

11. CALCULATIONS:

See summary of heat loss calculations, Table 46-A, and heat loss calculation sheet for living room, Table 46-B.

TABLE 46-A. SUMMARY OF HEAT LOSS CALCULATIONS FOR RESIDENCE SHOWN IN FIG. 10

ROOM OR SPACE NO.	ROOM	GLASS TRANSMISSION LOSSES	OTHER TRANSMISSION LOSSES	INFILTRATION LOSSES	TOTAL
1	Living Room.....	7,100	9,040	8,970	25,110
2	Dining Room.....	2,640	4,640	742	8,022
3	Kitchen.....	1,060	3,300	663	5,023
4	Dining Alcove.....	1,370	3,718	807	5,895
5	Entry.....	1,888	1,312	4,320	7,520
6	Vestibule.....	1,854	1,436	3,900	7,190
7	Bedroom (A) and Closet.....	3,773	3,558	1,445	8,776
8	Bedroom (B) and Closet.....	3,960	4,070	1,445	9,475
9	Bedroom (C) and Closet.....	2,900	3,765	1,660	8,325
10	Upstairs Hall.....	1,450	920	1,660	4,030
11	Bath.....	1,450	1,940	1,660	5,050
12	Attic (heated).....	3,040	28,021	1,125	32,186
GRAND TOTAL of heat required for building in B.t.u. per hour at -8 deg. with a 17-mile southwest wind.....					126,602

TABLE 46-B. HEAT LOSS CALCULATION SHEET FOR LIVING ROOM (FIG. 10)

PART OF BUILDING	EXPOSURE	NET SURFACE AREA OR CRACK LENGTH	CO-EFFICIENT	TEMP. DIFFERENCE	NET B.T.U.	EXPOSURE FACTOR	TOTAL B.T.U.
Wall.....	E	75.6	0.263	78	1,550		1,550
Glass.....	E	15.0	1.13	78	1,320		1,320
Crack $\frac{1}{8}$ in. ^a	E	19.0	0.5	78	(742) ^d		
Wall ^b	S	127.6	0.263	78	2,620	1.15	3,010
Doors.....	S	42.0	1.13 ^c	78	3,710	1.15	4,260
Crack $\frac{1}{8}$ in. ^a	S	40.0	2.50	78	7,800	1.15	8,970 ^d
Wall.....	W	75.6	0.263	78	1,550	1.15	1,780
Glass.....	W	15.0	1.13	78	1,320	1.15	1,520
Crack $\frac{1}{8}$ in. ^a	W	19.0	0.50	78	(742) ^d		
Floor.....	Over Basement	241.0	0.339	33 ^e	2,700		2,700
GRAND TOTAL of heat required for room in B.t.u. per hour at -8 deg. with a 17-mile southwest wind.....							25,110

^aWindows weatherstripped.

^bChimney figured as part of wall, that is, of the same construction.

^cTransmission coefficient taken same as glass for entire door.

^dThree sides of this room are exposed and therefore only the wall having the greatest infiltration loss is used in estimating the total leakage for the room. If the infiltration loss for the south side of the room containing the two outside doors had been less than half the total infiltration loss for the room, then half the total leakage would have been used.

^eAir temperature at floor assumed 65 deg. Fahr. Air temperature in basement assumed 32 deg. Fahr.

PREVENTION OF CONDENSATION ON INTERIOR BUILDING SURFACES

Condensation on the interior surface of buildings is often a serious problem. Water dripping from a ceiling may cause irreparable damage to manufactured articles and machinery. It often results in short-circuiting of electric power and lighting systems, necessitating shut-downs and incurring costly repairs. It also causes rotting of wood roof structures, corrosion of metal roofs, and spalling and disintegration of gypsum and other types of roof decks not properly protected.

Condensation is caused by the contact of the warm humid air in a building with surfaces below the dew-point temperature, and can be remedied in two ways, (1) by increasing the temperature of such surfaces above the dew-point temperature, or (2) by lowering the humidity.

Dehumidification, of course, is not permissible where a high relative humidity is necessary for manufacturing processes. Hence, the only alternative is to increase the surface temperature by decreasing the inside surface resistance. This can be accomplished by increasing the velocity of air passing over the surface, or by increasing the overall resistance of the wall or roof by installing a sufficient thickness of insulation.

The latter method is generally used, and the thickness of insulation is determined by ascertaining the amount of resistance to be added to increase the temperature of the interior surface above the dew-point temperature for the maximum conditions involved. This in turn is based on the fundamental principle that the drop in temperature is proportional to the resistance.

The thickness of insulation required to prevent condensation on the interior surface of a wall or roof can be determined by means of the following formula:

$$x = k \left[\frac{t - t_0}{f_i (t - t_d)} - \frac{1}{U} \right] \quad (17)$$

where

x = thickness in inches of insulation to prevent condensation.

k = conductivity of insulation in B.t.u. per hour per square foot per degree Fahrenheit per inch thickness.

U = coefficient of transmission of uninsulated wall or roof in B.t.u. per hour per square foot per degree Fahrenheit.

f_i = conductance of interior surface of wall or roof in B.t.u. per hour per square foot per degree Fahrenheit.

t = dry-bulb temperature of air near wall or roof surface.

t_d = dew-point temperature of air near wall or roof surface.

t_0 = minimum outside temperature (usually taken as 15 deg. above lowest temperature on record for locality of building).

Example showing Use of Condensation Formula

The following example will illustrate the use of this formula:

Determine the thickness of insulation required to prevent ceiling condensation on a roof constructed of 1-in. yellow pine sheathing covered with built-up roofing for an inside temperature at the ceiling of 85 deg.