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LEAKAGE AREAS FOR OPAQUE WOOD FRAME WALLS - A PRELIMINARY STUDY

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ABSTRACT

The ASHRAE Handbook of Fundamentals contains valuable air leakage tables for building components that need to be expanded. This paper addresses an air infiltration issue not yet quantified in the leakage tables: the reduction in the leakage area of opaque wood frame walls with the application of sheetings and sheathings. Air flow data were obtained from tests conducted by independent test agencies for private sheathing manufacturers. Calculation of leakage areas using the LBL model at 4 Pa pressure differential yielded three opaque wall groupings and associated leakage areas:

I. Continuous exterior air infiltration barriers installed according to manufacturer's specifications (0.055 to 0.210 cm^2/m^2)

II. Non-continuous, rigid sheathing materials or incorrectly installed continuous air infiltration barriers (0.252 to 0.414 cm^2/m^2)

III. Non-rigid wall sheetings, or no sheeting or sheathing at all (0.515 to 0.918 cm^2/m^2).

A table for wall component leakage areas is derived from these data. The limitations of results are discussed and directions for new work proposed.

INTRODUCTION

The ASHRAE Handbook of Fundamentals [1] contains building component leakage tables that are essential to the designer in estimating residential air infiltration. These tables, based upon a report by Reinhold and Sonderegger [2], summarize the data available in the literature when the report was written. Certain gaps in the test data were acknowledged to exist; Reinhold and Sonderegger specifically cited the lack of data on the effect of a continuous polyethylene vapor barrier (or air-vapor barrier), and suggested using the "minimum" values for all listed wall components as a way of approximating this effect.

This lack of information has become more problematic as more and more houses are employing materials and techniques to systematically reduce infiltration through the wall, such as interior air-vapor barriers, airtight drywall detailing and exterior air infiltration barriers. This paper attempts to organize and analyze the available leakage data on opaque frame wall sections, particularly the data concerning the effect of wall sheetings (non-rigid fabrics or papers) and sheathings (rigid board materials) on air leakage through the wall, so that these component leakage areas may be taken into account when estimating overall house leakage.

TEST DESCRIPTION

Collection of data on the effect of various wall sheathings (testing principally sponsored by sheathing manufacturers and carried out by independent testing agencies) yielded results on 17 opaque, wood-frame wall constructions, described in detail in Table 1. All had 2 x 4 wood studs at 16" o.c., R-11 glass fiber insulation with an attached foil vapor barrier and thin wood paneling on the inside. Construction types designated by AL, HB and VN used aluminum, hardboard and vinyl siding respectively. These wall constructions also comprised one electric outlet. Construction HR has additional horizontal "belt" rails between the studs and hardboard siding (typical of some manufactured home wall sections). No electric outlet was included in construction HR.

Six sheeting and sheathing materials and/or assemblies were tested:

- polystyrene with kraft paper facings tested for proper and "loose" installation
- polyolefin over fiberboard
- laminated fiberboard/foil
- corrugated board/foil
- paper/foil laminate
- 38# kraft paper

The air infiltration tests were performed according to the ASTM Standard E 283: "Standard Test Method for Rate of Air Leakage through Exterior Windows, Curtain Walls and Doors"[3].

Test pressure differentials across the wall construction ranged from approximately 12 Pa to approximately 75 Pa. The measured air flow rates ranged from approximately 0.4E(-04) m^3/s per m^2 of opaque of wall area to 27E(-04) m^3/s per m^2 of opaque wall area. The test pressure differentials and air flow rates are listed as reported by the test agency in Table 1. Table 3 presents the same information expressed in SI units, using the following formulae:

$$1 \text{ ft.}^3\text{/min per ft}^2 \text{ of wall} = 0.0050802 \text{ m}^3\text{/s per m}^2 \text{ of wall}$$

$$1 \text{ inch } H_2O = 249.08 \text{ Pa}$$

$$\text{Pressure (in } H_2O) = 0.000482 \; v^2 \text{ (mph)}$$

$$\text{Pressure (Pa)} = 0.1200575 \; v^2 \text{ (mph)}$$

The pressure differentials and air flow rates listed in Tables 3 and 5 are used to calculate the estimated air flow at 4 Pa and then the leakage area. (Since all calculations were performed in SI units, both pressure and air flow values were carried to 3 digits after the decimal point, thereby avoiding the introduction of significant conversion errors in the final result. This numerical format is not indicative of the accuracy of the tests, but simply documents the calculations. Table 1 should be consulted for reported test conditions and results.)

CALCULATION OF LEAKAGE AREAS

According to the Lawrence Berkeley Laboratory infiltration model[2]:

$$L = 10{,}000 * Q_{pr} * [RO / (2 * \text{delta } P_r)]^{1/2} \qquad (1)$$

where:

- L = Leakage area in cm^2/m^2 of wall area
- Q_{pr} = Air flow through the wall at the reference pressure differential delta P_r in m3/s per m2 of wall area
- delta P_r = reference pressure differential in Pa
- RO = air density in kg/m^3

The air density was assumed to be 1.2 kg/m^3. Since delta P_r = 4, equation (1) becomes:

$$L = 3872.9833 * Q_{pr} \qquad (2)$$

Q_{pr} was calculated by fitting the air-pressure/air-flow data points to the power curve:

$$Q = A * (\text{delta } P)^B \qquad (3)$$

where:

- Q = Air flow through the wall at test pressure differential delta P in m^3/s per m^2
- delta P = Test pressure differential in Pa
- A, B = Regression coefficients

For the power curve, the B coefficient was restricted to a range of 0.5 to 1.0. Please refer to Table 2 for a listing of these coefficients and of the correlation coefficients obtained.

Q_{pr} was calculated for each wall construction by using the equation (3) with the appropriate A and B coefficients and with delta P = delta P_r = 4 Pa. Both Q_{pr} and L (obtained with equation 2) are listed in Table 3.

Noting that the exponent in the power curve is very often close to 1.0, a linear curve fit was also attempted:

$$Q = A + B * (\text{delta } P) \qquad (4)$$

The results of the linear regressions are presented in Table 4, and the calculated leakage areas in Table 5.

The first five tightest walls are in the same order and have approximately the same leakage area as when the calculations were done using the power curve. This seems to indicate that very tight opaque walls could have a linear relationship between the air flow and pressure. More test results are needed to verify this hypothesis.

INTERPRETATION OF RESULTS

Table 3 presents the test results listed in order of increasing leakage area, as calculated using the power curve regression. Analysis of these data shows a breakdown of wall assemblies into three distinct groups:

1) Walls with properly installed polystyrene sheathing and those with polyolefin over fiberboard have leakage areas above 0.05 cm^2/m^2 but below 0.25 cm^2/m^2, with the arithmetic mean of the tested assemblies being 0.150 cm^2/m^2 and with a standard deviation of 0.059 cm^2/m^2. The coefficient of variation, a relative measure of data dispersion which measures the ratio between standard deviation and arithmetic mean is 39.3%.

2) Laminated fiberboard/foil, loosely installed polystyrene sheathing, and board/foil sheathing have leakage areas between 0.25 and 0.50 cm^2/m^2 with the arithmetic mean of tested assemblies of 0.349 cm^2/m^2 and the standard deviation of 0.064 cm^2/m^2. The coefficient of variation is 18.3%.

3) Walls with paper/foil sheeting, 38# building paper sheeting or no sheeting or sheathing at all have leakage areas between 0.50 to 1.00 cm^2/m^2 with an arithmetic mean of 0.732 cm^2/m^2 and the standard deviation of 0.137 cm^2/m^2. The coefficient of variation is 18.7%.

It is of interest to note that the coefficient of variation is very close in the last two groups (18.3% and 18.7% respectively), supporting the proposed breakdown. The coefficient of variation within the first group is considerably higher (39.3%), but the standard deviation itself is very small (0.059 cm^2/m^2), not justifying the creation of an additional category.

The effect of various wall sidings was also analyzed. The walls were tested with 3 siding types: aluminum, hardboard and vinyl. Table 6 presents the variation in leakage area due to siding type for walls with polyolefin/fiberboard sheathing, walls with loosely installed polystyrene sheathing and walls with no sheeting or sheathing. As one could expect, the tighter the sheathing, the less the impact of the siding; siding had the most impact upon the unsheathed walls and very little effect upon the walls with continuous infiltration barriers. The variation in leakage area due to siding type for sheathed walls is much less than the decrease in leakage area due to the sheathing itself. Based on these limited data, it appears that the effect of siding type can be neglected when addressing with the reduction in leakage area due to the installation of an air infiltration barrier.

DISCUSSION OF TEST RESULTS

Based upon the above analysis of the test data, which shows that typical frame-wall construction falls into three categories according to the ability of the sheathing to reduce infiltration, it is proposed that the following grouping be used for creating a wall component leakage area table.

Group I: Continuous exterior air infiltration barriers, installed according to manufacturers' specifications (polystyrene stapled at 6" o.c. with staples at the folds, polyolefin installed over a rigid sheathing).

Group II: Non-continuous, rigid sheathing materials, or continuous air infiltration barriers installed incorrectly.

Group III: Non-rigid wall sheetings, or no sheeting or sheathing at all.

This breakdown into groups has been used to generate Table 7, Opaque Wall Leakage Areas.

CONCLUSIONS

These preliminary data suggest that the use of infiltration barriers has a significant effect in reducing the amount of air leakage through a typical 2 x 4 frame wall. Comparing the wall construction with the lowest leakage area (continuous, properly installed polystyrene infiltration barrier) to the wall construction with the highest leakage area (aluminum siding with no sheeting or sheathing) shows a reduction in leakage area of 0.86 cm^2/m^2, or 94%. More conservatively, comparing the arithmetic mean values for Groups I and III, a reduction in leakage area of 0.58 cm^2/m^2, or 80% is shown.

This analysis naturally suggests the need for further testing and research to better define the performance characteristics of walls and the effects of air infiltration barriers:

1. The test data reported in this paper needs to be reproduced. For some sheathings there is a single set of tests, and continued testing would be useful to confirm the findings.

2. The test data reported here refer to leakage through fairly homogeneous wall areas. The air is assumed to leak through cracks and material joints that occur with regularity in wall construction: joints between gypsum boards or wall paneling sheets, the edge of gypsum boards or paneling at the baseboard, joints between sheathing boards, electric receptacles, electric switches, etc. It is recognized that leakage areas occurring at penetrations of the homogeneous wall area, such as at windows, doors, pipes, building corners, etc., need to be quantified separately, as indeed many of them already have been in the ASHRAE Handbook of Fundamentals. Testing is needed on the effect of continuous air infiltration barriers at these joints and penetrations.

   Test data have been examined where overall leakage through a wall area including a window has been measured. This type of test, however, makes it nearly impossible to assess the separate effects of leakage through the net, opaque wall area, through the window, or through the joint between the window and the wall. This test practice should be discouraged, as it can only confuse the questions at hand.

3. 2 x 6 frame walls should be tested for comparison to 2 x 4 walls. Preliminary testing suggests that there is no great variation in leakage areas due to thicker framing and fibrous insulation.

4. Non-continuous, rigid wall sheathings are usually installed and have been tested with mechanical fastening to the framing, but no taping or sealing between the boards. Currently, some energy codes are giving credit for infiltration reduction from boards that are taped or caulked. Testing should be done to evaluate the infiltration and moisture effects of these procedures.

5. These tests were performed with an interior finish of 5/32" wood paneling. Tests should examine the effect of gypsum board, both as installed in typical construction practice, and using the "airtight drywall" approach[4].

6. Further analysis is needed of the possible linear relationship between leakage and pressure, especially for tight walls. The analysis presented in Table 4 shows a good fit for the data using a linear equation, with much lower standard error estimates than for the power curve. This paper did not attempt to explain the presence and magnitude of the intercepts. However, in the instances where the equation of the power curve was linear with zero intercept (Table 2, tests 1, 2, 3 and 6), the standard error estimate was not significantly higher than for the best linear fit with non-zero intercepts (Table 4, tests 1, 2, 3 and 6). Further testing and study in this area might lead to practices that would simplify future testing of wall assemblies.

REFERENCES

1. ASHRAE Fundamentals 1985, chapter 22, pp. 14-15

2. C. Reinhold and R. Sonderegger, Component Leakage Areas in Residential Buildings , (Lawrence Berkeley Laboratory Report LBL-16221, 1983), Lawrence Berkeley Laboratory, University of California.

3. ANSI/ASTM E 283-73, Standard Test Method for Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors.

4. James K. Lischkoff and Joseph Lstiburek, The Airtight House - Using the Airtight Drywall Approach, (Iowa State University Research Foundation, Inc., Report, 1984) Iowa State University Foundation, Inc.

TABLE 1

REPORTED TEST RESULTS FOR AIR INFILTRATION THROUGH OPAQUE WALLS

Test No.	Wall Type	Sheathing	Air Flow ($ft.^3$/min. per ft^2 of wall) Test Pressure (in. H_2O) 0.05	0.10	0.20	0.30	Test Pressure (mph) 10	15	20	25	Test Date
1	VN	Polystyrene: proper	007	.019	.035	.051					12/11/84
2	HB	Polyolefin over fiberboard		.042	.094	.133					9/25/84
3	AL	Polyolefin over fiberboard		.049	.102	.152					9/25/84
4	VN	Polyolefin over fiberboard		.049	.094	.133					9/25/84
5	VN	Polyolefin over fiberboard	.028	.051	.092	.128					12/11/84
6	AL	Laminate Fiberboard/Foil	.016	.073	.164	.242					9/25/84
7	VN	Polystyrene: loose		.070	.127	.177					9/25/84
8	HB	Polystyrene: loose		.083	.148	.205					9/25/84
9	HR	Polystyrene: loose					.04	.08	.12	.15	12/10/80
10	AL	Board/Foil		.095	.172	.238					9/25/84
11	AL	Polystyrene: loose		.091	.163	.219					9/25/84
12	AL	Paper/Foil		.123	.233	.311					9/25/84
13	AL	38# Paper	.078	.148	.242	.320					9/25/84
14	HR	None					.08	.15	.23	.29	12/10/80
15	VN	None	.102	.188	.344	.469					9/25/84
16	HB	None	.109	.211	.375	.531					9/25/84
17	AL	None	.117	.227	.383	.531					9/25/84

WALL CONSTRUCTION DESCRIPTION:

Type	Description
AL	2 x 4 studs, 16" o.c., 18" vertical aluminum siding, R-11 glass-fiber insulation with foil vapor barrier, 5/32" wood panelling with 1 electric outlet.
HB	2 x 4" studs, 16" o.c., hardboard siding, R-11 glass-fiber insulation with foil vapor barrier, 5/32" wood panelling with 1 electric outlet.
VN	2 x 4" studs, 16" o.c., horizontal vinyl siding, R-11 glass-fiber insulation with foil vapor barrier, 5/32" wood panelling with 1 electric outlet.
HR	2 x 4 studs, 16" o.c., hardboard siding, 1 x 2 belt rails, R-11 glass-fiber insulation, 5/32" wood panelling.

TABLE 2

CURVE FITTING FOR OPAQUE WALLS INFILTRATION DATA - POWER CURVE

Test No.	Wall Type	Sheathing	A Coefficient *E(+05)	B Coefficient	Air Flow Standard Error Estimate (m^3/s per m^2)	Correlation Coefficient	Number of Data Points
1	VN	Polystyrene: proper	0.352	1.000	0.740 E(-05)	.998	4
2	HB	Polyolefin over fiberboard	0.916	1.000	2.726 E(-05)	.997	3
3	AL	Polyolefin over fiberboard	1.033	1.000	0.871 E(-05)	.999	3
4	VN	Polyolefin over fiberboard	1.331	0.912	0.017	.999	3
5	VN	Polyolefin over Fiberboard	1.676	0.850	0.009	.999	4
6	AL	Laminate Fiberboard/Foil	1.625	1.000	9.117 E(-05)	.997	4
7	VN	Polystyrene: loose	2.348	0.846	0.008	.999	3
8	HB	Polystyrene: loose	2.986	0.824	0.006	.999	3
9	HR	Polystyrene: loose	3.458	0.730	0.073	.994	4
10	AL	Board/Foil	3.271	0.838	0.011	.999	3
11	AL	Polystyrene: loose	3.511	0.804	0.023	.999	3
12	AL	Paper/Foil	4.082	0.853	0.043	.997	3
13	AL	38# Paper	5.718	0.783	0.055	.997	4
14	HR	None	7.078	0.713	0.050	.997	4
15	VN	None	6.037	0.856	0.021	.999	4
16	HB	None	6.149	0.879	0.028	.999	4
17	AL	None	7.440	0.836	0.045	.998	4

Note: $Q = A * (\text{delta } P)^B$

Sheathing Type	Description
Polystyrene: loose installation	1/4" extruded polystyrene with building paper facing. The sheathing is delivered folded every 2 feet and is stapled at random points at top and bottom of the basewall.
Polystyrene: proper installation	1/4" extruded polystyrene with building paper facing. The sheathing is delivered folded every 2 feet and is installed with staples at six inches, so as to include a staple over the folds in the long board at the top and bottom of the basewall.
Polyolefin: over fiberboard	Spun-bonded polyolefin sheeting mounted over 1/2" fiberboard.
Laminate Fiberboard/Foil:	Pressure laminated fiberboard with aluminum foil on one side.
Board/Foil:	.21 inch corrugated paper board with aluminum foil liner on one side. The product is delivered as a continuous fan-folded sheet, folded every 32 inches.
Paper/Foil:	Rolled paper with aluminum foil laminate on one side.
38# Paper:	38 pound building paper.

TABLE 3

LEAKAGE AREAS FOR OPAQUE WALLS - POWER CURVE CALCULATIONS

Test No.	Wall Type	Sheathing	Leakage Area (cm^2/m^2)	Reference Pressure (Pa)	Air Flow (m^3/s per m^2 of wall)*E(+04) — Test Pressure (Pa)								Test Date
				4.00	12.006	12.454	24.908	27.010	48.023	49.816	74.725	75.036	
1	VN	Polystyrene proper installation	0.055*	0.141*		0.406	0.965			1.778	2.591		12/11/84
2	HB	Polyolefin over fiberboard	0.142*	0.367*			2.134			4.775	6.757		9/25/84
3	AL	Polyolefin over fiberboard	0.160*	0.413*			2.489			5.182	7.722		9/25/84
4	VN	Polyolefin over fiberboard	0.182*	0.471*			2.489			4.775	6.757		9/25/84
5	VN	Polyolefin over fiberboard	0.210*	0.542*		1.422	2.591			4.674	6.503		12/11/84
6	AL	Laminate Fiberboard/Foil	0.252*	0.650*		0.813	3.709			8.332	12.294		9/25/84
7	VN	Polystyrene loose installation	0.292*	0.756*			3.556			6.452	8.992		9/25/84
8	HB	Polystyrene loose installation	0.362*	0.934*			4.217			7.519	10.414		9/25/84
9	HR	Polystyrene loose installation	0.367*	0.949*	2.032			4.064	6.096			7.620	12/10/80
10	AL	Board/Foil	0.405*	1.045*			4.826			8.738	12.091		9/25/84
11	AL	Polystyrene loose installation	0.414*	1.070*			4.623			8.281	11.126		9/25/84
12	AL	Paper/Foil	0.515*	1.330*			6.249			11.837	15.799		9/25/84
13	AL	38# Paper	0.655*	1.690*		3.963	7.519			12.294	16.257		9/25/84
14	HR	None	0.736*	1.900*	4.064			7.620	11.684			14.733	12/10/80
15	VN	None	0.765*	1.976*		5.182	9.551			17.476	23.826		9/25/84
16	HB	None	0.804*	2.077*		5.537	10.719			19.050	26.976		9/25/84
17	AL	None	0.918*	2.372*		5.944	11.532			19.457	26.976		9/25/84

* Calculated

Note: All tests were performed by the National Certified Testing Laboratories (NCTL).

TABLE 4

CURVE FITTING FOR OPAQUE WALLS INFILTRATION DATA - LINE EQUATION

Test No.	Wall Type	Sheathing	A Coefficient *E(+05)	B Coefficient *E(+05)	Air Flow Standard Error Estimate m^3/s per m^2 *E(+05)	Correlation Coefficient	Number of Data Points
1	VH	Polystyrene Proper Installation	0.383	0.345	0.688	.998	4
2	HB	Polyolefin over fiberboard	-0.676	0.928	2.691	.996	3
3	AL	Polyolefin over fiberboard	-1.019	1.050	0.626	.999	3
4	VN	Polyolefin over fiberboard	4.057	0.857	1.242	.999	4
5	VN	Polyolefin over fiberboard	5.034	0.814	1.283	.998	4
7	VN	Polystyrene loose installation	8.974	1.091	1.454	.999	3
8	HB	Polystyrene loose installation	11.864	1.244	1.663	.999	3
9	HR	Polystyrene loose installation	14.140	0.873	5.607	.982	4
10	AL	Board/Foil	12.868	1.458	2.283	.999	3
11	AL	Polystyrene loose installation	15.071	1.305	3.319	.997	3
12	AL	Paper/Foil	17.451	1.917	6.639	.995	3
13	AL	38# Paper	21.617	1.939	7.190	.994	4
15	VN	None	18.836	2.996	6.607	.997	4
16	HB	None	17.742	3.409	5.470	.998	4
14	HR	None	27.082	1.682	9.324	.986	4
17	AL	None	25.394	3.320	8.179	.997	4

Note: Q = A + B * (delta P)

TABLE 5

LEAKAGE AREAS FOR OPAQUE WALLS - LINEAR CALCULATIONS

Test No.	Wall Type	Sheathing	Leakage Area (cm^2/m^2)	Air Flow (m^3/s per m^2 of wall)*E(+04) Reference Pressure (Pa)	Test Pressure (Pa)								Test Date
				4.00	12.006	12.454	24.908	27.010	48.023	49.816	74.725	75.036	
1	VN	Polystyrene proper installation	0.068*	0.176*		0.406	0.965			1.778	2.591		12/11/84
2	HB	Polyolefin over fiberboard	0.118*	0.30*			2.134			4.775	6.757		9/25/84
3	AL	Polyolefin over fiberboard	0.123*	0.32*			2.489			5.182	7.722		9/25/84
4	VN	Polyolefin over fiberboard	0.290*	0.75*			2.489			4.775	6.757		9/25/84
6	AL	Laminate Fiberboard/Foil	0.715*	1.85*		0.813	3.709			8.333	12.299		9/25/84
5	VN	Polyolefin over fiberboard	0.320*	0.83*		1.422	2.591			4.674	6.503		12/11/84
7	VN	Polystyrene loose installation	0.516*	1.33			3.556			6.452	8.992		9/25/84
8	HB	Polystyrene loose installation	0.650*	1.68*			4.217			7.519	10.414		9/25/84
9	HR	Polystyrene loose installation	0.683*	1.76*	2.032			4.064	6.096			7.62	12/10/80
10	AL	Board/Foil	0.724*	1.87*			4.826			8.738	12.091		9/25/84
11	AL	Polystyrene loose installation	0.785*	2.03*			4.623			8.281	11.126		9/25/84
12	AL	Paper/Foil	0.973*	2.51*			6.249			11.837	15.799		9/25/84
13	AL	38# Paper	1.138*	2.94*		3.963	7.519			12.294	16.257		9/25/84
15	VN	None	1.193*	3.08*		5.182	9.551			17.476	23.826		9/25/84
16	HB	None	1.215*	3.138*		5.537	10.719			19.050	26.976		9/25/84
14	HR	None	1.310*	3.384*	4.064			7.62	11.684			14.733	12/10/80
17	AL	None	1.498*	3.87*		5.944	11.532			19.457	26.976		9/25/84

* Calculated

Notes: All tests were performed by the National Certified Testing Laboratories (NCTL). Wall construction is described in Table 1.

TABLE 6

LEAKAGE AREA AS A FUNCTION OF SIDING TYPE

Test No.	Wall Type	Sheathing	Leakage Area (cm^2/m^2)	Change in Leakage Area Area over AL Siding (cm^2/m^2)	Change in Leakage Area Over Polyolefin/Fiberboard (cm^2/m^2)
4	VN	Polyolefin over fiberboard	0.182	0.036	0.00
2	HB	Polyolefin over fiberboard	0.119	-0.027	0.00
3	AL	Polyolefin over fiberboard	0.146	0.00	0.00
7	VN	Polystyrene loose installation	0.292	-0.122	0.110
8	HB	Polystyrene loose installation	0.361	-0.053	0.242
11	AL	Polystyrene loose installation	0.414	0.00	0.268
15	VN	None	0.765	-0.153	0.583
16	HB	None	0.804	-0.114	0.685
17	AL	None	0.918	0.00	0.772

Note: Wall construction is described in Table 1

TABLE 7

PROPOSED LEAKAGE AREAS FOR OPAQUE WALLS

Sheathing Type	Best Estimate	Max	Min	Unit
Continuous Air Infiltration Barriers	0.150	0.210	0.055	cm^2/m^2
Rigid Sheathings	0.349	0.414	0.252	cm^2/m^2
Non-rigid Sheetings, or no Sheeting or Sheathing at all	0.732	0.918	0.515	cm^2/m^2