An Attic Condensation Problem

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TECHNICAL NOTE

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SUBJECT AN ATTIC CONDENSATION PROBLEM

The problem of condensation in attic and roof spaces has been of particular interest to the Atlantic Regional Station for some time. Although there are numerous examples of this problem in the area as evidenced by the inquiries received, the opportunity to carry out a detailed investigation did not occur until the early winter of 1960-61. At that time a homeowner requested an investigation of an apparent attic condensation problem in his new home.

The preliminary survey disclosed severe frosting on the protruding nails, on the gable ends, and on the underside of the roof deck, with consequent dripping to the ceiling below where some staining occurred. The freezing would occur at night with subsequent melting and dripping as the sun shone on the roof during the day.

The house is of wood-frame construction on a crawl space and heated with a reverse flow furnace with ductwork connecting the perimeter floor registers. The duct for the return air side of the system is run in the attic space from the ceiling grilles to the furnace plenum. The interior finish of the house is dry wall with fibreboard tile ceilings. The exterior of the house is sheathed in 5/8-in. fibreboard covered with building paper and finished with cedar clapboards. Wood frame sashless sliding windows have been used throughout (Figure 1).

The house is built on a crawl space on a well drained site. Relative humidity conditions in the crawl space as measured by a recorder

were not such as to make an apparent contribution to the moisture problem under investigation. The block walls of the crawl space were uninsulated, and the ground surface was covered with a thin layer of concrete and no vapour barrier was used under the concrete skin. The addition of a light skin of concrete over the crawl space fill has the advantage of making the crawl space much more usable as storage space (Figure 2). Access to the crawl space is conveniently located in the floor of the closet serving the main entrance. Heat is introduced to the crawl space by outlets taken from the main plenum. Figure 3 (AR-531) illustrates the position of the house relative to the surrounding area.

In the construction of the house the ceiling insulation consisting of 2 in. thick wool batts was placed after the ceiling had been strapped and the ceiling tile installed. This method of installing the ceiling insulation after the ceiling is up is quite common in this area and does not provide a continuous thermal barrier nor a very effective vapour barrier (Figure 4). The roof deck of 3/8-in. plywood is placed on 2 x 6 rafters and covered with a standard low-slope asphalt shingle. The end walls or gable ends of the roof space have exposed fibreboard sheathing on the wall studs with no interior finish.

The ventilation provided for this attic space originally consisted of two 8- x 12-in. aluminum louvered vents, one at each end of the attic space at the peak. These louvered vents were screened and provided in total a net free area of 80 sq in. The insulated ceiling has a total area of 89,280 sq in. which would require a vent area of 1/300 of 89,280 or 297.6 sq in. The vent area provided, therefore, was only 27 per cent of this requirement.

For a period of three weeks in late November and early December of 1960, constant temperature and humidity records were kept to establish the existing condition before any changes in the original arrangements were made. The readings in Table I for 6 December are indicative of the moisture content of the wood in the attic space prior to any alteration in the venting. The readings in Table II and the curves in Figures 5 and 6 up to 21 December illustrate the temperature and humidity conditions for the period before any changes were made.

In December of 1960 soffit vents were added (Figure 4) and this work was completed in the third week of December. This additional venting provided a total area of 390 sq in. which is 30 per

cent more than that suggested by the 1/300 normally required.

The change in wood moisture content in the attic following the increased ventilation is illustrated by the readings recorded in Table I for 27 December 1960 and 3 and 10 January 1961. Table II and Figures 5 and 6 for this period show a gradual fall in the attic humidity and a slight drop in the attic temperature.

As the increase in the vent area was made, a gradual improvement was noted in the attic condition. The ice disappeared first from the gable ends and the underside of the roof and consequently the moisture content of the wood decreased and the condition generally improved. Two weeks after the alterations in the vent area were made the attic conditions could be considered normal for this time of year.

The thermal barrier on the ceiling was discussed following the drying out of the attic space. The addition of a positive vapour barrier under the insulation was difficult without removal of the ceiling tile and the homeowner was not in favour of this if it could be avoided. Because the condensation problem had improved with the increased ventilation in the attic space, it seemed reasonable to suggest the addition of loose fill insulation without a vapour barrier. Loose mineral wool was used because of its non-hygroscopic properties. The addition of ceiling insulation to a uniform depth of 4 in. was not completed until 12 February so that any change before this time is difficult to assess. Figure 6 illustrates the close relationship between the attic and outdoor temperature after 12 February.

It is difficult to draw any conclusions regarding the relative humidity for the house due to the fact that the homeowner was adding storm windows throughout the instrumented period, and the infiltration rate was not constant.

In conclusion, the experience to date has indicated that adequate ventilation of roof or attic space is extremely important in the prevention of condensation. If the ventilation is adequate, then a vapour barrier on the ceiling may not be necessary. One documented case, however, is not conclusive proof of this supposition. The fact that the nails protruded through the roof deck certainly added to the problem, although in this case the condensation and consequent freezing was so severe that the underside of the roof deck was also affected.

Up to the present time there has been no evidence of damp insulation or condensation in the attic area. Observations will be continued for an additional heating period now that all changes contemplated by the owner have been completed.

TABLE I

PER CENT MOISTURE CONTENT OF WOOD IN ATTIC SPACE

Date	End Wall	Studs	Plywood Roof Deck	Rafters
1960				
Dec. 6	50-60	22	22-65	25
27	50-60	22	22-65	25
1961				
Jan. 3	12	12	14-18	12
10	14	11½	18-20	11½

TABLE II

TEMPERATURE AND HUMIDITY RECORDS

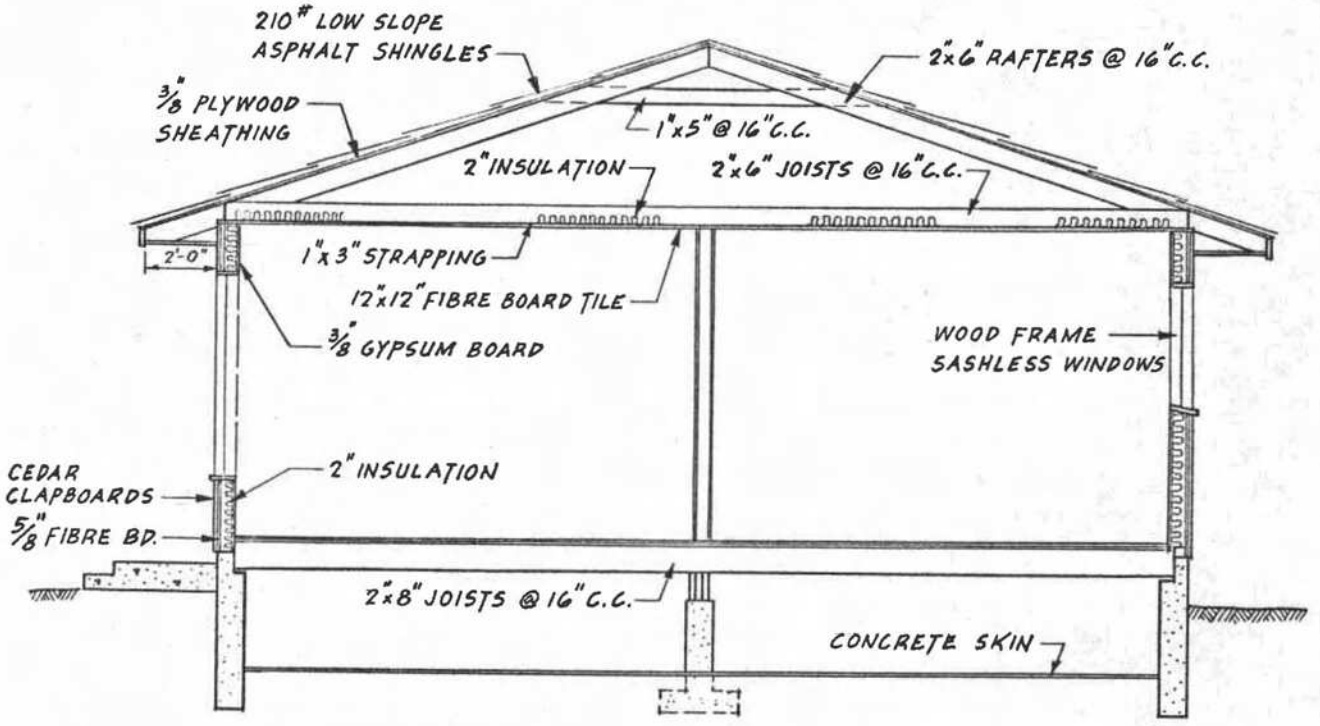
Date	Attic		Outside		House	
	Temp.	Humidity	Temp.	Humidity	Temp.	Humidity
1960						
Dec. 2	49	73	28	67	72	44
3	45	71	33	69	68	42
4	45	70	35	77	70	43
6	50	72	36	80	70	42
7	52	72	40	92	70	43
8	45	71	26	87	70	41
9	43	71	16	67	70	40
10	44	70	32	74	70	38
11	39	72	13	64	70	37
21	37	56	33	75	70	35
22	35	55	40	77	70	40
23	47	60	30	74	68	35
24	37	65	20	69	72	33
25	37	62	28	82	72	32
26	30	63	39	85	70	38
28	30	61	14	61	70	36
29	33	59	31	76	72	34
30	37	59	34	100	70	38
31	37	61	33	87	72	39
1961						
Jan. 1	37	62	32	94	70	39
2	39	58	35	89	72	40
5	37	56	20	78	68	37
6	37	57	25	81	68	36

TABLE II (continued)

Date	Attic Temp.	Attic Humidity	Outside Temp.	Outside Humidity	House Temp.	House Humidity
1961						
Jan. 7	38	58	34	89	70	39
8	39	60	36	95	70	40
9	38	61	28	81	70	41
10	37	62	18	72	70	36
11	37	55	26	80	70	34
12	32	56	25	71	70	37
13	27	54	18	68	70	34
14	35	59	39	87	70	35
15	37	55	24	77	70	38
16	33	58	29	89	70	34
21	43	58	14	78	72	29
22	35	55	13	76	72	28
23	29	52	14	73	70	27
24	25	55	13	71	72	29
26	25	54	8	72	70	25
27	29	56	13	69	70	28
28	24	57	14	71	70	25
29	29	56	19	66	70	29
30	29	56	17	68	70	29
31	29	54	7	69	70	27
Feb. 5	27	53	17	64	70	32
6	34	54	21	65	70	31
7	35	55	24	70	70	31

TABLE II (continued)

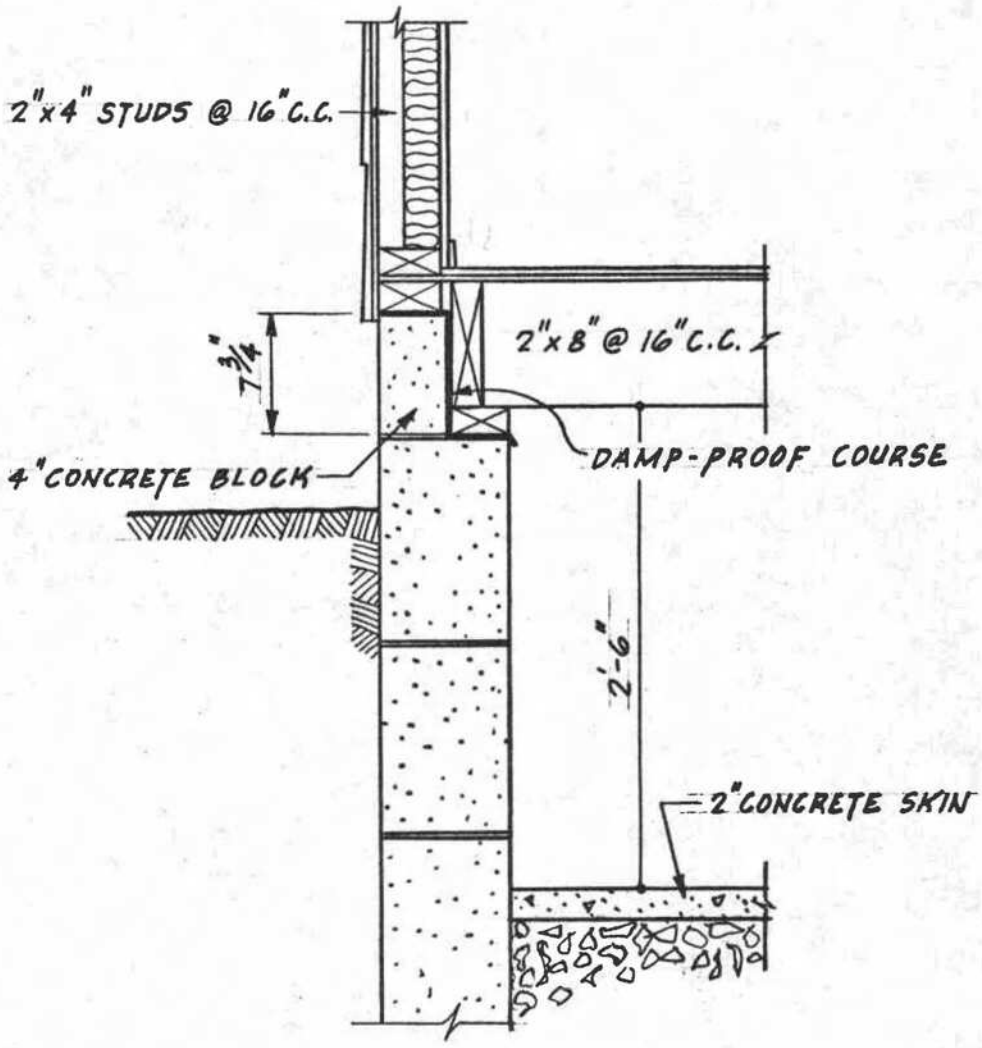
Date	Attic		Outside		House	
	Temp.	Humidity	Temp.	Humidity	Temp.	Humidity
1961						
Feb. 8	30	56	26	73	70	32
9	37	57	32	76	70	37
10	39	61	30	94	70	39
12	31	60	15	73	70	35
13	33	57	16	71	70	34
14	31	55	23	92	70	34
15	29	57	32	81	70	37
16	37	54	15	71	70	34
17	29	51	17	69	70	32
18	35	54	35	95	68	40
19	47	50	33	68	70	39
20	37	49	24	57	70	35
21	40	52	34	69	70	38
22	40	49	29	73	70	39
23	35	53	21	86	70	37



SCALE: 1/4" = 1'-0"

FIGURE 1

BR. 3421-1

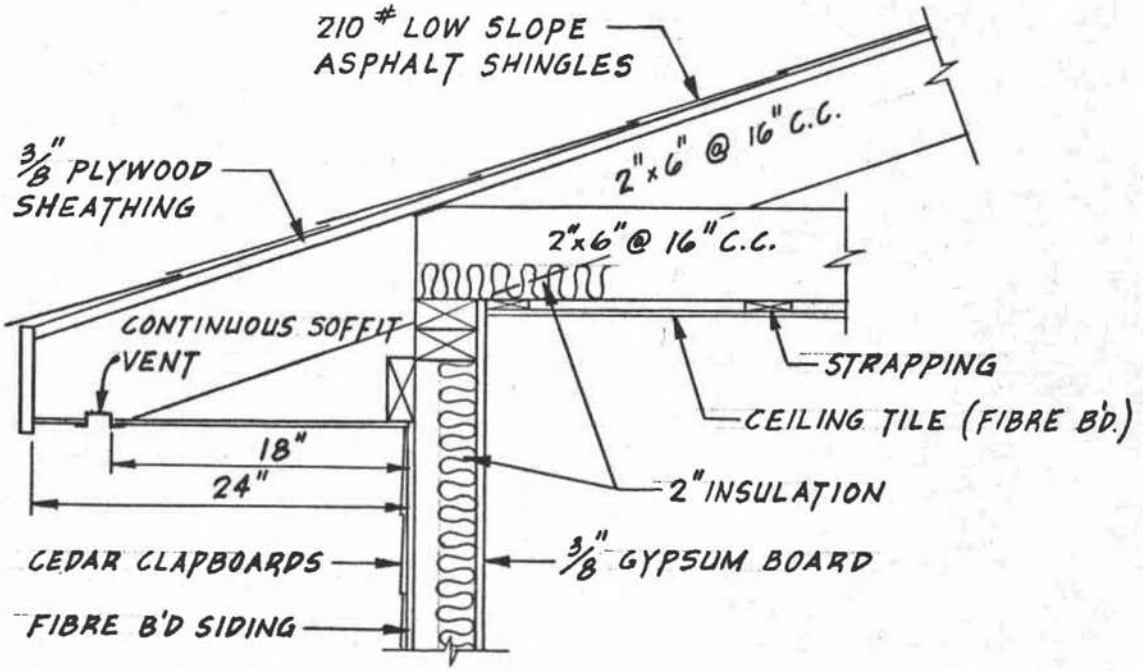


SCALE: 1" = 1'-0"

FIGURE 2

BR. 3421-2

Figure 3. House under observation.



SCALE: 1"=1'-0"

FIGURE 4

BR. 3421-3

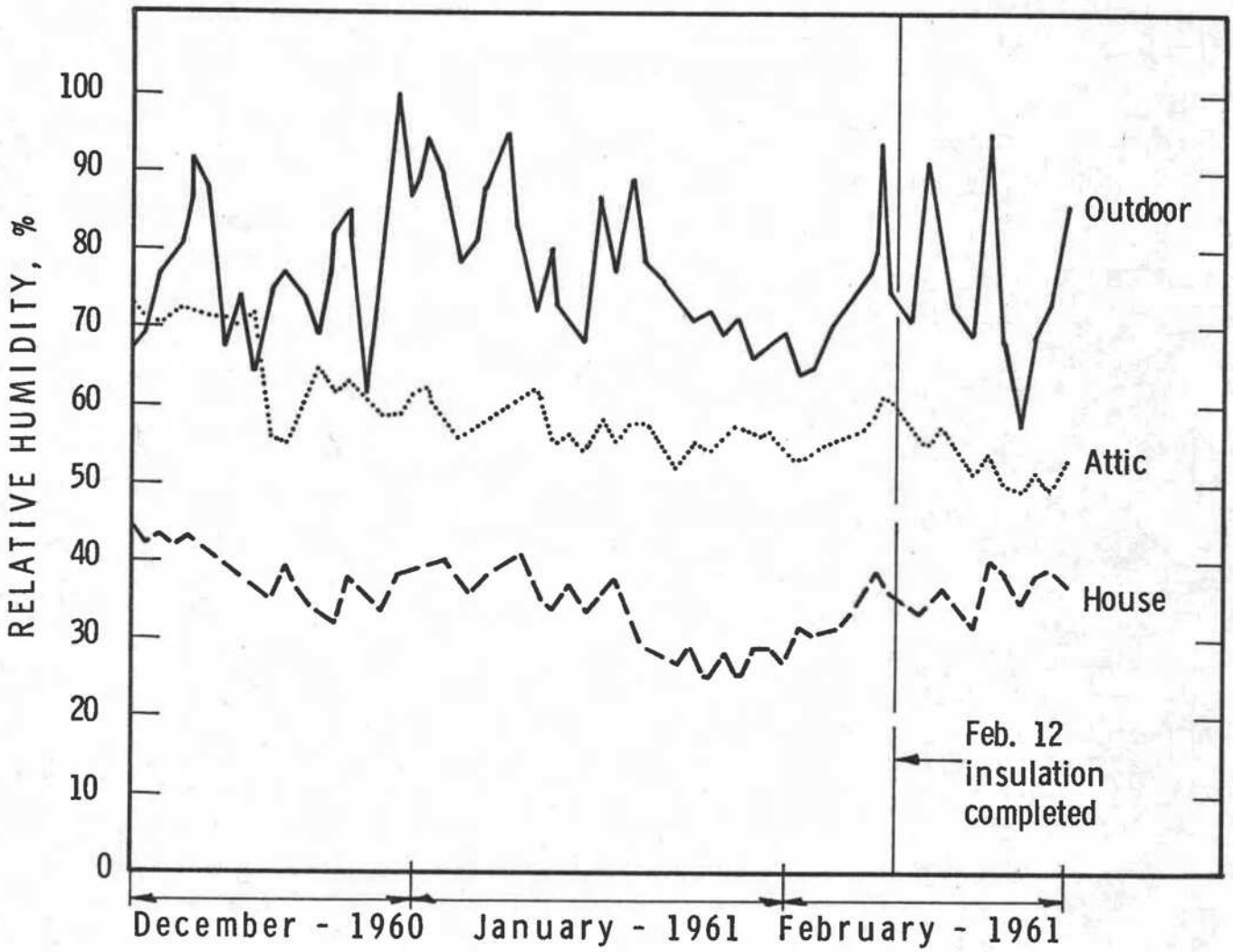


FIGURE 5

RECORD OF RELATIVE HUMIDITY
(DAILY AVERAGES)

BR. 3421-4

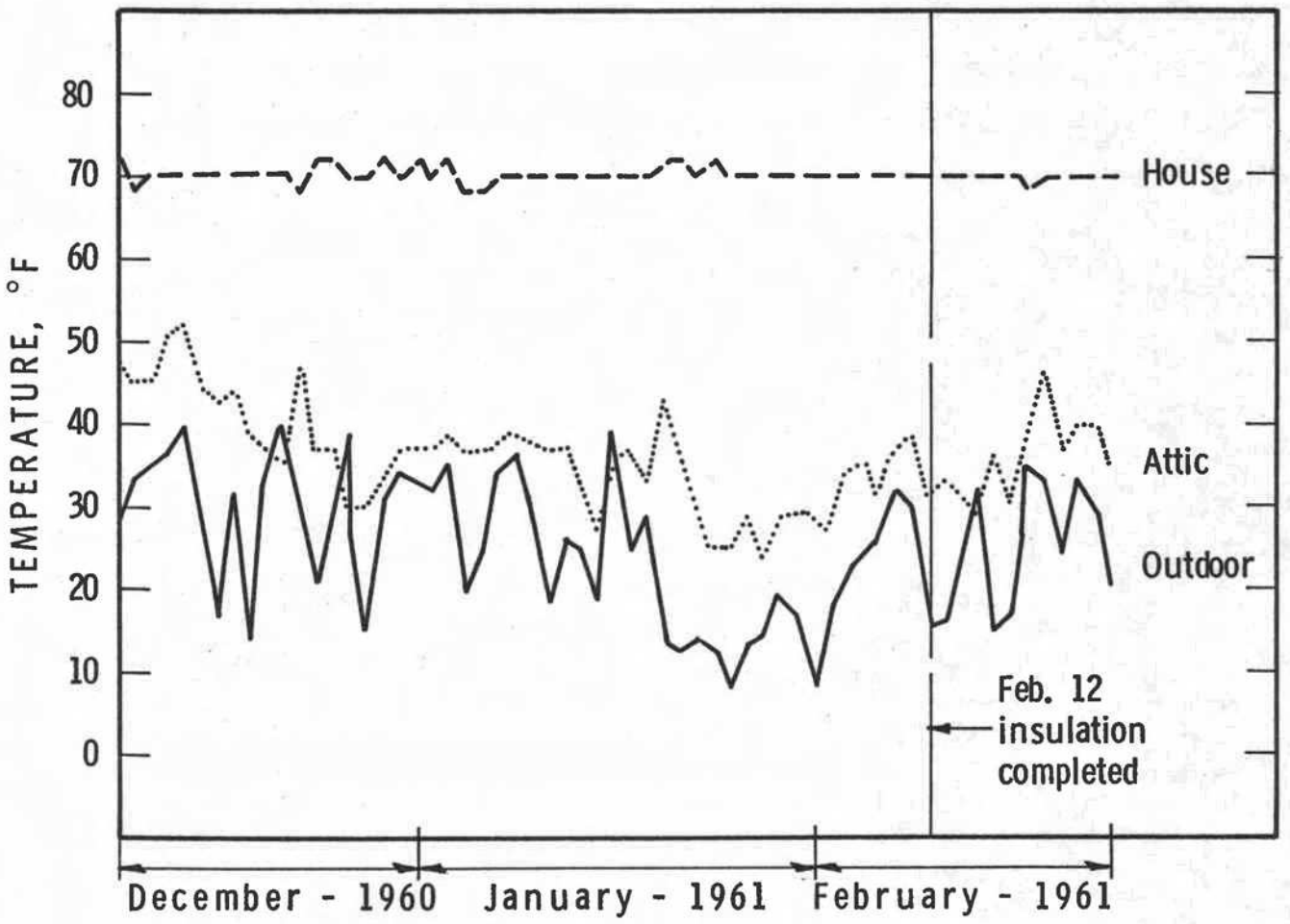


FIGURE 6

RECORD OF TEMPERATURES
(DAILY AVERAGES)

BR. 3421-5