF ZONE 3 (T3)	11.5	12	12.5	13	13.5	14	14.5	15	15.5
TEMP DIFF (Z1 - Z2)	0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5
TEMP DIFF (Z1 - Z3)	1	2.5	4	5.5	7	8.5	10	11.5	13
TEMP DIFF (Z2 - Z3)	0.5	1	1.5	2	2.5	3	3.5	4	4.5

b) Zone 2 and 3 was kept at 12 °C and 11 °C respectively while zone 1 was heated to mean temperature of 10.5, 12.5, 14.5, 16.5, 18.5, 20.5, 22.5, 24.5 and 26.5°C.

SAMPLE CALCULATION

This is a sample calculation for the relative humidity of Zone 2 with total moisture release rate of 4 Kg/day at 12.5 °C. The mean internal vapour pressure for the three zones were calculated using the above moisture transfer model.

For 4Kg/day of moisture release in the house :

The moisture release rate at Zone 1 (Mg1) $= \frac{1}{2} \times 4$

$= 2$ Kg/day

Moisture release rate in g/s $= \frac{2 \times 1000}{3600 \times 24} = 0.0231$

The moisture release rate at Zone 2 (Mg2) $= \frac{1}{3} \times 4$

$= 1.33$ Kg/day

Moisture release rate in g/s $= \frac{1.33 \times 1000}{3600 \times 24} = 0.01539$

The moisture release rate at Zone 3 (Mg3) $= \frac{1}{6} \times 4$

$= 0.67$ Kg/day

Moisture release rate in g/s $= \frac{0.67 \times 1000}{3600 \times 24} = 7.7546 \times 10^{-3}$

Data

t_1	= 12.5 °C (285.5K)	Mg1	= 0.023 g/s
t_2	= 12 °C (285K)	Mg2	= 0.0153 g/s
t_3	= 11.5 °C (284.5K)	Mg3	= 7.7546×10^{-3} g/s
t_o	= 5 °C (278K)	V_1	= 60 m^3
T_1	= 285.25 K	V_2	= 120 m^3
T_2	= 285K	V_3	= 60m^3
T_3	= 284.75K	W	= 0.7 m
ΔT_{1-2}	= 0.5	H	= 2.1 m
ΔT_{1-3}	= 1	P_{vo}	= 0.83 X 10^3
ΔT_{2-3}	= 0.5		

i) To evaluate the Inflitration Rate

[18] $F_{01} = F_{10} = \frac{(0.242 \sqrt{t1 - to})\ V1}{3600}$

$F_{01} = F_{10} = \frac{(0.242 \sqrt{7.5})\ 60}{3600}$

$F_{02} = F_{20} = \frac{(0.242 \sqrt{7})\ 120}{3600}$

$F_{03} = F_{30} = \frac{(0.242 \sqrt{6.5})\ 60}{3600}$

ii) To evaluate the Discharge Coefficient

$$Cd = 0.0835 \, (\Delta T / T_m)^{-0.313}$$

$$Cd = 0.0835 \, [(T_1 - T_2)/T_1]^{-0.313}$$

$$Cd_{1-2} = 0.0835 \, (0.5/285.25)^{-0.313}$$

$$= 0.6087$$

$$Cd_{1-3} = [0.0835 \, (T1 - T3)/T2]^{-0.313}$$

$$= 0.4898$$

$$Cd_{2-3} = [0.0835 \, (T2 - T3)/T3]^{-0.313}$$

$$= 0.6084$$

iii) To evaluate the Interzonal Flow Rate

$$\text{Using } F_{21} = F_{12} = (Cd \, W/3) \, [gH^3 \, \Delta T/T]^{0.5}$$

$$= 0.0567 \ m^3/s$$

$$F_{13} = F_{31} = 0.06453 \ m^3/s$$

$$F_{23} = F_{32} = 0.0567 \ m^3/s$$

iv) To evaluate the Air Change Rate

$$A1 = (F_{10} + F_{12} + F_{13})/V1$$

$$= 2.205 \ X \ 10^{-3} \text{ air change per seconds}$$

$$A2 = (F_{20} + F_{21} + F_{23})/V2$$

$$= 1.1228 \times 10^{-3} \text{ air change per seconds}$$

$$A3 = (F_{30} + F_{31} + F_{32})/V3$$

$$= 2.192 \times 10^{-3} \text{ air change per seconds}$$

v) To evaluate the variable K

$$K1 = F_{01}/A_1V_1$$

$$= 0.08352$$

$$K2 = F_{21}/ A_1V_1$$

$$= 0.4286$$

$$K3 = F_{31}/ A_1V_1$$

$$= 0.4878$$

$$K4 = Mg1/ A_1V_1$$

$$= 0.1747$$

vi) To evaluate the variable M

$$M1 = F_{02}/ A_2V_2$$

$$= 0.1584$$

$$M2 = F_{12}/ A_2V_2$$

$$= 0.4208$$

$$M3 = F_{32}/ A_2V_2$$

$$= 0.4208$$

$$M4 = Mg2/ A_2V_2$$

$$= 0.1142$$

vii) To evaluate the variable N

$$N1 = F_{03}/ A_3V_3$$

$$= 0.0783$$

$$N2 = F_{13}/ A_3V_3$$

$$= 0.4906$$

$$N3 = F_{23}/ A_3V_3$$

$$= 0.4311$$

$$N4 = Mg3/ A_3V_3$$

$$= 0.05897$$

viii) To evaluate X1

$$X1 = [(M1 + M2K1)(M3N2 + M2) - (M1N2 - M2N1)(M3 + M2K3)]/ [(1 - M2K2)(M3N2 + M2) - (N2 + M2N3)(M3 + M2K3)$$

By substituting all the variables into the above equations,

$$X1 = 1$$

ix) To evaluate X2

$$X2 = [(M4 + M2K4)(M3N2 + M2) - (M4N2 - M2N4)(M3 + M2K3)]/ [(1 - M2K2)(M3N2 + M2) - (N2 + M2N3)(M3 + M2K3)]$$

$$= 1.05195$$

x) To evaluate the Mean Internal Vapour Pressure (Pv_2)

Using,

$$Pv_2 = (T_2/T_o)\, Pv_o X1 + (0.461) T_2 X2$$

$$= 0.009891 \text{ bar}$$

xi) To evaluate the Relative Humidity (RH)

$$RH = \frac{Ps}{Pv_2} \times 100$$

From steam table,

At 12 C , Ps = 0.01401

$$RH = \frac{0.009891}{0.01401} \times 100$$

$$= 70.6\%$$

The rest of the calculation were done by a spreadsheet package called "Microsoft Excel". They were tabulated as :

a) Calculation for the RH of the Three Zones with a Moisture Release Rate of 4Kg/day (Table 10C).

b) Calculation for the RH of the Three Zones with a Moisture Release Rate of 8Kg/day (Table 11C).

c) Calculation for the RH of the Three Zones with a Moisture Release Rate of 10Kg/day (Table 12C).

d) Calculation for the RH of the zones with No Interflow between zone (3) and the other zones (Table 13C).

e) Calculation for the RH of the zones with a Moisture Release Rate of 4Kg/day (Case B) (Table 14C).

f) Calculation for the RH of the zones with a Moisture Release Rate of 8Kg/day (Case B) (Table 15C).

g) Calculation for the RH of the zones with a Moisture Release Rate of 10Kg/day (Case B) (Table 16C).

ANALYSIS OF RESULTS

The data that are used to plot the graphs are listed below :

a) Data for Graph of RH Vs Temp at Zone 1 (Table 1C)

b) Data for Graph of RH Vs Temp at Zone 2 (Table 2C)

c) Data for Graph of RH Vs Temp at Zone 3 (Table 3C)

d) Data for Graph of RH2 - RH1 Vs Temp Diff (Table 4C)

e) Data for Graph of RH3 - RH1 Vs Temp Diff (Table 5C)

f) Data for Graph of RH3 - RH2 Vs Temp Diff (Table 6C)

g) Data for Interzone and No Interzone air flow (Table 7C)

h) Data for Graph of RH1 - RH2 Vs Temp Diff (Case B - 3 Zone) (Table 8C)

i) Data for Graph of RH1 - RH3 Vs Temp Diff (Case B - 3 Zone) (Table 9C)

CASE A

FIG 1C, 2C, 3C show the variation of relative humidity with temperature for zone 1, zone 2, zone 3 of the house respectively. The effects of variation in moisture release rate are clearly shown in these figures. Relative humidities in the range of 70 - 85% are obtained in zone 1, for an infiltration rate

of 0.66 air change per hour and an air change inclusive of interzonal air movement of 7.9 per hour at a temperature of about 12.5 Degree Celcius. The recommended [5] relative humidity should be less than 70% to prevent mould growth, which implies temperature in the range 12.5 - 15 Degree Celcius are required. Therefore the temperature range for zone 2 and 3 to prevent mould growth are 12 - 14.5 Degree Celcius and 11.8 - 13 Degree Celcius respectively. Generally, all the three zones have the same characteristics where the relative humidity are found to be high when the temperature are low and moisture release rate are large. The temperature range required to prevent mould growth for the three zones are quite similar. The temperature range for zone 3 is the lowest follow by zone 2 and 1. This is due to the moisture release rate, temperature of the zone and infiltration rate. Since zone 3 has the lowest values for all of the above parameter, therefore the range is the lowest too.

Fig 4C shows the relative humidity difference between zone 1 and 2 Vs the temperature difference between them. The relative humidity difference (RH2 - RH1) is found to increase from about 0.5% to 19.5% (depending on the moisture release rate) as the temperature difference is increased from 0.5 to 8.5 Degree Celcius. In Fig 5C, it shows the relative humidity difference between zone 1 and 3 Vs the temperature difference

between them. The relative humidity difference (RH1 - RH3) is found to increase from 3.5% to 27% as the temperature difference is increased from 1 to 13 Degree Celcius.

In Fig 6C, it shows the relative humidity difference between zone 2 and 3 Vs the temperature difference between them. The relative humidity difference (RH2 - RH3) is found to decrease from 3.7% to -1.5% and then increased gradually to 7.5%. The drop is due to the high flow rate. At this point, the relative humidity at zone 3 is less than the relative humidity at zone 2 therefore the sign is negative.

In Fig 7C, 8C and 9C, they show the effects of interzone air flows on the relative humidity in zone 1, 2 and 3 repectively. These figures show that for zone 1, with no interzone air flow results in a relative humidity about 4% higher than that with interzone air flow at a temperature of 12.5 Degree Celcius. The relative humidity difference tends to narrow down at the temperature of about 12.5 Degree Celcius.

For zone 2, under the condition with no interzone air flow results in a relative humidity 2% higher than that with interzone air flow at a temperature of 12 Degree Celcius. The difference in relative humidity narrow down at higher temperature. The effect with no interzonal air flow is not

significant here but this may be due to the large air space and the assumed temperature.

For zone 3, under the condition with no interzone air flow results in a relative humidity 5% higher than for the condition with interzone air flow at a temperature of 15.5 Degree Celcius. However, it tapered off at low temperature and intersect the no interzone air flow curve at 12 Degree Celcius. This is partly due to the low temp and the moisture is transferred to zone 3 from zone 1 and 2 as they have higher moisture generation rate. Furthermore the space is small and the rate of moisture build up is much faster than the interzone air flow rate.

CASE B

The assumption is valid only when the lower floor is provided with heating. The estimated relative humidity for zone 2 is about 80% for a mean internal temperature of 12 Degree Celcius and a moisture release rate of 2.67Kg/day. On the other hand, the estimated relative humidity for zone 3 is about 84% for a mean internal temperature of 11.5 Degree Celcius and a moisture release rate of 1.33 Kg/day. At this high relative humidity, condensation and mould growth will occur.

In Fig 10C, it shows the variation of RH2 - RH1 with temperature difference. The relative humidity differences in the range 47% - 55% may be reached for a temperature difference of 16.5 Degree Celcius. Relative humidity difference in the range of 37% - 45% may exist if zone 1 is heated to about 22 Degree Celcius when zone 2 is maintained at 12 Degree Celcius.

In Fig 11C, it shows the variation of RH3 - RH1, with temperature difference. The relative humidity difference in the range 27.5% - 33% may be reached for a temperature difference of 17.5 Degree Celcius. There is a drastic drop in the difference of relative humidity between zone 3 and 1 at a temperature difference of 3.5 Degree Celcius. This is partly due to the increased in air flow rate which caused a reduction in the relative humidity.

CONCLUSIONS

The results analysed from both the two-zone and three-zone models show that the air flow rate between the zones increase significantly with increase in temperature difference. The effect of the interzonal air flows on moisture transfer was found to be significant and therefore should be included in condensation models.

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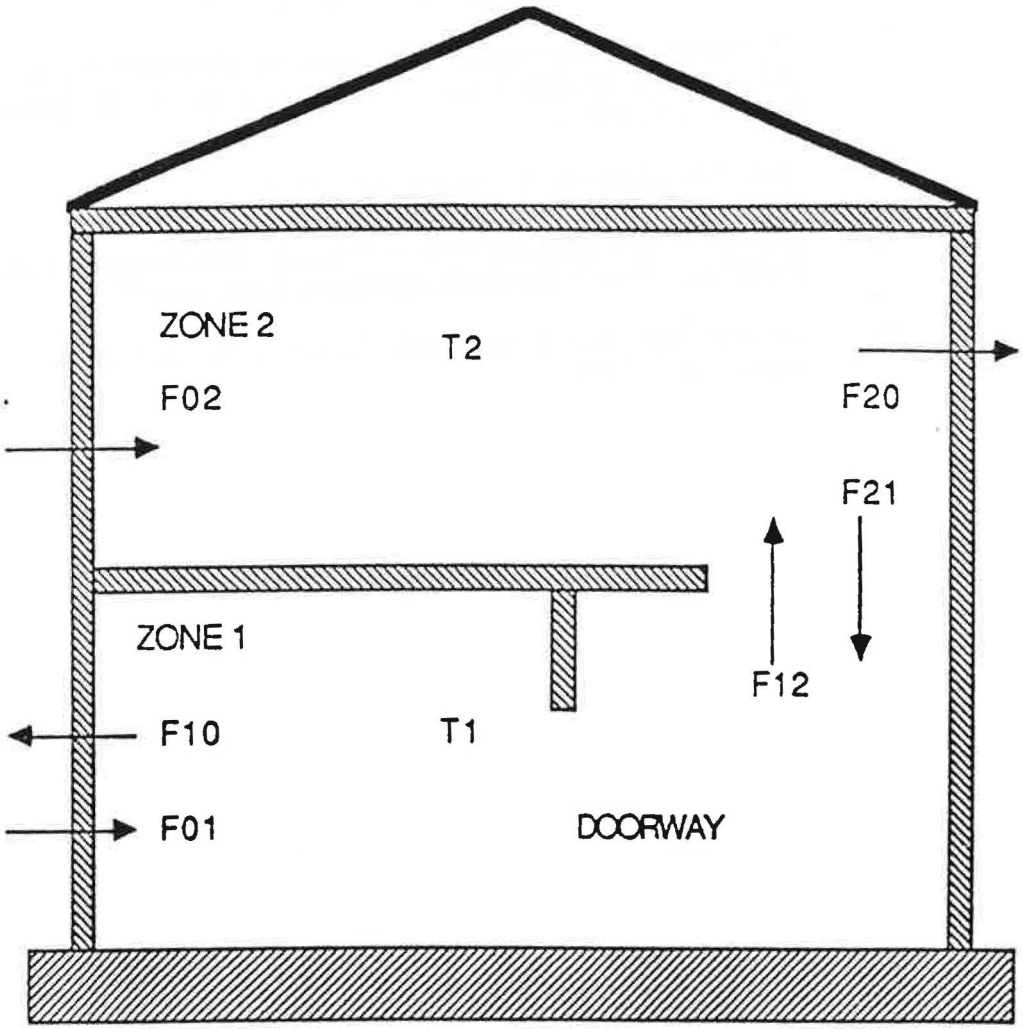

FIG 12E - INTERZONE AIR FLOW IN A TWO ZONE HOUSE

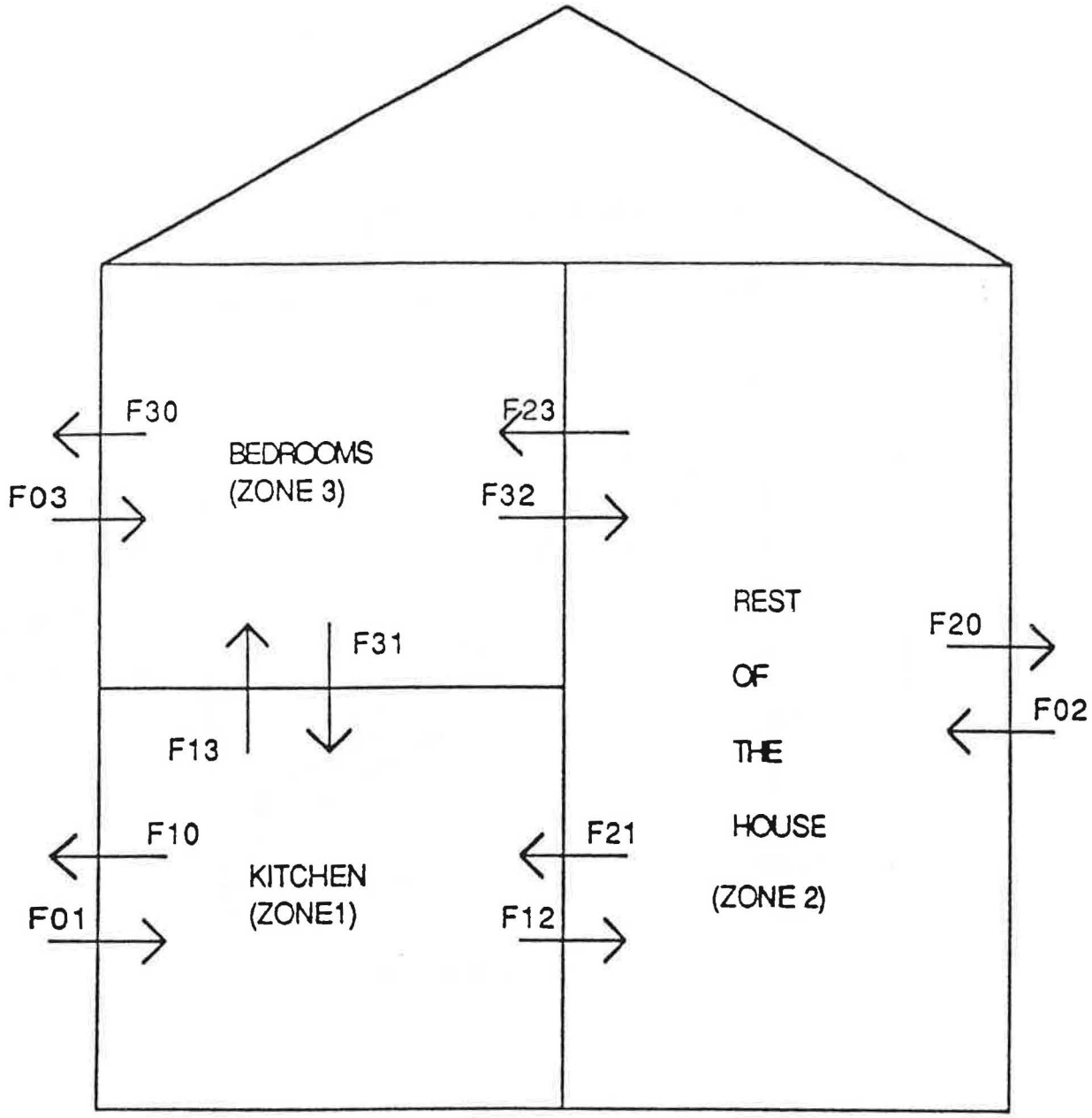

Fig 13E - INTERZONE MOISTURE MOVEMENT

FIG 1B - GRAPH OF RH. VS TEMP. OF LOWER FLOOR

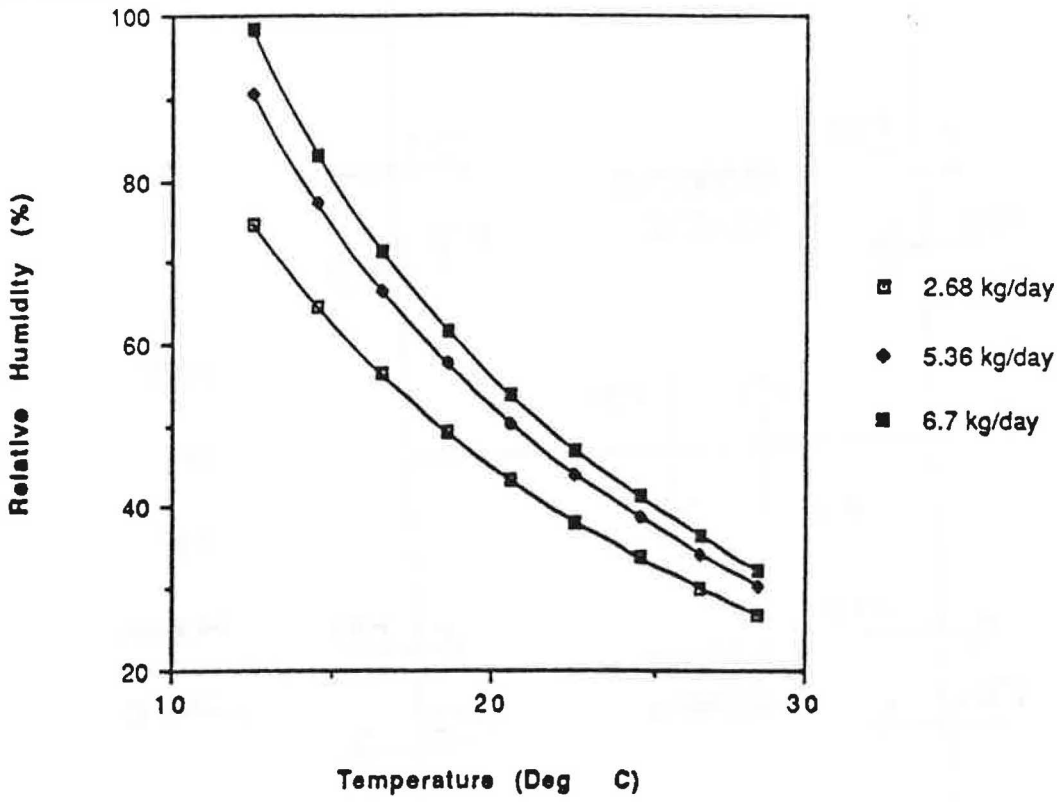

FIG 4B - GRAPH OF RH. VS TEMP. IN LOWER ZONE

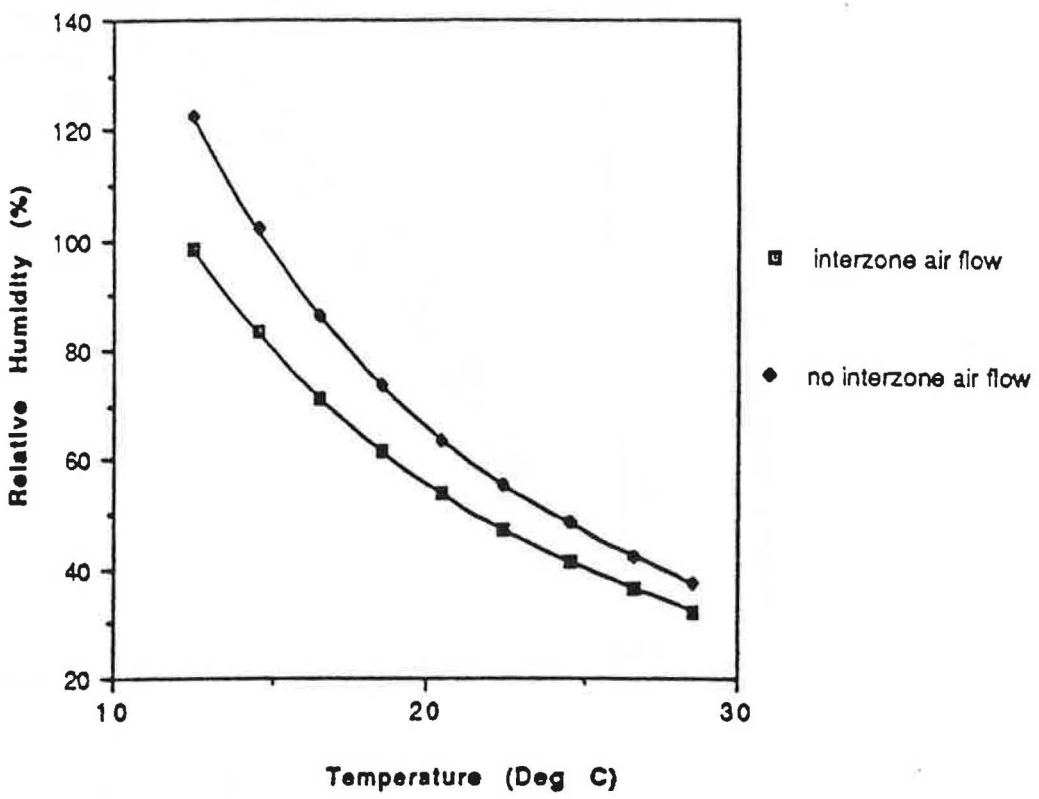

FIG 3B - GRAPH OF VARIATION IN RH. VS. VARIATION IN TEMP.

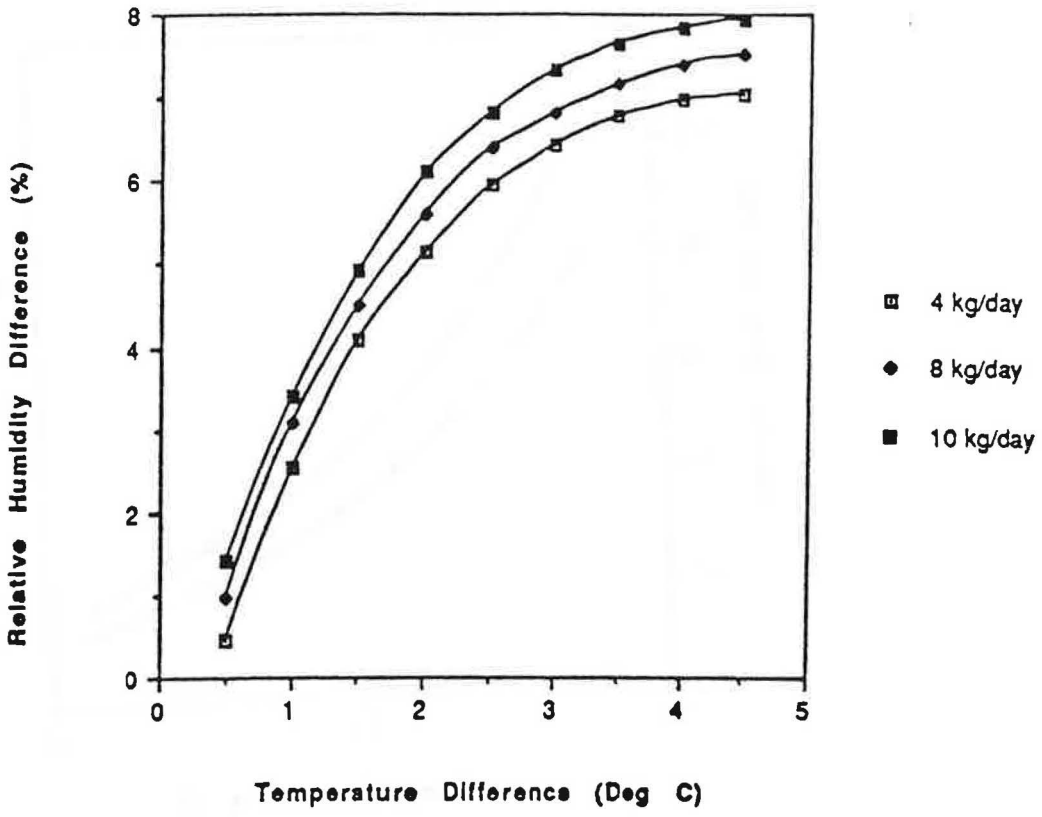

FIG 5B - GRAPH OF RH. VS TEMP. IN UPPER ZONE

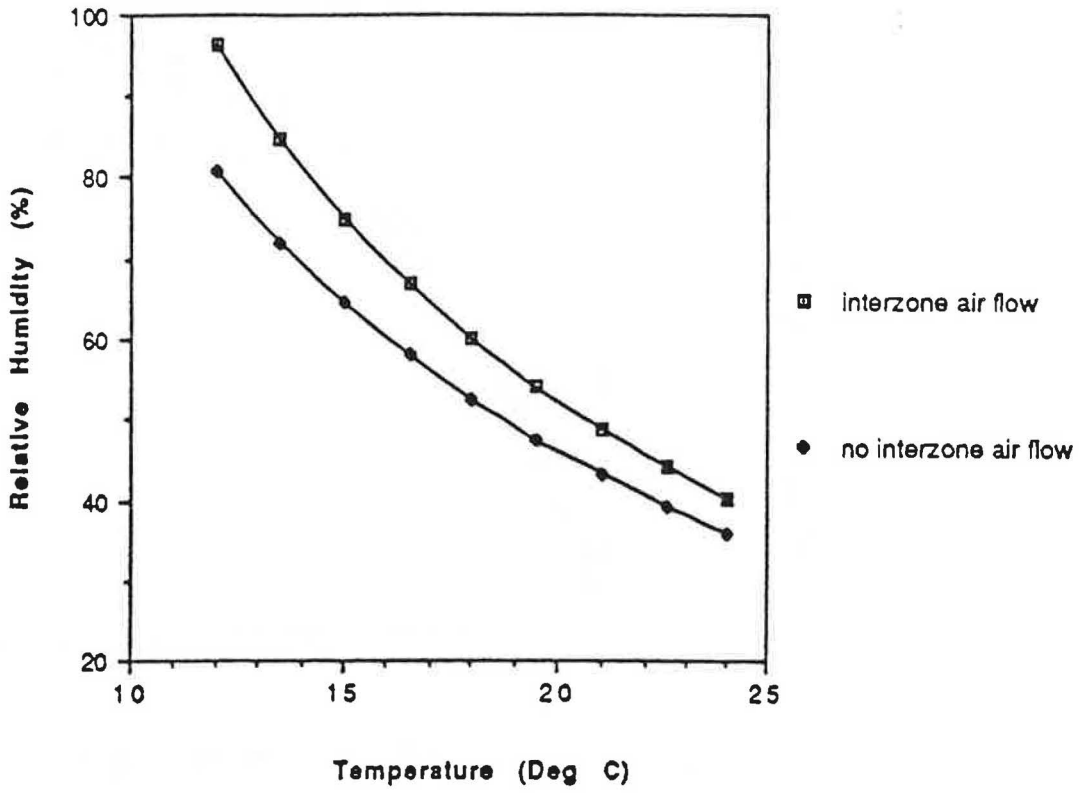

FIG 6B - GRAPH OF VARIATION IN RH. VS VARIATION IN TEMP.
(CASE B)

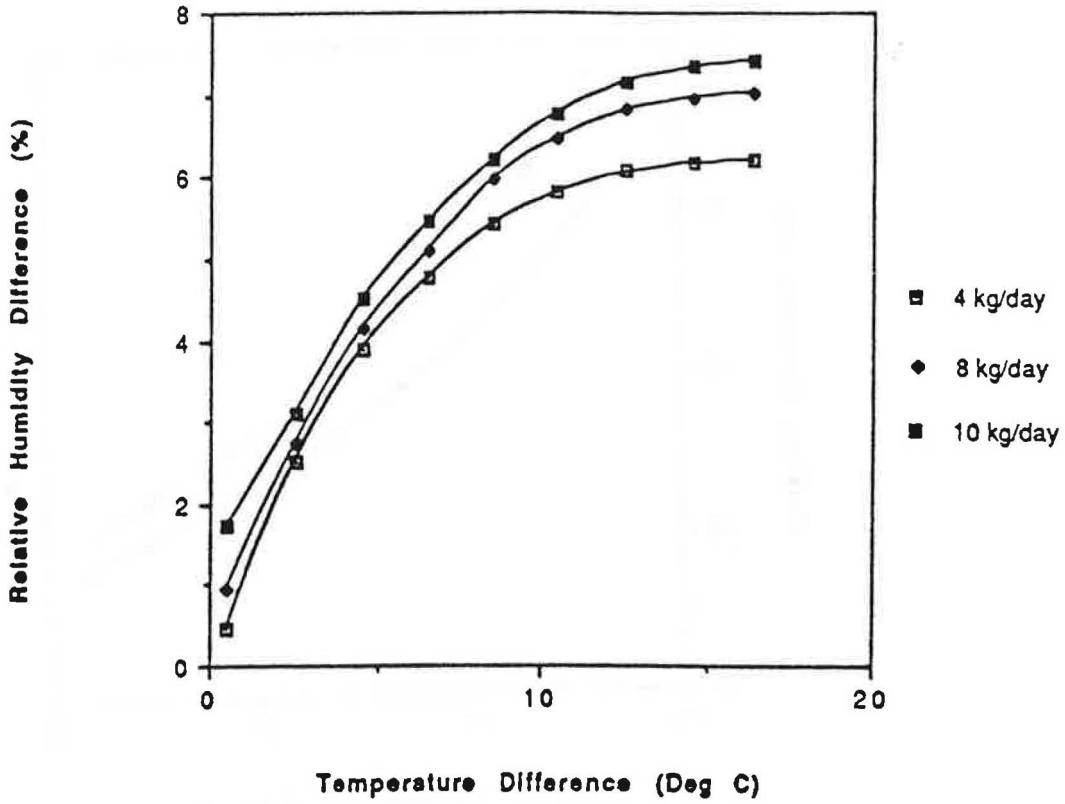

FIG 1C - GRAPH OF RELATIVE HUMIDITY VS TEMPERATURE FOR ZONE 1 (3 ZONE)

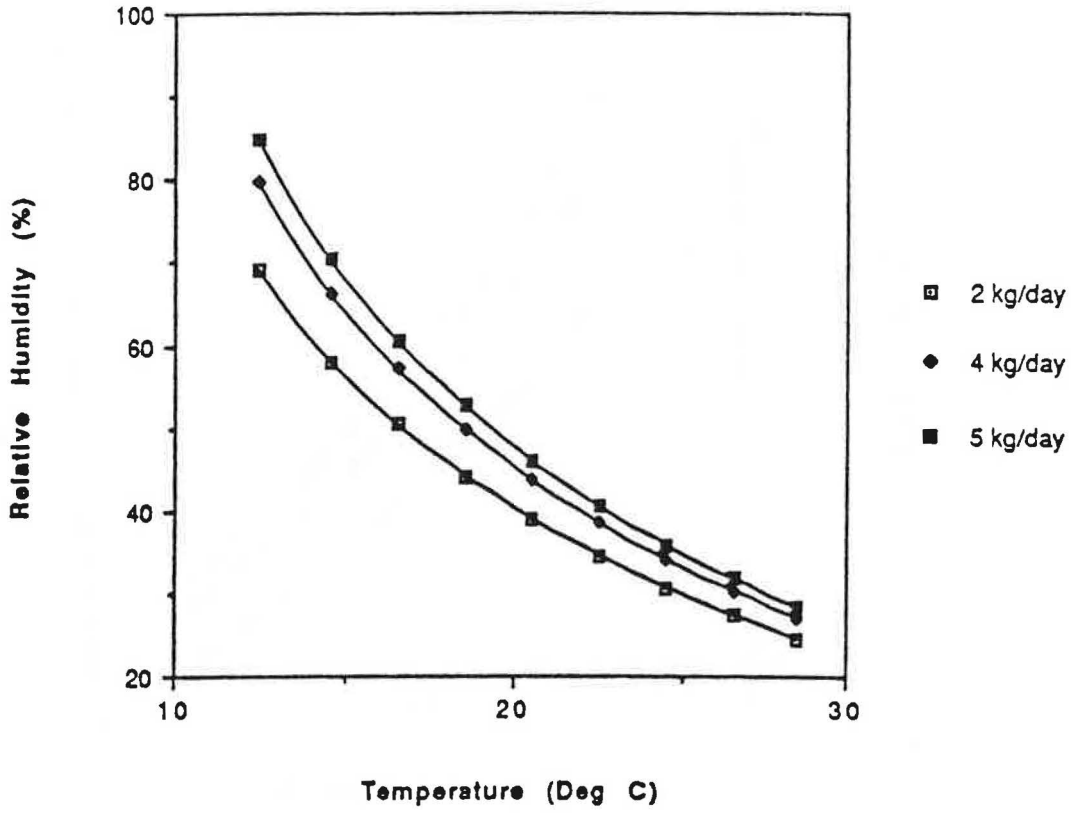

FIG 2C - GRAPH OF RELATIVE HUMIDITY VS TEMPERATURE FOR ZONE 2 (3 ZONE)

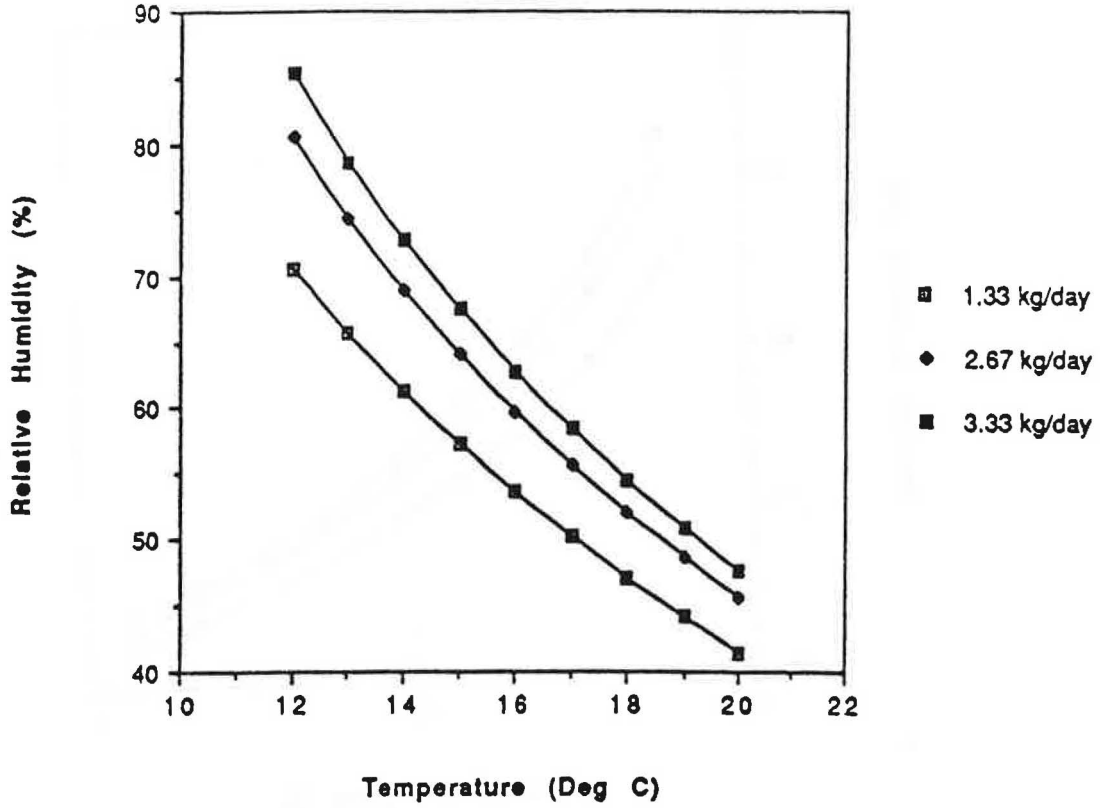

FIG 3C - GRAPH OF RELATIVE HUMIDITY VS TEMPERATURE FOR ZONE 3 (3 ZONE)

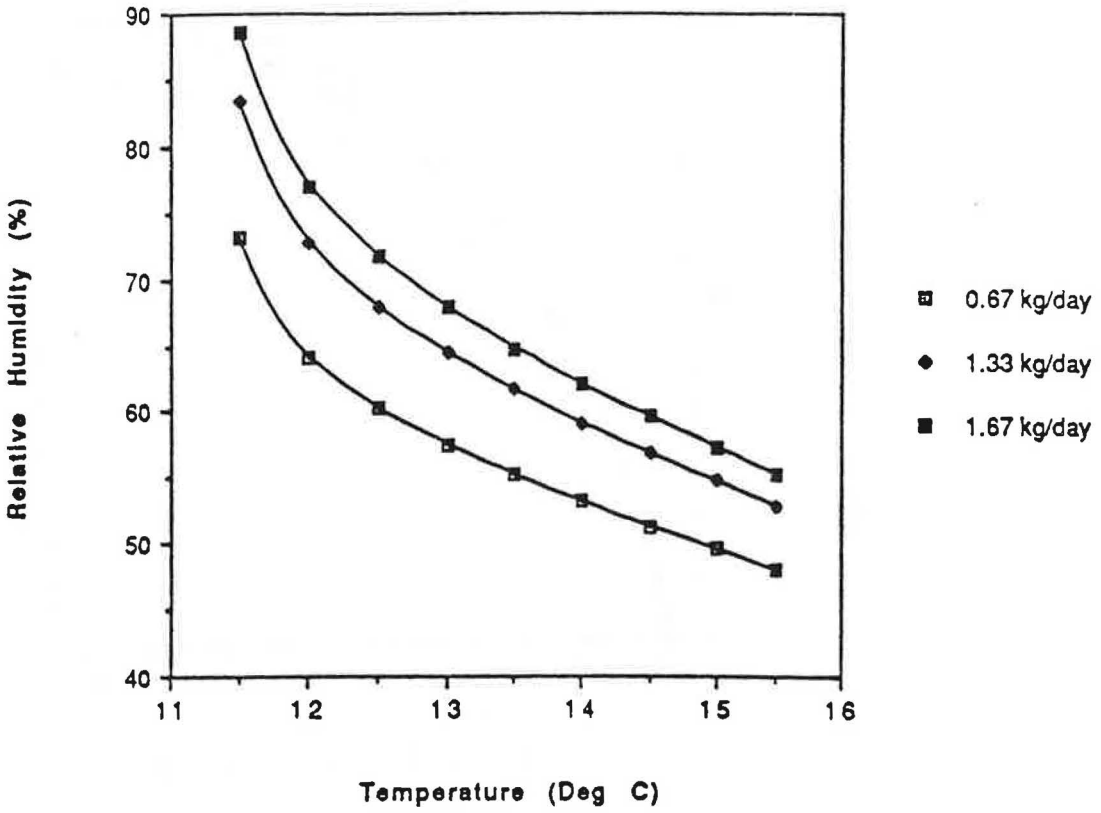

FIG 4C - GRAPH OF DIFF. IN RH. (2 - 1) VS DIFF. IN TEMP.

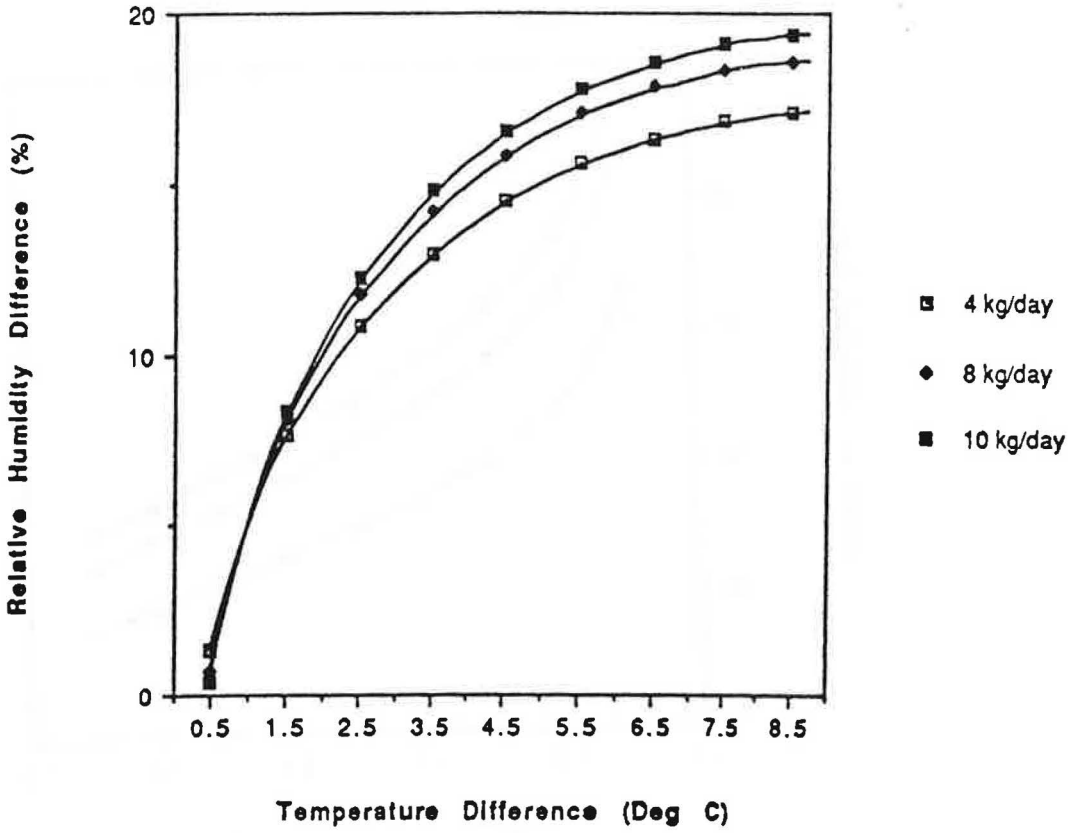

FIG 5C - GRAPH OF DIFF. IN RH. (3 - 1) VS DIFF. IN TEMP.

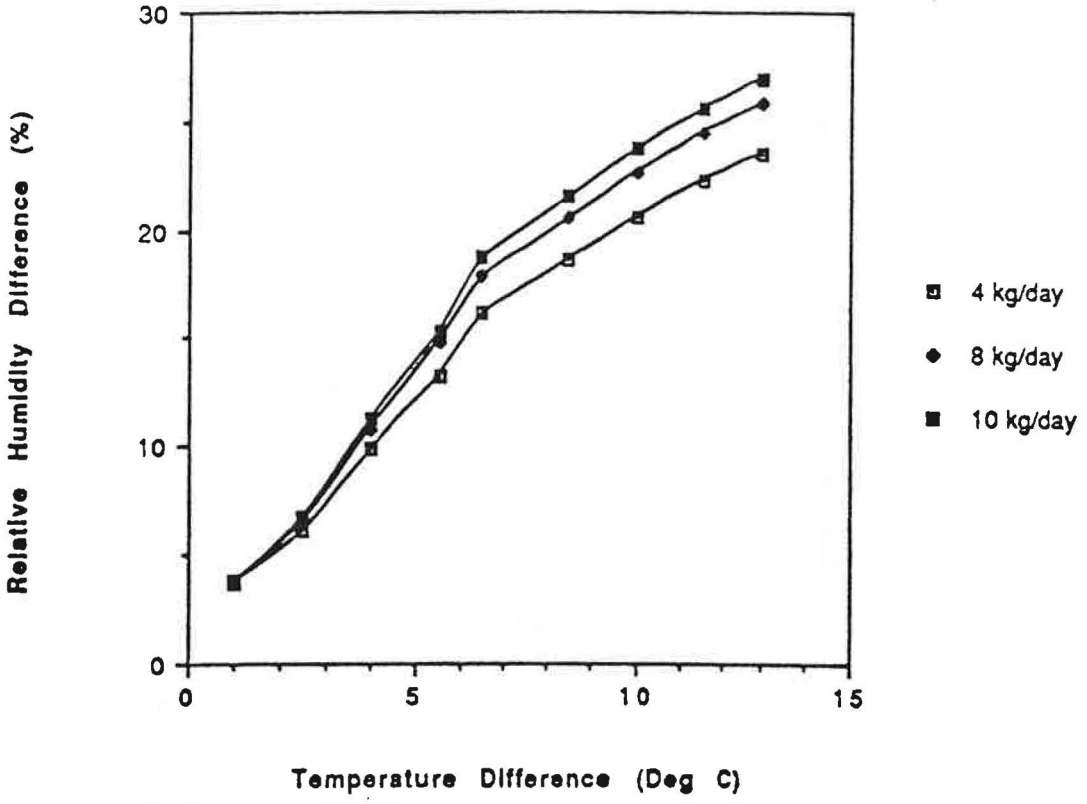

FIG 6C - GRAPH OF DIFF. IN RH.(3 - 2) VS DIFF. IN TEMP.

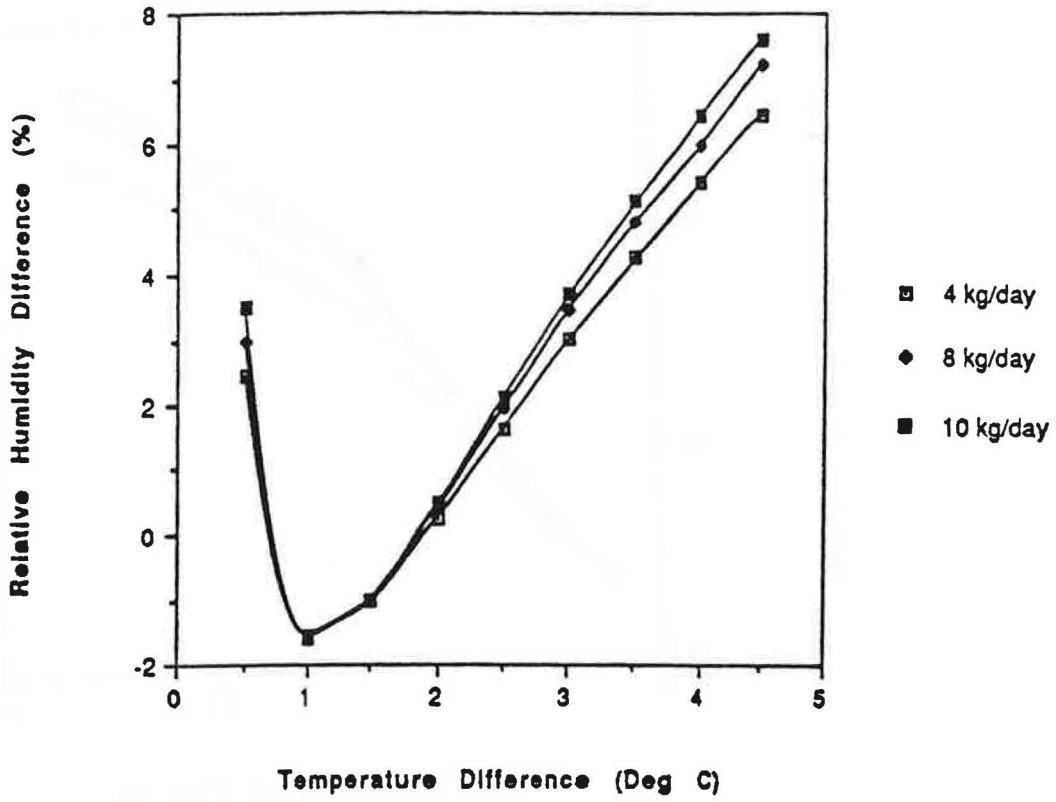

FIG 7C - GRAPH OF RH. VS TEMP. IN ZONE 1 (3 ZONE)

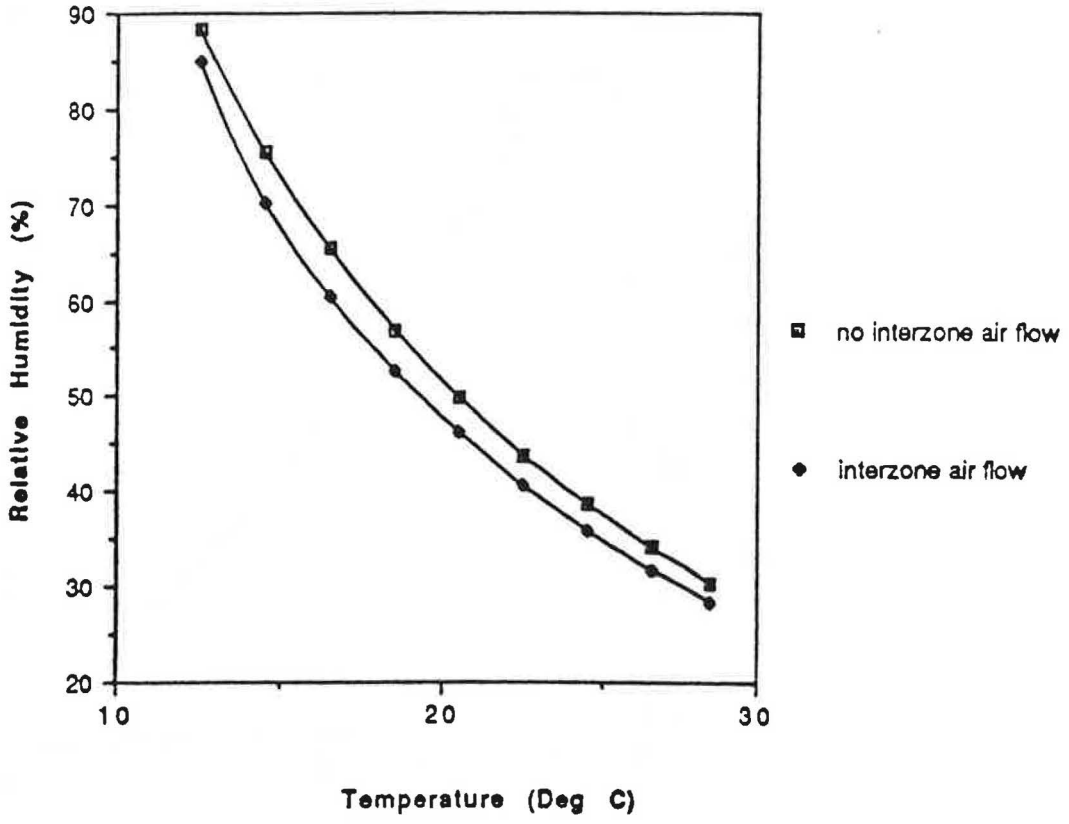

FIG 8C - GRAPH OF RH. VS TEMP. IN ZONE 2 (3 ZONE)

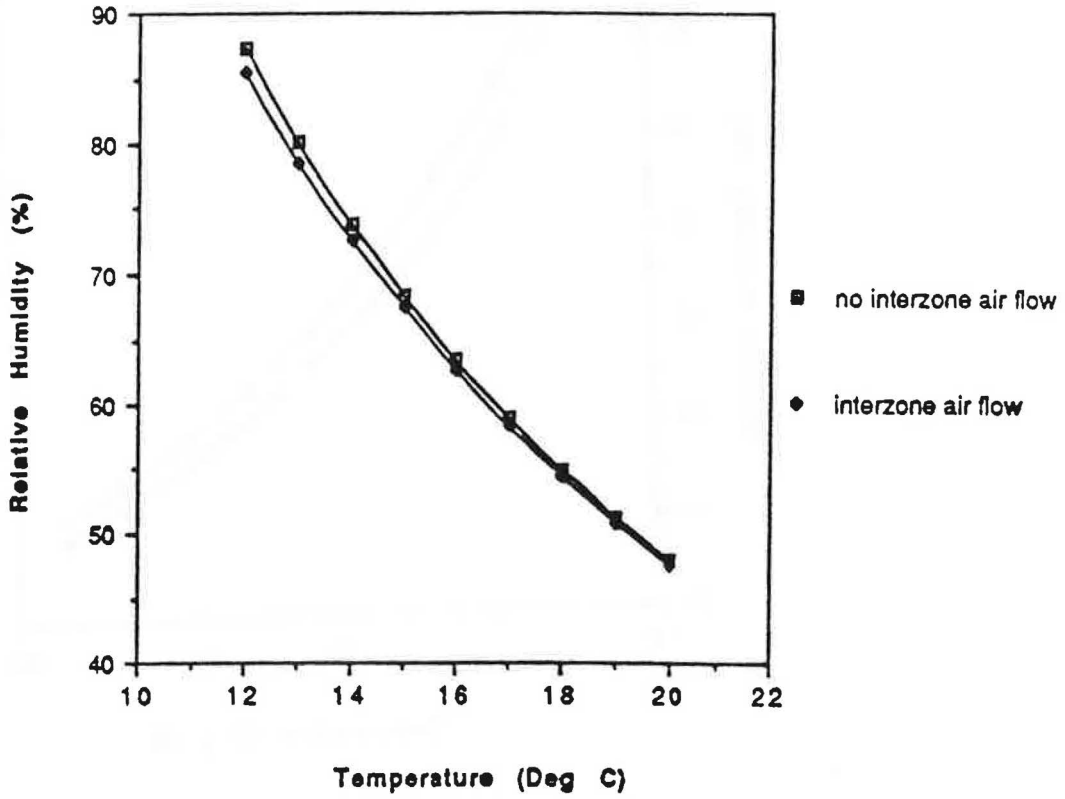

FIG 9C - GRAPH OF RH. VS TEMP. IN ZONE 3 (3 ZONE)

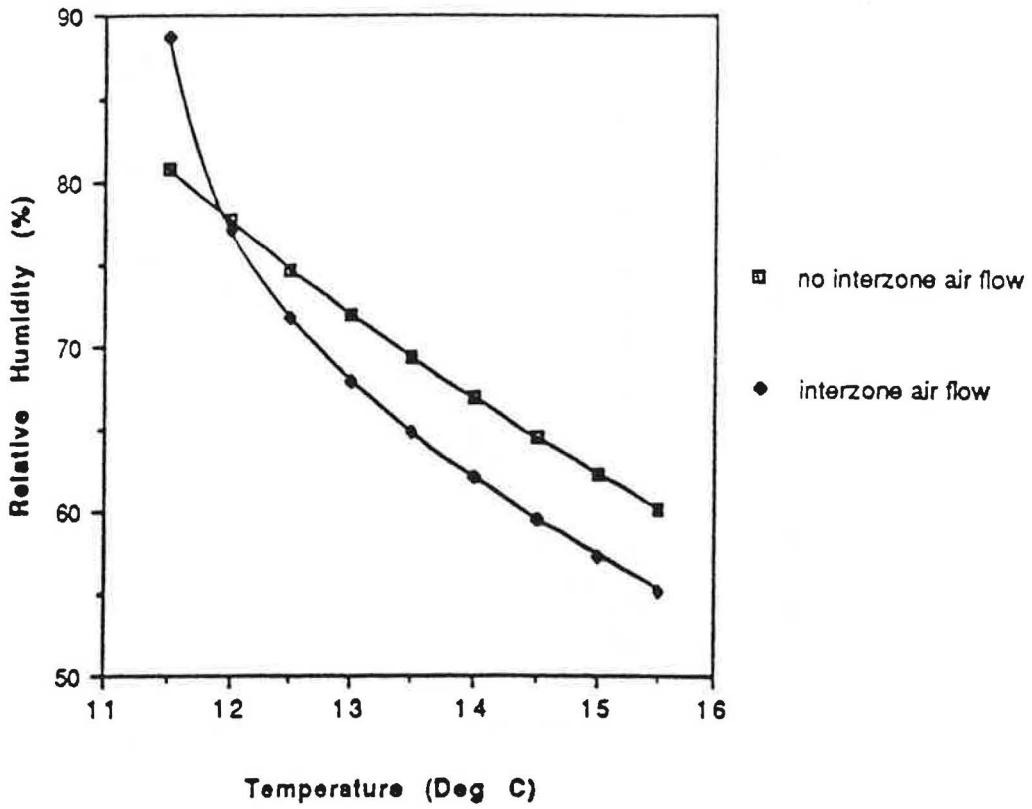

FIG 10C - GRAPH OF VARIATION IN RH. VS VARIATION IN TEMPERATURE (CASE B = RH2 - RH1)

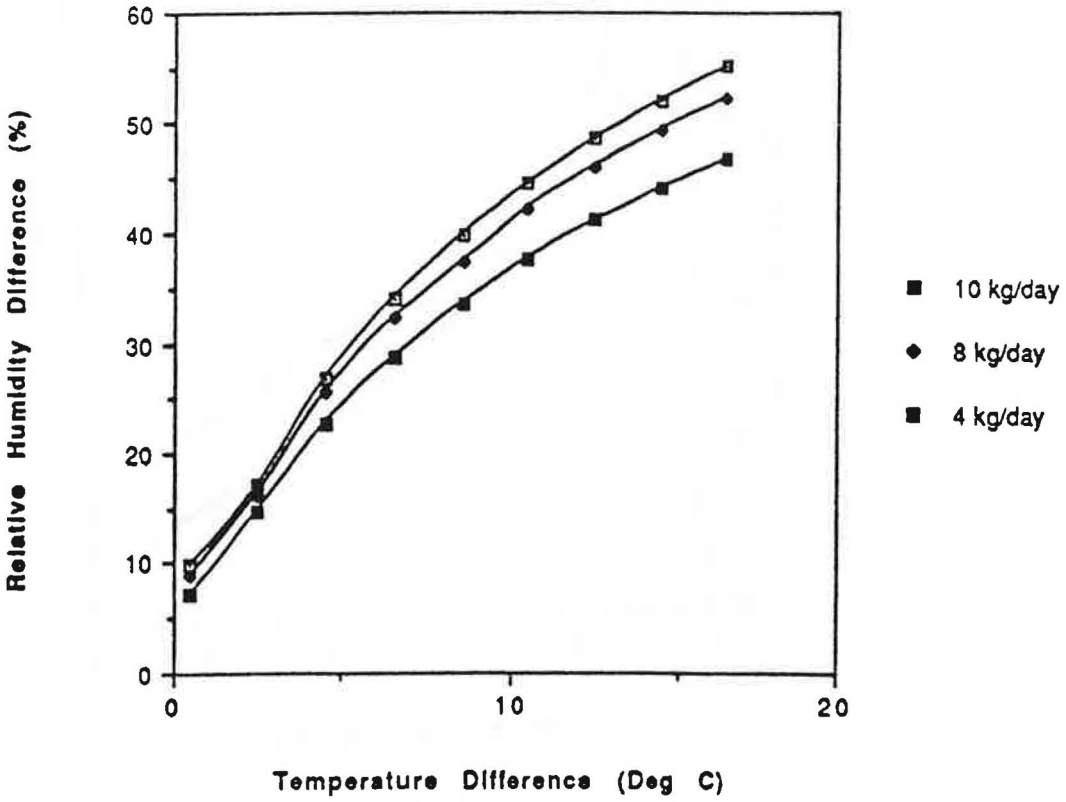

FIG 11C - GRAPH OF VARIATION IN RH. VS VARIATION IN TEMP.
(CASE B = RH3 - RH1)

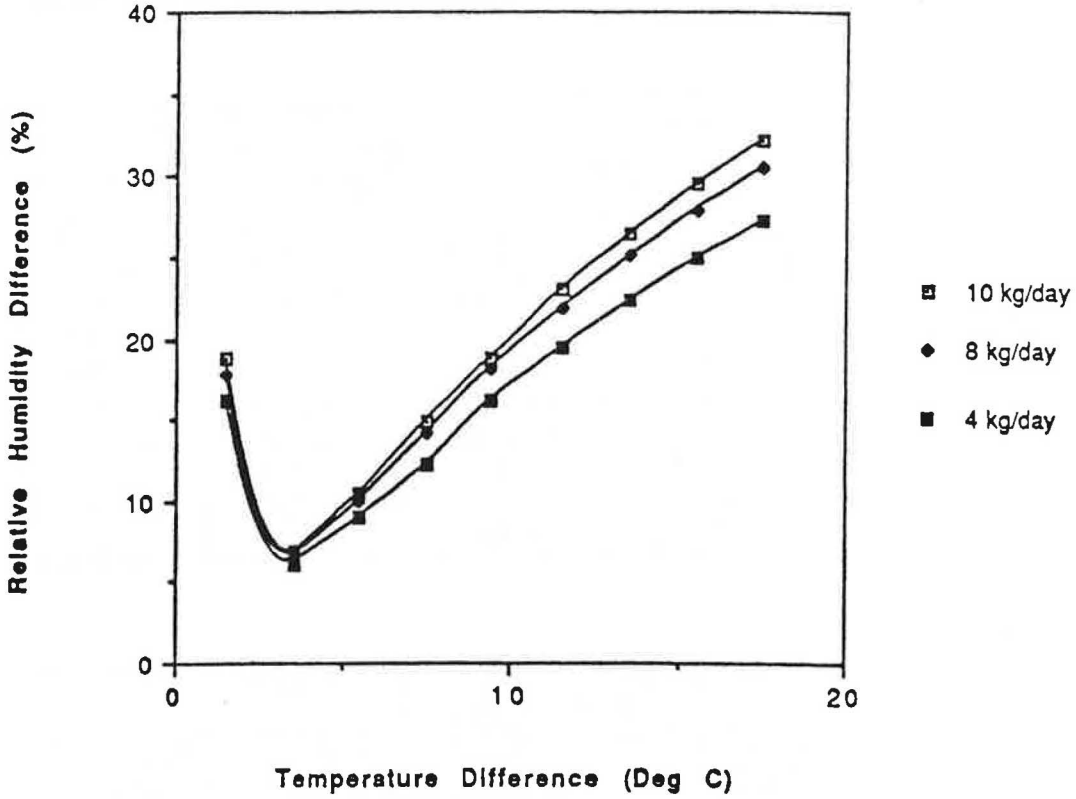

TABLE 1B - DATA FOR GRAPH OF RELATIVE HUMIDITY VS TEMPERATURE IN LOWER FLOOR			
TEMPERATURE	RELATIVE HUMIDITY		
	@ 4KG/DAY	@ 8KG/DAY	@ 10KG/DAY
12.5	74.578	90.467	98.223
14.5	64.498	77.100	83.250
16.5	56.290	66.428	71.419
18.5	49.227	57.659	61.774
20.5	43.311	50.346	53.779
22.5	38.251	44.177	47.070
24.5	33.881	38.912	41.367
26.5	30.089	34.386	36.484
28.5	26.800	30.488	32.292

TABLE 2B - DATA FOR GRAPH OF RELATIVE HUMIDITY VS TEMPERATURE IN UPPER FLOOR			
TEMPERATURE	RELATIVE HUMIDITY		
	@ 4KG/DAY	@ 8KG/DAY	@ 10KG/DAY
12	75.038	89.505	96.506
13.5	67.029	78.900	84.645
15.0	60.278	70.207	75.012
16.5	54.362	62.770	66.839
18.0	49.236	56.439	59.925
19.5	44.168	50.439	53.895
21.0	40.656	46.065	48.682
22.5	37.052	41.787	44.070
24.0	33.848	38.008	40.020

TABLE 3B - DATA FOR RELATIVE HUMIDITY DIFF VS TEMPERATURE DIFF			
TEMPERATURE	DIFFERENCE IN RELATIVE HUMIDITY		
DIFFERENCE	@ 4KG/DAY	@ 8KG/DAY	@ 10KG/DAY
0.5	0.460	0.960	1.400
1.0	2.530	3.100	3.400
1.5	4.080	4.500	4.900
2.0	5.140	5.600	6.100
2.5	5.930	6.390	6.810
3.0	6.410	6.810	7.320
3.5	6.770	7.150	7.650
4.0	6.960	7.400	7.850
4.5	7.050	7.520	7.950

TABLE 4B - DATA FOR THE EFFECT OF INTERFLOW IN LOWER FLOOR		
TEMPERATURE	RELATIVE HUMIDITY	
	(FLOW)	(NO FLOW)
12.5	98.223	122.59
14.5	83.25	102.09
16.5	71.419	86.385
18.5	61.774	73.891
20.5	53.779	63.739
22.5	47.069	55.353
24.5	41.367	48.321
26.5	36.484	42.366
28.5	32.292	37.303

TABLE 5B - DATA FOR THE EFFECT OF INTERFLOW IN UPPER FLOOR		
TEMPERATURE	RELATIVE HUMIDITY	
	(FLOW)	(NO FLOW)
12.0	96.506	80.877
13.5	84.645	71.934
15.0	75.012	64.463
16.5	66.839	57.964
18.0	59.925	52.363
19.5	53.895	47.398
21.0	48.682	43.053
22.5	44.070	39.167
24.0	40.019	37.222

TABLE 6B - DATA FOR GRAPH OF VARIATION IN RH VS VARIATION IN TEMP (CASE B)			
TEMPERATURE	RELATIVE HUMIDITY		
	@ 4KG/DAY	@ 8KG/DAY	@ 10KG/DAY
0.5	0.460	0.963	1.720
2.5	2.530	2.092	1.840
4.5	3.890	3.934	3.920
6.5	4.780	5.115	5.250
8.5	5.430	5.965	6.200
10.5	5.800	6.465	6.770
12.5	6.060	6.812	7.160
14.5	6.170	6.971	7.340
16.5	6.200	7.024	7.410

TABLE 7B - CALCULATION FOR THE RH OF THE LOWER FLOOR AT A MOISTURE RELEASE RATE OF 4KG/DAY							
LOW. TEMP(K	UPP. TEMP(K	TEMP. DIFF.	AVG TEMP.	Cd	F12 = F21	F01 = F10	A1
285.50	285.00	0.50	285.25	0.60869	0.05668	0.01105	0.00113
287.50	286.50	1.00	287.00	0.49091	0.06445	0.01243	0.00128
289.50	288.00	1.50	288.75	0.43322	0.06944	0.01368	0.00139
291.50	289.50	2.00	290.50	0.39667	0.07320	0.01482	0.00147
293.50	291.00	2.50	292.25	0.37061	0.07623	0.01588	0.00154
295.50	292.50	3.00	294.00	0.35070	0.07879	0.01687	0.00159
297.50	294.00	3.50	295.75	0.33481	0.08100	0.01781	0.00165
299.50	295.50	4.00	297.50	0.32169	0.08296	0.01870	0.00169
301.50	297.00	4.50	299.25	0.31062	0.08471	0.01955	0.00174

F02 = F20	A2	K1	PV1 (Pa)	PV1 (Bar)	RH (%)	LOW.TEMP(C)
0.01779	0.00074	1.73414	1080.63145	0.01081	74.57774	12.5
0.01960	0.00084	1.55561	1064.53988	0.01065	64.49802	14.5
0.02126	0.00091	1.42552	1054.58383	0.01055	56.19951	16.5
0.02280	0.00096	1.32449	1048.29269	0.01048	49.22718	18.5
0.02424	0.00100	1.24291	1044.44643	0.01044	43.31107	20.5
0.02560	0.00104	1.17517	1042.33618	0.01042	38.25087	22.5
0.02688	0.00108	1.11773	1041.51331	0.01042	33.88137	24.5
0.02812	0.00111	1.06820	1041.67699	0.01042	30.08888	26.5
0.02930	0.00114	1.02492	1042.61657	0.01043	26.79559	28.5

TABLE 8B - CALCULATION FOR THE RH OF THE LOWER FLOOR AT A MOISTURE RELEASE RATE OF 8KG/DAY							
LOW. TEMP(K)	UPP. TEMP(K)	TEMP. DIFF.	AVG TEMP.	Cd	F12 - F21	F01 - F10	A1
285.5	285.0	0.5	285.25	0.60869	0.05668	0.01105	0.00113
287.5	286.5	1.0	287.00	0.49091	0.06445	0.01243	0.00128
289.5	288.0	1.5	288.75	0.43322	0.06944	0.01368	0.00139
291.5	289.5	2.0	290.50	0.39667	0.07320	0.01482	0.00147
293.5	291.0	2.5	292.25	0.37061	0.07623	0.01588	0.00154
295.5	292.5	3.0	294.00	0.35070	0.07879	0.01687	0.00159
297.5	294.0	3.5	295.75	0.33481	0.08100	0.01781	0.00165
299.5	295.5	4.0	297.50	0.32169	0.08296	0.01870	0.00169
301.5	297.0	4.5	299.25	0.31062	0.08471	0.01955	0.00174

F02 - F20	A2	K1	PV1 (Pa)	PV1 (Bar)	RH (%)	LOW. TEMP(C)
0.01779	0.00074	3.48353	1310.87804	0.01311	90.46777	12.5
0.01960	0.00084	3.12496	1272.53799	0.01273	77.10015	14.5
0.02126	0.00091	2.86362	1246.51236	0.01247	66.42752	16.5
0.02280	0.00096	2.66064	1227.84667	0.01228	57.65892	18.5
0.02424	0.00100	2.49672	1214.09195	0.01214	50.34592	20.5
0.02560	0.00104	2.36062	1203.82470	0.01204	44.17705	22.5
0.02689	0.00108	2.24521	1196.14387	0.01196	38.91164	24.5
0.02812	0.00111	2.14569	1190.44518	0.01190	34.38605	26.5
0.02930	0.00114	2.05871	1186.30541	0.01186	30.48845	28.5

TABLE 9B - CALCULATION FOR THE RH OF THE LOWER FLOOR AT A MOISTURE RELEASE RATE OF 10KG/DAY							
LOW. TEMP(K)	UPP. TEMP(K)	TEMP. DIFF.	AVG TEMP.	Qd	F12 - F21	F01 - F10	A1
285.5	285.0	0.5	285.25	0.60869	0.05668	0.01105	0.00113
287.5	286.5	1.0	287.00	0.49091	0.06445	0.01243	0.00128
289.5	288.0	1.5	288.75	0.43322	0.06944	0.01368	0.00139
291.5	289.5	2.0	290.50	0.39667	0.07320	0.01482	0.00147
293.5	291.0	2.5	292.25	0.37061	0.07623	0.01588	0.00154
295.5	292.5	3.0	294.00	0.35070	0.07879	0.01687	0.00159
297.5	294.0	3.5	295.75	0.33481	0.08100	0.01781	0.00165
299.5	295.5	4.0	297.50	0.32169	0.08296	0.01870	0.00169
301.5	297.0	4.5	299.25	0.31062	0.08471	0.01955	0.00174

F02 - F20	A2	K1	PV1 (Pa)	PV1 (Bar)	RH (%)	LOW. TEMP(C)
0.01779	0.00074	4.33738	1423.25820	0.01423	98.22348	12.5
0.01960	0.00084	3.89084	1374.04607	0.01374	83.25029	14.5
0.02126	0.00091	3.56547	1340.18057	0.01340	71.41916	16.5
0.02280	0.00096	3.31278	1315.48176	0.01315	61.77421	18.5
0.02424	0.00100	3.10872	1296.89802	0.01297	53.77972	20.5
0.02560	0.00104	2.93930	1282.65633	0.01283	47.06996	22.5
0.02689	0.00108	2.79564	1271.63460	0.01272	41.36742	24.5
0.02812	0.00111	2.67177	1263.08039	0.01263	36.48412	26.5
0.02930	0.00114	2.56350	1256.46679	0.01256	32.29162	28.5

TABLE 10B - CALCULATION FOR THE RH OF THE UPPER FLOOR AT A MOISTURE RELEASE RATE OF 4KG/DAY							
LOW. TEMP(K)	UPP. TEMP(K)	TEMP. DIFF.	AVG TEMP.	Cd	F12 = F21	F01 = F10	A1
285.5	285.00	0.50	285.25	0.60869	0.05668	0.01105	0.00113
287.5	286.50	1.00	287.00	0.49091	0.06445	0.01243	0.00128
289.5	288.00	1.50	288.75	0.43322	0.06944	0.01368	0.00139
291.5	289.50	2.00	290.50	0.39667	0.07320	0.01482	0.00147
293.5	291.00	2.50	292.25	0.37061	0.07623	0.01588	0.00154
295.5	292.50	3.00	294.00	0.35070	0.07879	0.01687	0.00159
297.5	294.00	3.50	295.75	0.33481	0.08100	0.01781	0.00165
299.5	295.50	4.00	297.50	0.32169	0.08296	0.01870	0.00169
301.5	297.00	4.50	299.25	0.31062	0.08471	0.01955	0.00174

F02 = F20	A2	K2	PV2 (Pa)	PV2 (Bar)	RH (%)	UPP. TEMP(C)
0.01779	0.00074	1.52514	1051.28021	0.01051	75.03785	12.0
0.01960	0.00084	1.37466	1036.93861	0.01037	67.02900	13.5
0.02126	0.00091	1.25989	1027.12920	0.01027	60.27754	15.0
0.02280	0.00096	1.16914	1020.36696	0.01020	54.36159	16.5
0.02424	0.00100	1.09515	1015.72896	0.01016	49.23553	18.0
0.02560	0.00104	1.03338	1012.63433	0.01013	44.66848	19.5
0.02689	0.00108	0.98079	1010.70054	0.01011	40.65569	21.0
0.02812	0.00111	0.93534	1009.66491	0.01010	37.05192	22.5
0.02930	0.00114	0.89554	1009.34061	0.01009	33.84777	24.0

TABLE 11B - CALCULATION FOR THE RH OF THE UPPER FLOOR AT A MOISTURE RELEASE RATE OF 8KG/DAY							
LOW. TEMP(K)	UPP. TEMP(K)	TEMP. DIFF.	AVG TEMP.	Qd	F12 - F21	F01 - F10	A1
285.5	285.00	0.50	285.25	0.60869	0.05668	0.01105	0.00113
287.5	286.50	1.00	287.00	0.49091	0.06445	0.01243	0.00128
289.5	288.00	1.50	288.75	0.43322	0.06944	0.01368	0.00139
291.5	289.50	2.00	290.50	0.39667	0.07320	0.01482	0.00147
293.5	291.00	2.50	292.25	0.37061	0.07623	0.01588	0.00154
295.5	292.50	3.00	294.00	0.35070	0.07879	0.01687	0.00159
297.5	294.00	3.50	295.75	0.33481	0.08100	0.01781	0.00165
299.5	295.50	4.00	297.50	0.32169	0.08296	0.01870	0.00169
301.5	297.00	4.50	299.25	0.31062	0.08471	0.01955	0.00174

F02 - F20	A2	K2	PV2 (Pa)	PV2 (Bar)	RH (%)	UPP. TEMP(C)
0.01779	0.00074	3.06780	1253.96262	0.01254	89.50483	12.0
0.01960	0.00084	2.76510	1220.58290	0.01221	78.89999	13.5
0.02126	0.00091	2.53426	1196.32536	0.01196	70.20689	15.0
0.02280	0.00096	2.35175	1178.19781	0.01178	62.77026	16.5
0.02424	0.00100	2.20298	1164.34290	0.01164	56.43931	18.0
0.02560	0.00104	2.07873	1153.59204	0.01154	50.88628	19.5
0.02689	0.00108	1.97298	1145.17577	0.01145	46.06499	21.0
0.02812	0.00111	1.88157	1138.56576	0.01139	41.78223	22.5
0.02930	0.00114	1.80153	1133.38628	0.01133	38.00759	24.0

TABLE 12B - CALCULATION FOR THE RH OF THE UPPER FLOOR AT A MOISTURE RELEASE RATE OF 10KG/DAY							
LOW. TEMP(K)	UPP. TEMP(K)	TEMP. DIFF.	AVG TEMP.	Qd	F12 - F21	F01 - F10	A1
285.5	285.0	0.5	285.25	0.60869	0.05668	0.01105	0.00113
287.5	286.5	1.0	287.00	0.49091	0.06445	0.01243	0.00128
289.5	288.0	1.5	288.75	0.43322	0.06944	0.01368	0.00139
291.5	289.5	2.0	290.50	0.39667	0.07320	0.01482	0.00147
293.5	291.0	2.5	292.25	0.37061	0.07623	0.01588	0.00154
295.5	292.5	3.0	294.00	0.35070	0.07879	0.01687	0.00159
297.5	294.0	3.5	295.75	0.33481	0.08100	0.01781	0.00165
299.5	295.5	4.0	297.50	0.32169	0.08296	0.01870	0.00169
301.5	297.0	4.5	299.25	0.31062	0.08471	0.01955	0.00174

F02 - F20	A2	K2	PV2 (Pa)	PV2 (Bar)	RH (%)	UPP. TEMP(C)
0.01779	0.00074	3.81441	1352.05501	0.01352	96.50642	12.0
0.01960	0.00084	3.43806	1309.46439	0.01309	84.64540	13.5
0.02126	0.00091	3.15100	1278.20851	0.01278	75.01224	15.0
0.02280	0.00096	2.92403	1254.57361	0.01255	66.83930	16.5
0.02424	0.00100	2.73899	1236.25148	0.01236	59.92494	18.0
0.02560	0.00104	2.58448	1221.78938	0.01222	53.89455	19.5
0.02689	0.00108	2.45297	1210.23057	0.01210	48.68184	21.0
0.02812	0.00111	2.33928	1200.91810	0.01201	44.07039	22.5
0.02930	0.00114	2.23974	1193.38470	0.01193	40.01961	24.0

TABLE 1C - DATA FOR GRAPH OF RH VS TEMP AT ZONE 1			
TEMPERATURE	RELATIVE HUMIDITY		
	@ 4KG/DAY	@ 8KG/DAY	@ 10KG/DAY
12.5	69.296	79.777	85.015
14.5	58.016	66.211	70.306
16.5	50.414	57.138	60.497
18.5	44.237	49.848	52.651
20.5	39.019	43.751	46.116
22.5	34.556	38.58	40.59
24.5	30.692	34.136	35.856
26.5	27.327	30.29	31.771
28.5	24.395	26.958	28.238

TABLE 2C - DATA FOR GRAPH OF RH VS TEMP AT ZONE 2			
TEMPERATURE	RELATIVE HUMIDITY		
	@ 4 KG/DAY	@ 8 KG/DAY	@ 10KG/DAY
12	70.600	80.490	85.426
13	65.674	74.330	78.650
14	61.282	68.929	72.745
15	57.244	64.045	67.479
16	53.558	59.644	62.682
17	50.185	55.661	58.394
18	47.047	51.993	54.461
19	44.174	48.659	50.898
20	41.502	45.583	47.619

TABLE 3C - DATA FOR GRAPH OF RH VS TEMP AT ZONE 3			
TEMPERATURE	RELATIVE HUMIDITY		
	@ 4 KG/DAY	@ 8KG/DAY	@ 10KG/DAY
11.5	73.036	83.467	88.684
12.0	64.129	72.739	77.045
12.5	60.252	67.914	71.745
13.0	57.503	64.470	67.954
13.5	55.193	61.595	64.795
14.0	53.198	59.128	62.093
14.5	51.313	56.827	59.585
15.0	49.608	54.761	57.338
15.5	47.966	52.794	55.208

TABLE 4C - DATA FOR GRAPH OF RH2 - RH1 VS TEMP DIFF			
TEMPERATURE	RELATIVE HUMIDITY		
	@ 4KG/DAY	@ 8KG/DAY	@ 10KG/DAY
0.5	1.304	0.713	0.411
1.5	7.658	8.119	8.344
2.5	10.868	11.791	12.248
3.5	13.007	14.197	14.828
4.5	14.539	15.893	16.566
5.5	15.629	17.081	17.804
6.5	16.355	17.857	18.605
7.5	16.847	18.369	19.127
8.5	17.107	18.625	19.381

TABLE 5C - DATA FOR GRAPH OF RH3 - RH1 VS TEMP DIFF			
TEMPERATURE	RELATIVE HUMIDITY		
	@ 4KG/DAY	@ 8KG/DAY	@ 10KG/DAY
1.0	3.740	3.690	3.669
2.5	6.113	6.528	6.739
4.0	9.868	10.776	11.248
5.5	13.266	14.822	15.303
6.5	16.174	17.844	18.679
8.5	18.642	20.548	21.503
10.0	20.621	22.691	23.729
11.5	22.281	24.471	25.567
13.0	23.570	25.836	26.970

TABLE 6C - DATA FOR GRAPH OF RH3 - RH2 VS TEMP DIFF			
TEMPERATURE	RELATIVE HUMIDITY		
	@ 4KG/DAY	@ 8KG/DAY	@ 10KG/DAY
0.5	2.436	2.977	3.528
1.0	-1.545	-1.591	-1.605
1.5	-1.030	-1.015	-1.000
2.0	0.259	0.425	0.475
2.5	1.635	1.951	2.114
3.0	3.013	3.467	3.699
3.5	4.266	4.834	5.124
4.0	5.434	6.012	6.440
4.5	6.464	7.211	7.589

TABLE 7C - DATA FOR INTERZONAL AND NO INTERZONAL AIR FLOW

ZONE 1			ZONE 2			ZONE 3		
TEMPERATURE	RELATIVE HUMIDITY		TEMPERATURE	RELATIVE HUMIDITY		TEMPERATURE	RELATIVE HUMIDITY	
	NO INTERFLOW	INTERFLOW		NO INTERFLOW	INTERFLOW		NO INTERFLOW	INTERFLOW
12.5	88.213	85.015	12	87.41	85.426	11.5	80.735	88.684
15.5	75.555	70.306	13	80.181	78.65	12	77.696	77.045
16.5	65.383	60.497	14	73.938	72.745	12.5	74.697	71.745
18.5	56.948	52.651	15	68.384	67.479	13	71.939	67.954
20.5	49.843	46.116	16	63.442	62.682	13.5	69.305	64.795
22.5	43.815	40.59	17	59.014	58.394	14	66.869	62.093
24.5	38.646	35.856	18	54.972	54.461	14.5	64.473	59.585
26.5	34.189	31.771	19	51.323	50.898	15	62.251	57.338
28.5	30.341	28.238	20	47.976	47.619	15.5	60.082	55.208

TABLE 8C - DATA FOR GRAPH OF RH1 - RH2 VS TEMP DIFF (CASE B - 3 ZONE)			
TEMPERATURE	RELATIVE HUMIDITY DIFFERENCE		
(Z1 - Z2)	@ 10KG/DAY	@ 8KG/DAY	@ 4KG/DAY
0.5	9.867	8.966	7.171
2.5	17.03	16.257	14.698
4.5	26.85	25.491	22.762
6.5	34.014	32.251	28.716
8.5	39.78	37.355	33.556
10.5	44.564	42.255	37.616
12.5	48.625	46.119	41.086
14.5	52.098	49.433	44.081
16.5	55.079	52.285	46.673

TABLE 9C - DATA FOR GRAPH OF RH1 - RH3 VS TEMP DIFF (CASE B - 3 ZONE)			
TEMPERATURE	RELATIVE HUMIDITY DIFFERENCE		
(Z1 - Z3)	@ 10KG/DAY	@ 8KG/DAY	@ 4KG/DAY
1.5	18.754	17.862	16.087
3.5	6.884	6.625	6.113
5.5	10.488	9.993	9.011
7.5	14.918	14.162	12.184
9.5	18.831	18.169	16.187
11.5	23.008	21.809	19.417
13.5	26.444	25.07	22.325
15.5	29.495	27.972	24.927
17.5	32.184	30.533	27.236

TABLE 10C - CALCULATION FOR THE RH OF THE THREE ZONES WITH A MOISTURE RELEASE RATE OF 4KG/DAY							
TEMP(ZONE1)	TEMP(ZONE2)	TEMP(ZONE3)	TEMP (1 - 2)	TEMP (1 - 3)	TEMP (2 - 3)	T1	T2
285.5	285	284.5	0.5	1.0	0.5	285.25	285.00
287.5	286	285.0	1.5	2.5	1.0	286.75	286.25
289.5	287	285.5	2.5	4.0	1.5	288.25	287.50
291.5	288	286.0	3.5	5.5	2.0	289.75	288.75
293.5	289	286.5	4.5	7.0	2.5	291.25	290.00
295.5	290	287.0	5.5	8.5	3.0	292.75	291.25
297.5	291	287.5	6.5	10.0	3.5	294.25	292.50
299.5	292	288.0	7.5	11.5	4.0	295.75	293.75
301.5	293	288.5	8.5	13.0	4.5	297.25	295.00

T3	Cd 12	Cd 13	Cd 23	F12 - F21	F13 - F31	F23 - F32	F10 - FO1
284.75	0.60869	0.48984	0.60835	0.05668	0.06453	0.05670	0.01105
285.50	0.43228	0.36821	0.49011	0.06953	0.07653	0.06451	0.01243
286.25	0.36901	0.31827	0.43205	0.07643	0.08349	0.06956	0.01368
287.00	0.33266	0.28847	0.39517	0.08131	0.08854	0.07337	0.01482
287.75	0.30800	0.26786	0.36881	0.08515	0.09255	0.07645	0.01588
288.50	0.28971	0.25240	0.34864	0.08832	0.09590	0.07907	0.01687
289.25	0.27539	0.24021	0.33248	0.09103	0.09878	0.08134	0.01781
290.00	0.26375	0.23023	0.31913	0.09341	0.10131	0.08336	0.01870
290.75	0.25402	0.22186	0.30783	0.09553	0.10358	0.08517	0.01955

CONTINUATION OF TABLE 10C

F20 - F02	F30 - F03	A1	A2	A3	K1	K2	K3
0.02134	0.01028	0.00220	0.00112	0.00219	0.08352	0.42855	0.48793
0.02282	0.01067	0.00264	0.00131	0.00253	0.07843	0.43872	0.48285
0.02420	0.01105	0.00289	0.00142	0.00273	0.07879	0.44027	0.48095
0.02551	0.01141	0.00308	0.00150	0.00289	0.08024	0.44031	0.47945
0.02675	0.01176	0.00323	0.00157	0.00301	0.08203	0.43985	0.47812
0.02794	0.01210	0.00335	0.00163	0.00312	0.08391	0.43919	0.47690
0.02908	0.01243	0.00346	0.00168	0.00321	0.08579	0.43845	0.47576
0.03018	0.01275	0.00356	0.00172	0.00329	0.08763	0.43768	0.47470
0.03124	0.01307	0.00364	0.00177	0.00336	0.08942	0.43689	0.47369

K4	M1	M2	M3	M4	N1	N2	N3
0.17466	0.15843	0.42072	0.42086	0.11424	0.07819	0.49070	0.43111
0.14574	0.14545	0.44329	0.41126	0.09811	0.07034	0.50444	0.42522
0.13306	0.14220	0.44909	0.40871	0.09043	0.06731	0.50880	0.42388
0.12508	0.14157	0.45127	0.40716	0.08541	0.06582	0.51087	0.42330
0.11933	0.14204	0.45205	0.40591	0.08171	0.06505	0.51200	0.42295
0.11488	0.14306	0.45214	0.40480	0.07879	0.06468	0.51264	0.42267
0.11126	0.14437	0.45187	0.40376	0.07639	0.06456	0.51300	0.42244
0.10823	0.14584	0.45137	0.40279	0.07437	0.06460	0.51317	0.42222
0.10564	0.14740	0.45074	0.40186	0.07261	0.06476	0.51323	0.42202

CONTINUATION OF TABLE 10C

N4	X1	X2	Y1	Y2	Z1	Z2	PV1 (Pa)
0.05897	1	1.05195	1.00040	1.07777	1.00019	1.15135	1004.09397
0.05111	1	0.98035	0.91433	0.91677	0.95863	1.01850	957.84489
0.04726	1	0.92065	0.89419	0.84227	0.94911	0.94348	946.26548
0.04474	1	0.87062	0.88616	0.78987	0.94542	0.88712	942.01702
0.04290	1	0.82796	0.88260	0.74871	0.94387	0.84148	940.94446
0.04145	1	0.79102	0.88114	0.71467	0.94332	0.80311	941.64294
0.04027	1	0.75864	0.88081	0.68567	0.94329	0.77010	943.46789
0.03928	1	0.72993	0.88112	0.66045	0.94357	0.74122	946.06957
0.03842	1	0.70425	0.88183	0.63817	0.94402	0.71562	949.23691

PV2 (Pa)	PV3 (Pa)	PV1 (Bar)	PV2 (Bar)	PV3 (Bar)	RH%(ZONE 1)	RH%(ZONE 2)	RH%(ZONE 3)
989.10971	991.09950	0.01004	0.00989	0.00991	69.29565	70.60027	73.03607
983.13994	898.44995	0.00958	0.00983	0.00898	58.01604	65.67401	64.12919
978.67925	873.05490	0.00946	0.00979	0.00873	50.41372	61.28236	60.25224
975.44614	860.81993	0.00942	0.00975	0.00861	44.23654	57.24449	57.50300
973.14938	853.84062	0.00941	0.00973	0.00854	39.01905	53.55803	55.19332
971.57916	849.57831	0.00942	0.00972	0.00850	34.55570	50.18487	53.19839
970.58483	846.92868	0.00943	0.00971	0.00847	30.69186	47.04725	51.31346
970.05588	845.32303	0.00946	0.00970	0.00845	27.32726	44.17376	49.60816
969.90933	844.43484	0.00949	0.00970	0.00844	24.39571	41.50232	47.96563

CONTINUATION OF TABLE 11C

F20 - F02	F30 - F03	A1	A2	A3	K1	K2	K3
0.02134	0.01028	0.00220	0.00112	0.00219	0.08352	0.42855	0.48793
0.02282	0.01067	0.00264	0.00131	0.00253	0.07843	0.43872	0.48285
0.02420	0.01105	0.00289	0.00142	0.00273	0.07879	0.44027	0.48095
0.02551	0.01141	0.00308	0.00150	0.00289	0.08024	0.44031	0.47945
0.02675	0.01176	0.00323	0.00157	0.00301	0.08203	0.43985	0.47812
0.02794	0.01210	0.00335	0.00163	0.00312	0.08391	0.43919	0.47690
0.02908	0.01243	0.00346	0.00168	0.00321	0.08579	0.43845	0.47576
0.03018	0.01275	0.00356	0.00172	0.00329	0.08763	0.43768	0.47470
0.03124	0.01307	0.00364	0.00177	0.00336	0.08942	0.43689	0.47369

K4	M1	M2	M3	M4	N1	N2	N3
0.35008	0.15843	0.42072	0.42086	0.22937	0.07819	0.49070	0.43111
0.29212	0.14545	0.44329	0.41126	0.19699	0.07034	0.50444	0.42522
0.26670	0.14220	0.44909	0.40871	0.18156	0.06731	0.50880	0.42388
0.25071	0.14157	0.45127	0.40716	0.17149	0.06582	0.51087	0.42330
0.23918	0.14204	0.45205	0.40591	0.16405	0.06505	0.51200	0.42295
0.23025	0.14306	0.45214	0.40480	0.15820	0.06468	0.51264	0.42267
0.22300	0.14437	0.45187	0.40376	0.15338	0.06456	0.51300	0.42244
0.21694	0.14584	0.45137	0.40279	0.14931	0.06460	0.51317	0.42222
0.21174	0.14740	0.45074	0.40186	0.14579	0.06476	0.51323	0.42202

TABLE 11C - CALCULATION FOR THE RH OF THE THREE ZONES WITH A MOISTURE RELEASE OF 10KG/DAY							
TEMP(ZONE1)	TEMP(ZONE2)	TEMP(ZONE3)	TEMP (1 - 2)	TEMP (1 - 3)	TEMP (2 - 3)	T1	T2
285.5	285	284.5	0.5	1.0	0.5	285.25	285.00
287.5	286	285.0	1.5	2.5	1.0	286.75	286.25
289.5	287	285.5	2.5	4.0	1.5	288.25	287.50
291.5	288	286.0	3.5	5.5	2.0	289.75	288.75
293.5	289	286.5	4.5	7.0	2.5	291.25	290.00
295.5	290	287.0	5.5	8.5	3.0	292.75	291.25
297.5	291	287.5	6.5	10.0	3.5	294.25	292.50
299.5	292	288.0	7.5	11.5	4.0	295.75	293.75
301.5	293	288.5	8.5	13.0	4.5	297.25	295.00

T3	Cd 12	Cd 13	Cd 23	F12 = F21	F13 = F31	F23 = F32	F10 = FO1
284.75	0.60869	0.48984	0.60835	0.05668	0.06453	0.05670	0.01105
285.50	0.43228	0.36821	0.49011	0.06953	0.07653	0.06451	0.01243
286.25	0.36901	0.31827	0.43205	0.07643	0.08349	0.06956	0.01368
287.00	0.33266	0.28847	0.39517	0.08131	0.08854	0.07337	0.01482
287.75	0.30800	0.26786	0.36881	0.08515	0.09255	0.07645	0.01588
288.50	0.28971	0.25240	0.34864	0.08832	0.09590	0.07907	0.01687
289.25	0.27539	0.24021	0.33248	0.09103	0.09878	0.08134	0.01781
290.00	0.26375	0.23023	0.31913	0.09341	0.10131	0.08336	0.01870
290.75	0.25402	0.22186	0.30783	0.09553	0.10358	0.08517	0.01955

CONTINUATION OF TABLE 11C

X1	X2	Y1	Y2	Z1	Z2	PV1 (Pa)
1	2.10653	1.00040	2.15705	1.00019	2.30533	1155.97526
1	1.96313	0.91433	1.83488	0.95863	2.03935	1093.14487
1	1.84358	0.89419	1.68578	0.94911	1.88914	1072.47181
1	1.74338	0.88616	1.58089	0.94542	1.77628	1061.50381
1	1.65795	0.88260	1.49850	0.94387	1.68489	1055.06097
1	1.58399	0.88114	1.43037	0.94332	1.60807	1051.29878
1	1.51914	0.88081	1.37232	0.94329	1.54197	1049.32801
1	1.46166	0.88112	1.32182	0.94357	1.48414	1048.64399
1	1.41024	0.88183	1.27724	0.94402	1.43288	1048.92982

PV3 (Pa)	PV1 (Bar)	PV2 (Bar)	PV3 (Bar)	RH%(ZONE 1)	RH%(ZONE 2)	RH%(ZONE 3)
1132.65229	0.01156	0.01128	0.01133	79.77745	80.49009	83.46738
1019.07534	0.01093	0.01113	0.01019	66.21108	74.32967	72.73914
984.07321	0.01072	0.01101	0.00984	57.13755	68.92853	67.91396
965.11280	0.01062	0.01091	0.00965	49.84756	64.04466	64.46979
952.87026	0.01055	0.01084	0.00953	43.75123	59.64385	61.59472
944.27048	0.01051	0.01078	0.00944	38.57977	55.66072	59.12777
937.93542	0.01049	0.01073	0.00938	34.13559	51.99262	56.82735
933.13302	0.01049	0.01069	0.00933	30.29012	48.65918	54.76133
929.42962	0.01049	0.01065	0.00929	26.95785	45.58277	52.79350

TABLE 12C - CALCULATION FOR THE RH OF THE THREE ZONES WITH A MOISTURE RELEASE RATE OF 10KG/DAY							
TEMP(ZONE1)	TEMP(ZONE2)	TEMP(ZONE3)	TEMP (1 - 2)	TEMP (1 - 3)	TEMP (2 - 3)	T1	T2
285.5	285	284.5	0.5	1.0	0.5	285.25	285.00
287.5	286	285.0	1.5	2.5	1.0	286.75	286.25
289.5	287	285.5	2.5	4.0	1.5	288.25	287.50
291.5	288	286.0	3.5	5.5	2.0	289.75	288.75
293.5	289	286.5	4.5	7.0	2.5	291.25	290.00
295.5	290	287.0	5.5	8.5	3.0	292.75	291.25
297.5	291	287.5	6.5	10.0	3.5	294.25	292.50
299.5	292	288.0	7.5	11.5	4.0	295.75	293.75
301.5	293	288.5	8.5	13.0	4.5	297.25	295.00

T3	Cd 12	Cd 13	Cd 23	F12 = F21	F13 = F31	F23 = F32	F10 = FO1
284.75	0.60869	0.48984	0.60835	0.05668	0.06453	0.05670	0.01105
285.50	0.43228	0.36821	0.49011	0.06953	0.07653	0.06451	0.01243
286.25	0.36901	0.31827	0.43205	0.07643	0.08349	0.06956	0.01368
287.00	0.33266	0.28847	0.39517	0.08131	0.08854	0.07337	0.01482
287.75	0.30800	0.26786	0.36881	0.08515	0.09255	0.07645	0.01588
288.50	0.28971	0.25240	0.34864	0.08832	0.09590	0.07907	0.01687
289.25	0.27539	0.24021	0.33248	0.09103	0.09878	0.08134	0.01781
290.00	0.26375	0.23023	0.31913	0.09341	0.10131	0.08336	0.01870
290.75	0.25402	0.22186	0.30783	0.09553	0.10358	0.08517	0.01955

CONTINUATION OF TABLE 12C

F20 = F02	F30 = F03	A1	A2	A3	K1	K2	K3
0.02134	0.01028	0.00220	0.00112	0.00219	0.08352	0.42855	0.48793
0.02282	0.01067	0.00264	0.00131	0.00253	0.07843	0.43872	0.48285
0.02420	0.01105	0.00289	0.00142	0.00273	0.07879	0.44027	0.48095
0.02551	0.01141	0.00308	0.00150	0.00289	0.08024	0.44031	0.47945
0.02675	0.01176	0.00323	0.00157	0.00301	0.08203	0.43985	0.47812
0.02794	0.01210	0.00335	0.00163	0.00312	0.08391	0.43919	0.47690
0.02908	0.01243	0.00346	0.00168	0.00321	0.08579	0.43845	0.47576
0.03018	0.01275	0.00356	0.00172	0.00329	0.08763	0.43768	0.47470
0.03124	0.01307	0.00364	0.00177	0.00336	0.08942	0.43689	0.47369

K4	M1	M2	M3	M4	N1	N2	N3
0.43779	0.15843	0.42072	0.42086	0.28609	0.07819	0.49070	0.43111
0.36531	0.14545	0.44329	0.41126	0.24570	0.07034	0.50444	0.42522
0.33353	0.14220	0.44909	0.40871	0.22646	0.06731	0.50880	0.42388
0.31352	0.14157	0.45127	0.40716	0.21389	0.06582	0.51087	0.42330
0.29910	0.14204	0.45205	0.40591	0.20461	0.06505	0.51200	0.42295
0.28794	0.14306	0.45214	0.40480	0.19731	0.06468	0.51264	0.42267
0.27887	0.14437	0.45187	0.40376	0.19131	0.06456	0.51300	0.42244
0.27129	0.14584	0.45137	0.40279	0.18623	0.06460	0.51317	0.42222
0.26479	0.14740	0.45074	0.40186	0.18184	0.06476	0.51323	0.42202

CONTINUATION OF TABLE 12C

N4	X1	X2	Y1	Y2	Z1	Z2	PV1 (Pa)
0.14676	1	2.63288	1.00040	2.69681	1.00019	2.88197	1231.87059
0.12722	1	2.45366	0.91433	2.29400	0.95863	2.54943	1160.75007
0.11761	1	2.30425	0.89419	2.10759	0.94911	2.36164	1135.53239
0.11136	1	2.17901	0.88616	1.97646	0.94542	2.22056	1121.20676
0.10677	1	2.07224	0.88260	1.87345	0.94387	2.10631	1112.08070
0.10317	1	1.97980	0.88114	1.78828	0.94332	2.01028	1106.08988
0.10023	1	1.89874	0.88081	1.71571	0.94329	1.92765	1102.22275
0.09776	1	1.82689	0.88112	1.65258	0.94357	1.85535	1099.89724
0.09563	1	1.76262	0.88183	1.59684	0.94402	1.79127	1098.74352

PV2 (Pa)	PV3 (Pa)	PV1 (Bar)	PV2 (Bar)	PV3 (Bar)	RH%(ZONE 1)	RH%(ZONE 2)	RH%(ZONE 3)
1196.82012	1203.44511	0.01232	0.01197	0.01203	85.01522	85.42613	88.68424
1177.39081	1079.39746	0.01161	0.01177	0.01079	70.30588	78.65002	77.04479
1161.73883	1039.59024	0.01136	0.01162	0.01040	60.49720	72.74507	71.74536
1149.15950	1017.26681	0.01121	0.01149	0.01017	52.65117	67.43894	67.95369
1138.92388	1002.39279	0.01112	0.01139	0.01002	46.11572	62.68156	64.79591
1130.50675	991.62459	0.01106	0.01131	0.00992	40.59045	58.39394	62.09296
1123.53105	983.44721	0.01102	0.01124	0.00983	35.85630	54.46103	59.58481
1117.72016	977.04687	0.01100	0.01118	0.00977	31.77057	50.89800	57.33843
1112.86639	971.93629	0.01099	0.01113	0.00972	28.23808	47.61944	55.20797

TABLE 13C - CALCULATION FOR THE RH OF THE ZONES WITH NO INTERFLOW BETWEEN ZONE (3) AND THE OTHER ZONES							
TEMP(ZONE1)	TEMP(ZONE2)	TEMP(ZONE3)	TEMP (1 - 2)	TEMP (1 - 3)	TEMP (2 - 3)	T1	T2
285.5	285	284.5	0.5	1.0	0.5	285.25	285.00
287.5	286	285.0	1.5	2.5	1.0	286.75	286.25
289.5	287	285.5	2.5	4.0	1.5	288.25	287.50
291.5	288	286.0	3.5	5.5	2.0	289.75	288.75
293.5	289	286.5	4.5	7.0	2.5	291.25	290.00
295.5	290	287.0	5.5	8.5	3.0	292.75	291.25
297.5	291	287.5	6.5	10.0	3.5	294.25	292.50
299.5	292	288.0	7.5	11.5	4.0	295.75	293.75
301.5	293	288.5	8.5	13.0	4.5	297.25	295.00

T3	Cd 12	Cd 13	Cd 23	F12 = F21	F13 = F31	F23 = F32	F10 = FO1
284.75	0.60869	0.48984	0.60835	0.05668	0	0	0.01105
285.50	0.43228	0.36821	0.49011	0.06953	0	0	0.01243
286.25	0.36901	0.31827	0.43205	0.07643	0	0	0.01368
287.00	0.33266	0.28847	0.39517	0.08131	0	0	0.01482
287.75	0.30800	0.26786	0.36881	0.08515	0	0	0.01588
288.50	0.28971	0.25240	0.34864	0.08832	0	0	0.01687
289.25	0.27539	0.24021	0.33248	0.09103	0	0	0.01781
290.00	0.26375	0.23023	0.31913	0.09341	0	0	0.01870
290.75	0.25402	0.22186	0.30783	0.09553	0	0	0.01955

CONTINUATION OF TABLE 13C

F20 - F02	F30 - F03	A1	A2	A3	K1	K2	K3
0.02134	0.01028	0.00113	0.00065	0.00017	0.16310	0.83690	0
0.02282	0.01067	0.00137	0.00077	0.00018	0.15167	0.84833	0
0.02420	0.01105	0.00150	0.00084	0.00018	0.15179	0.84821	0
0.02551	0.01141	0.00160	0.00089	0.00019	0.15415	0.84585	0
0.02675	0.01176	0.00168	0.00093	0.00020	0.15718	0.84282	0
0.02794	0.01210	0.00175	0.00097	0.00020	0.16040	0.83960	0
0.02908	0.01243	0.00181	0.00100	0.00021	0.16364	0.83636	0
0.03018	0.01275	0.00187	0.00103	0.00021	0.16681	0.83319	0
0.03124	0.01307	0.00192	0.00106	0.00022	0.16989	0.83011	0

K4	M1	M2	M3	M4	N1	N2	N3
0.85496	0.27355	0.72645	0	0.49398	1	0	0
0.70639	0.24706	0.75294	0	0.41732	1	0	0
0.64256	0.24048	0.75952	0	0.38299	1	0	0
0.60228	0.23880	0.76120	0	0.36078	1	0	0
0.57313	0.23909	0.76091	0	0.34442	1	0	0
0.55044	0.24036	0.75964	0	0.33150	1	0	0
0.53196	0.24214	0.75786	0	0.32086	1	0	0
0.51644	0.24421	0.75579	0	0.31183	1	0	0
0.50310	0.24644	0.75356	0	0.30400	1	0	0

CONTINUATION OF TABLE 13C

N4	X1	X2	Y1	Y2	Z1	Z2	PV1 (Pa)
1.87688	1	2.84427	1	1.87688	1	3.23532	1278.21019
1.80861	1	2.62749	1	1.80861	1	2.93537	1247.41027
1.74728	1	2.44825	1	1.74728	1	2.71919	1227.23631
1.69180	1	2.30035	1	1.69180	1	2.54803	1212.71345
1.64128	1	2.17600	1	1.64128	1	2.40710	1201.96640
1.59504	1	2.06964	1	1.59504	1	2.28811	1193.94645
1.55250	1	1.97734	1	1.55250	1	2.18573	1187.98748
1.51319	1	1.89625	1	1.51319	1	2.09638	1183.63631
1.47672	1	1.82428	1	1.47672	1	2.01745	1180.57011

PV2 (Pa)	PV3 (Pa)	PV1 (Bar)	PV2 (Bar)	PV3 (Bar)	RH%(ZONE 1)	RH%(ZONE 2)	RH%(ZONE 3)
1224.59360	1095.56774	0.01278	0.01225	0.01096	88.21326	87.40854	80.73454
1200.30869	1088.52309	0.01247	0.01200	0.01089	75.55483	80.18094	77.69615
1180.79158	1082.36125	0.01227	0.01181	0.01082	65.38286	73.93811	74.69712
1165.26906	1076.94153	0.01213	0.01165	0.01077	56.94827	68.38433	71.93998
1152.74843	1072.15274	0,01202	0,01153	0,01072	49.84310	63,44240	69,30528
1142.51804	1067.90564	0.01194	0,01143	0.01068	43.81455	59.01436	66.86948
1134.07507	1064.12767	0.01188	0.01134	0.01064	38.64631	54.97213	64.47305
1127.05675	1060.75920	0.01184	0.01127	0.01061	34.18938	51.32317	62.25113
1121.19489	1057.75064	0.01181	0.01121	0.01058	30.34105	47.97582	60.08240

TABLE 14C - CALCULATION FOR THE RH OF THE THREE ZONES WITH A MOISTURE RELEASE RATE OF 4KG/DAY (CASE B)							
TEMP(ZONE1)	TEMP(ZONE2)	TEMP(ZONE3)	TEMP (1 - 2)	TEMP (1 - 3)	TEMP (2 - 3)	T1	T2
285.5	285	284	0.5	1.5	1	285.25	284.75
287.5	285	284	2.5	3.5	1	286.25	285.75
289.5	285	284	4.5	5.5	1	287.25	286.75
291.5	285	284	6.5	7.5	1	288.25	287.75
293.5	285	284	8.5	9.5	1	289.25	288.75
295.5	285	284	10.5	11.5	1	290.25	289.75
297.5	285	284	12.5	13.5	1	291.25	290.75
299.5	285	284	14.5	15.5	1	292.25	291.75
301.5	285	284	16.5	17.5	1	293.25	292.75

T3	Cd 12	Cd 13	Cd 23	F12 = F21	F13 = F31	F23 = F32	F10 = FO1
284.5	0.60869	0.43134	0.48957	0.05668	0.06963	0.06455	0.01105
284.5	0.36821	0.33122	0.48957	0.07653	0.08153	0.06455	0.01243
284.5	0.30667	0.28784	0.48957	0.08537	0.08866	0.06455	0.01368
284.5	0.27362	0.26150	0.48957	0.09138	0.09389	0.06455	0.01482
284.5	0.25186	0.24311	0.48957	0.09602	0.09807	0.06455	0.01588
284.5	0.23599	0.22925	0.48957	0.09983	0.10157	0.06455	0.01687
284.5	0.22370	0.21826	0.48957	0.10307	0.10460	0.06455	0.01781
284.5	0.21378	0.20925	0.48957	0.10590	0.10727	0.06455	0.01870
284.5	0.20552	0.20166	0.48957	0.10842	0.10966	0.06455	0.01955

CONTINUATION OF TABLE 14C

F20 = F02	F30 = F03	A1	A2	A3	K1	K2	K3
0.02134	0.00988	0.00229	0.00119	0.00240	0.08042	0.41265	0.50693
0.02134	0.00988	0.00284	0.00135	0.00260	0.07292	0.44889	0.47820
0.02134	0.00988	0.00313	0.00143	0.00272	0.07287	0.45479	0.47234
0.02134	0.00988	0.00333	0.00148	0.00281	0.07406	0.45670	0.46924
0.02134	0.00988	0.00350	0.00152	0.00288	0.07563	0.45731	0.46707
0.02134	0.00988	0.00364	0.00155	0.00293	0.07730	0.45735	0.46535
0.02134	0.00988	0.00376	0.00157	0.00298	0.07899	0.45712	0.46389
0.02134	0.00988	0.00386	0.00160	0.00303	0.08066	0.45673	0.46261
0.02134	0.00988	0.00396	0.00162	0.00307	0.08228	0.45626	0.46146

K4	M1	M2	M3	M4	N1	N2	N3
0.16819	0.14970	0.39753	0.45277	0.10795	0.06858	0.48332	0.44810
0.13549	0.13140	0.47117	0.39743	0.09475	0.06335	0.52274	0.41391
0.12307	0.12462	0.49845	0.37693	0.08986	0.06058	0.54362	0.39581
0.11545	0.12039	0.51548	0.36413	0.08681	0.05869	0.55780	0.38350
0.11001	0.11732	0.52783	0.35485	0.08460	0.05727	0.56852	0.37421
0.10583	0.11492	0.53751	0.34758	0.08287	0.05613	0.57710	0.36676
0.10245	0.11294	0.54544	0.34161	0.08144	0.05518	0.58425	0.36057
0.09962	0.11128	0.55216	0.33657	0.08024	0.05437	0.59035	0.35527
0.09721	0.10983	0.55797	0.33220	0.07920	0.05367	0.59568	0.35066

CONTINUATION OF TABLE 14C

N4	X1	X2	X2	Y2	Z1	Z2	PV1 (Pa)
0.05383	1	1.06229	1.06229	1.35644	1.12387	1.29416	1128.31228
0.04972	1	1.03473	1.03473	0.86861	0.91534	1.01534	920.26139
0.04755	1	1.00827	1.00827	0.77369	0.88373	0.94707	890.23223
0.04607	1	0.98480	0.98480	0.72325	0.86979	0.90458	878.54346
0.04495	1	0.96387	0.96387	0.68940	0.86195	0.87279	873.40144
0.04406	1	0.94503	0.94503	0.66408	0.85703	0.84707	871.50210
0.04331	1	0.92791	0.92791	0.64393	0.85374	0.82532	871.49561
0.04268	1	0.91223	0.91223	0.62722	0.85146	0.80643	872.71044
0.04212	1	0.89777	0.89777	0.61297	0.84986	0.78969	874.76865

PV2 (Pa)	PV3 (Pa)	PV1 (Bar)	PV2 (Bar)	PV3 (Bar)	RH%(ZONE 1)	RH%(ZONE 2)	RH%(ZONE 3)
990.46794	1232.70191	0.01128	0.00990	0.01233	77.86834	70.69721	93.95594
986.84785	811.51371	0.00920	0.00987	0.00812	55.73964	70.43882	61.85318
983.37069	740.48522	0.00890	0.00983	0.00740	47.42846	70.19063	56.43942
980.28693	707.31808	0.00879	0.00980	0.00707	41.25586	69.97052	53.91144
977.53744	687.56206	0.00873	0.00978	0.00688	36.21818	69.77426	52.40564
975.06190	674.34399	0.00872	0.00975	0.00674	31.98173	69.59757	51.39817
972.81254	664.87321	0.00871	0.00973	0.00665	28.35054	69.43701	50.67631
970.75245	657.77474	0.00873	0.00971	0.00658	25.20827	69.28997	50.13527
968.85291	652.28319	0.00875	0.00969	0.00652	22.48185	69.15438	49.71671

TABLE 15C - CALCULATION FOR THE RH OF THE THREE ZONES WITH A MOISTURE RELEASE RATE OF 8KG/DAY (CASE B)							
TEMP(ZONE1)	TEMP(ZONE2)	TEMP(ZONE3)	TEMP (1 - 2)	TEMP (1 - 3)	TEMP (2 - 3)	T1	T2
285.5	285	284	0.5	1.5	1	285.25	284.75
287.5	285	284	2.5	3.5	1	286.25	285.75
289.5	285	284	4.5	5.5	1	287.25	286.75
291.5	285	284	6.5	7.5	1	288.25	287.75
293.5	285	284	8.5	9.5	1	289.25	288.75
295.5	285	284	10.5	11.5	1	290.25	289.75
297.5	285	284	12.5	13.5	1	291.25	290.75
299.5	285	284	14.5	15.5	1	292.25	291.75
301.5	285	284	16.5	17.5	1	293.25	292.75

T3	Cd 12	Cd 13	Cd 23	F12 - F21	F13 - F31	F23 - F32	F10 - FO1
284.5	0.60869	0.43134	0.48957	0.05668	0.06963	0.06455	0.01105
284.5	0.36821	0.33122	0.48957	0.07653	0.08153	0.06455	0.01243
284.5	0.30667	0.28784	0.48957	0.08537	0.08866	0.06455	0.01368
284.5	0.27362	0.26150	0.48957	0.09138	0.09389	0.06455	0.01482
284.5	0.25186	0.24311	0.48957	0.09602	0.09807	0.06455	0.01588
284.5	0.23599	0.22925	0.48957	0.09983	0.10157	0.06455	0.01687
284.5	0.22370	0.21826	0.48957	0.10307	0.10460	0.06455	0.01781
284.5	0.21378	0.20925	0.48957	0.10590	0.10727	0.06455	0.01870
284.5	0.20552	0.20166	0.48957	0.10842	0.10966	0.06455	0.01955

CONTINUATION OF TABLE 15C

F20 - F02	F30 - F03	A1	A2	A3	K1	K2	K3
0.02134	0.00988	0.00229	0.00119	0.00240	0.08042	0.41265	0.50693
0.02134	0.00988	0.00284	0.00135	0.00260	0.07292	0.44889	0.47820
0.02134	0.00988	0.00313	0.00143	0.00272	0.07287	0.45479	0.47234
0.02134	0.00988	0.00333	0.00148	0.00281	0.07406	0.45670	0.46924
0.02134	0.00988	0.00350	0.00152	0.00288	0.07563	0.45731	0.46707
0.02134	0.00988	0.00364	0.00155	0.00293	0.07730	0.45735	0.46535
0.02134	0.00988	0.00376	0.00157	0.00298	0.07899	0.45712	0.46389
0.02134	0.00988	0.00386	0.00160	0.00303	0.08066	0.45673	0.46261
0.02134	0.00988	0.00396	0.00162	0.00307	0.08228	0.45626	0.46146

K4	M1	M2	M3	M4	N1	N2	N3
0.33710	0.14970	0.39753	0.45277	0.21673	0.06858	0.48332	0.44810
0.27157	0.13140	0.47117	0.39743	0.19024	0.06335	0.52274	0.41391
0.24667	0.12462	0.49845	0.37693	0.18043	0.06058	0.54362	0.39581
0.23139	0.12039	0.51548	0.36413	0.17430	0.05869	0.55780	0.38350
0.22050	0.11732	0.52783	0.35485	0.16986	0.05727	0.56852	0.37421
0.21212	0.11492	0.53751	0.34758	0.16638	0.05613	0.57710	0.36676
0.20534	0.11294	0.54544	0.34161	0.16352	0.05518	0.58425	0.36057
0.19968	0.11128	0.55216	0.33657	0.16111	0.05437	0.59035	0.35527
0.19484	0.10983	0.55797	0.33220	0.15902	0.05367	0.59568	0.35066

CONTINUATION OF TABLE 15C

N4	X1	X2	Y1	Y2	Z1	Z2	PV1 (Pa)
0.10683	1	2.12719	1.24436	2.71489	1.12387	2.59114	1299.01524
0.09868	1	2.07201	0.82295	1.73853	0.91534	2.03303	1055.14340
0.09436	1	2.01901	0.75384	1.54856	0.88373	1.89634	1016.92209
0.09143	1	1.97201	0.72251	1.44759	0.86979	1.81128	1000.38658
0.08922	1	1.93011	0.70444	1.37984	0.86195	1.74763	991.77023
0.08744	1	1.89238	0.69276	1.32916	0.85703	1.69612	987.16505
0.08596	1	1.85810	0.68470	1.28882	0.85374	1.65258	984.95213
0.08470	1	1.82670	0.67891	1.25537	0.85146	1.61474	984.31450
0.08360	1	1.79776	0.67463	1.22685	0.84986	1.58122	984.78576

PV2 (Pa)	PV3 (Pa)	PV1 (Bar)	PV2 (Bar)	PV3 (Bar)	RH%(ZONE 1)	RH%(ZONE 2)	RH%(ZONE 3)
1130.38038	1410.55536	0.01299	0.01130	0.01411	89.64908	80.68382	107.51184
1123.13022	925.40663	0.01055	0.01123	0.00925	63.90935	80.16633	70.53404
1116.16730	841.93313	0.01017	0.01116	0.00842	54.17805	79.66933	64.17173
1109.99233	802.15183	0.01000	0.01110	0.00802	46.97753	79.22857	61.13962
1104.48681	777.95678	0.00992	0.01104	0.00778	41.12669	78.83560	59.29549
1099.52989	761.41874	0.00987	0.01100	0.00761	36.22624	78.48179	58.03496
1095.02589	749.30490	0.00985	0.01095	0.00749	32.04138	78.16031	57.11165
1090.90091	740.01521	0.00984	0.01091	0.00740	28.43196	77.86588	56.40360
1087.09740	732.65475	0.00985	0.01087	0.00733	25.30932	77.59439	55.84259

TABLE 16C - CALCULATION FOR THE RH OF THE THREE ZONES WITH A MOISTURE RELEASE RATE OF 10KG/DAY (CASE B)							
TEMP(ZONE1)	TEMP(ZONE2)	TEMP(ZONE3)	TEMP (1 - 2)	TEMP (1 - 3)	TEMP (2 - 3)	T1	T2
285.5	285	284	0.5	1.5	1	285.25	284.75
287.5	285	284	2.5	3.5	1	286.25	285.75
289.5	285	284	4.5	5.5	1	287.25	286.75
291.5	285	284	6.5	7.5	1	288.25	287.75
293.5	285	284	8.5	9.5	1	289.25	288.75
295.5	285	284	10.5	11.5	1	290.25	289.75
297.5	285	284	12.5	13.5	1	291.25	290.75
299.5	285	284	14.5	15.5	1	292.25	291.75
301.5	285	284	16.5	17.5	1	293.25	292.75

T3	Cd 12	Cd 13	Cd 23	F12 = F21	F13 = F31	F23 = F32	F10 = FO1
284.5	0.60869	0.43134	0.48957	0.05668	0.06963	0.06455	0.01105
284.5	0.36821	0.33122	0.48957	0.07653	0.08153	0.06455	0.01243
284.5	0.30667	0.28784	0.48957	0.08537	0.08866	0.06455	0.01368
284.5	0.27362	0.26150	0.48957	0.09138	0.09389	0.06455	0.01482
284.5	0.25186	0.24311	0.48957	0.09602	0.09807	0.06455	0.01588
284.5	0.23599	0.22925	0.48957	0.09983	0.10157	0.06455	0.01687
284.5	0.22370	0.21826	0.48957	0.10307	0.10460	0.06455	0.01781
284.5	0.21378	0.20925	0.48957	0.10590	0.10727	0.06455	0.01870
284.5	0.20552	0.20166	0.48957	0.10842	0.10966	0.06455	0.01955

CONTINUATION OF TABLE 16C

F20 - F02	F30 - F03	A1	A2	A3	K1	K2	K3
0.02134	0.00988	0.00229	0.00119	0.00240	0.08042	0.41265	0.50693
0.02134	0.00988	0.00284	0.00135	0.00260	0.07292	0.44889	0.47820
0.02134	0.00988	0.00313	0.00143	0.00272	0.07287	0.45479	0.47234
0.02134	0.00988	0.00333	0.00148	0.00281	0.07406	0.45670	0.46924
0.02134	0.00988	0.00350	0.00152	0.00288	0.07563	0.45731	0.46707
0.02134	0.00988	0.00364	0.00155	0.00293	0.07730	0.45735	0.46535
0.02134	0.00988	0.00376	0.00157	0.00298	0.07899	0.45712	0.46389
0.02134	0.00988	0.00386	0.00160	0.00303	0.08066	0.45673	0.46261
0.02134	0.00988	0.00396	0.00162	0.00307	0.08228	0.45626	0.46146

K4	M1	M2	M3	M4	N1	N2	N3
0.42155	0.14970	0.39753	0.45277	0.27032	0.06858	0.48332	0.44810
0.33961	0.13140	0.47117	0.39743	0.23728	0.06335	0.52274	0.41391
0.30847	0.12462	0.49845	0.37693	0.22504	0.06058	0.54362	0.39581
0.28936	0.12039	0.51548	0.36413	0.21740	0.05869	0.55780	0.38350
0.27575	0.11732	0.52783	0.35485	0.21186	0.05727	0.56852	0.37421
0.26526	0.11492	0.53751	0.34758	0.20751	0.05613	0.57710	0.36676
0.25679	0.11294	0.54544	0.34161	0.20395	0.05518	0.58425	0.36057
0.24971	0.11128	0.55216	0.33657	0.20094	0.05437	0.59035	0.35527
0.24365	0.10983	0.55797	0.33220	0.19833	0.05367	0.59568	0.35066

CONTINUATION OF TABLE 16C

N4	X1	X2	Y1	Y2	Z1	Z2	PV1 (Pa)
0.13397	1	2.65873	1.24436	3.39419	1.12387	3.23929	1384.32236
0.12375	1	2.58978	0.82295	2.17352	0.91534	2.54150	1122.53492
0.11834	1	2.52354	0.75384	1.93601	0.88373	2.37061	1080.21740
0.11466	1	2.46480	0.72251	1.80979	0.86979	2.26426	1061.25885
0.11188	1	2.41242	0.70444	1.72507	0.86195	2.18469	1050.90572
0.10966	1	2.36526	0.69276	1.66172	0.85703	2.12030	1044.94802
0.10780	1	2.32241	0.68470	1.61128	0.85374	2.06586	1041.63226
0.10622	1	2.28316	0.67891	1.56947	0.85146	2.01856	1040.06876
0.10484	1	2.24698	0.67463	1.53381	0.84986	1.97665	1039.74686

PV2 (Pa)	PV3 (Pa)	PV1 (Bar)	PV2 (Bar)	PV3 (Bar)	RH%(ZONE 1)	RH%(ZONE 2)	RH%(ZONE 3)
1200.21641	1499.49253	0.01384	0.01200	0.01499	95.53640	85.66855	114.29059
1191.15755	982.35738	0.01123	0.01191	0.00982	67.99121	85.02195	74.87480
1182.45489	892.66027	0.01080	0.01182	0.00893	57.55021	84.40078	68.03813
1174.73663	849.57148	0.01061	0.01175	0.00850	49.83606	83.84987	64.75392
1167.85497	823.15677	0.01051	0.01168	0.00823	43.57892	83.35867	62.74061
1161.65897	804.95869	0.01045	0.01162	0.00805	38.34672	82.91641	61.35356
1156.02907	791.52335	0.01042	0.01156	0.00792	33.88524	82.51457	60.32952
1150.87290	781.13810	0.01040	0.01151	0.00781	30.04243	82.14653	59.53796
1146.11855	772.84326	0.01040	0.01146	0.00773	26.72184	81.80718	58.90574