

U. S. DEPARTMENT OF COMMERCE

Bureau of Standards

DEC 11 1940

BUILDING MATERIALS AND STRUCTURES

REPORT BMS57

Roofing in the
United States—Results of
a Questionnaire

by

LEO J. WALDRON

and HUBERT R. SNOKE

NATIONAL
BUREAU OF STANDARDS



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ISSUED SEPTEMBER 18, 1940

The National Bureau of Standards is a fact-finding organization; it does not "approve" any particular material or method of construction. The technical findings in this series of reports are to be construed accordingly.

UNITED STATES GOVERNMENT PRINTING OFFICE • WASHINGTON • 1940

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Foreword

This report summarizes the replies to a questionnaire submitted to the Home Owners' Loan Corporation and the Federal Housing Administration in an effort to obtain a general picture of roofing practices and conditions throughout the country. Information obtained by this method is intended to supplement that obtained in field surveys which have been previously reported in this series.

LYMAN J. BRIGGS, *Director.*

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ABSTRACT

In an effort to obtain a general picture of roofing practices and conditions throughout the country, a questionnaire was circulated to 148 field offices of the Home Owners' Loan Corporation and Federal Housing Administration in 48 States and the District of Columbia. This report summarizes the combined results of these replies.

The questionnaires covered the following items: Distribution, durability, unsuitability, and restrictions of various roofing materials; customary roofing practices; materials for nails, valleys, flashings, gutters, and downspouts; causes of premature roof failures; and the use of new types of roofing materials.

The data are presented graphically where possible.

I. INTRODUCTION

In planning the work of the National Bureau of Standards on roofing materials for low-cost housing construction, a comprehensive survey of the various types of commercial roofing materials used throughout the United States was contemplated together with observations on their weathering qualities on roofs of known history in locations typical of widely differing climatic conditions. The program embraced research to establish the characteristic and significant properties of roofing materials in general, the determination of the properties of those materials whose usage is well established to serve as a basis of comparison for newly developed materials, and the study of methods of installing roofing materials to determine which

methods are most conducive to long service life.

Definite conclusions concerning the weathering qualities and extent of use of roofing materials can be based only on observations in the field. In two field surveys in 20 Eastern States made during 1938, the kinds of roofing material were totaled for 20,841 dwellings, along 4,038 miles of highway. The results have been published as Building Materials and Structures Reports BMS6, Survey of Roofing Materials in the Southeastern States,¹ and BMS29, Survey of Roofing Materials in the Northeastern States.² These reports also discuss at length the weathering qualities of the various roofing materials and contain a total of 96 photographs illustrating types of weathering.

The original plan to include all sections of the country in similar surveys requires very considerable time, however, so it was thought desirable to obtain a general picture of roofing practices and conditions throughout the country by means of questionnaires filled in by competent observers.

The Home Owners' Loan Corporation and the Federal Housing Administration, through their representatives in the field, furnished an ideal set up for this questionnaire plan. The chief point of difference between the two questionnaires was that an attempt was made in the

¹ Price 15 cents. See cover page III.

² Price 10 cents. See cover page III.

one sent to the Federal Housing Administration to secure information concerning the extent of use of some of the roofing materials that have been developed recently. When the questionnaires were circulated, these agencies maintained a total of 148 field offices, 83 representing the Home Owners' Loan Corporation, and 65, the Federal Housing Administration, distributed throughout the 48 States and the District

surveys have been made by representatives of the National Bureau of Standards with the results obtained in the surveys indicates the reliability of the data in those sections.

It should be emphasized that the material in this report is simply a compilation of data furnished by others. Also that the questionnaire method was not intended as a substitute for surveys in the field, but instead, was expected

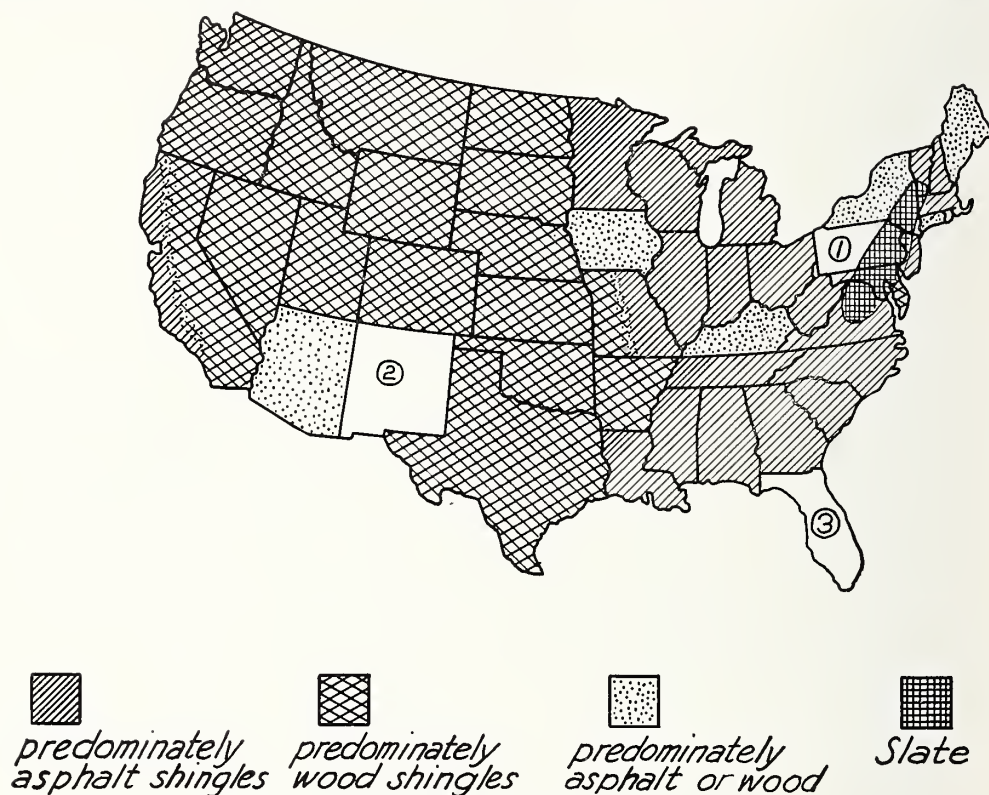


FIGURE 1.—Distribution of principal roofing materials.

1. Predominately slate, wood, or asphalt.

2. 50 percent built-up roofing.

3. Predominately tile, cement-asbestos, or asphalt.

of Columbia. Each of these offices contained men who were thoroughly familiar with local roofing practices, usually through previous experience in the architectural, building, roofing, or real-estate fields.

The data presented herein are based upon the combined returns from both agencies (148 offices). In many offices several persons collaborated in furnishing the information. While the data represent the opinions of the persons who filled in the questionnaire forms, in most cases these were carefully considered opinions of qualified observers. Comparison of the returns from the two sections in which field

to supplement the information obtained by such surveys.

The data are presented graphically where possible.

The various items that were used with the questionnaire are regiven in italic type at the beginning of the following sections.

II. DISTRIBUTION OF ROOFING MATERIALS

List the approximate percentage of each type of roof on urban and on suburban dwellings in your district.

The following materials were listed: Slate,

wood shingles, asphalt shingles, metal shingles, cement-asbestos shingles, tile, sheet metal, asphalt roll roofing, asphalt built-up roofing, and coal-tar pitch built-up roofing.

The map (fig. 1) summarizes these replies and shows the predominating roofing material on both urban and suburban dwellings in each of the States of the Union.

In general, wood shingles were reported as the predominating roofing material in the Western States, and asphalt shingles in the Eastern States. The Mississippi River divides the country roughly into two sections with respect to the use of these two materials. There are, however, States in both sections where these two materials are used to almost an equal extent and where it is difficult to determine from the data at hand the predominating material. Some of these areas are indicated on the map. Slate-producing areas in the Middle Atlantic States are noted.

Although other materials, such as metal, built-up roofing, cement-asbestos shingles, tile, and roll roofing, have comparatively wide use in certain sections of the country, the data indicate that their use is not sufficiently large to make them the predominating material in any one State.

III. DURABILITY OF ROOFING MATERIALS

List the approximate years of service before replacement of roofs on dwellings in your district.

This question referred to the types of roofs listed in section II.

The average years of service that were reported for wood and asphalt shingles are given in the maps (figs. 2 and 3). Geographic location appears to be a controlling factor in deter-

mining the life of asphalt shingles, as a much longer life obtains in the northern section of this country than in the south. This is confirmed by the results of actual surveys in Northeastern and Southeastern States (see footnotes 1 and 2, page 1). Twenty-six States north of the dotted line in figure 3, which corresponds roughly to the 40th parallel of latitude, reported an average life of 16 years for asphalt shingles; 21 States south of this line reported an average life of 12 years.

That these figures would vary over a considerable range was to be expected, since in many cases factors other than the material itself determine the ultimate service life of roofs. This is particularly true of materials whose

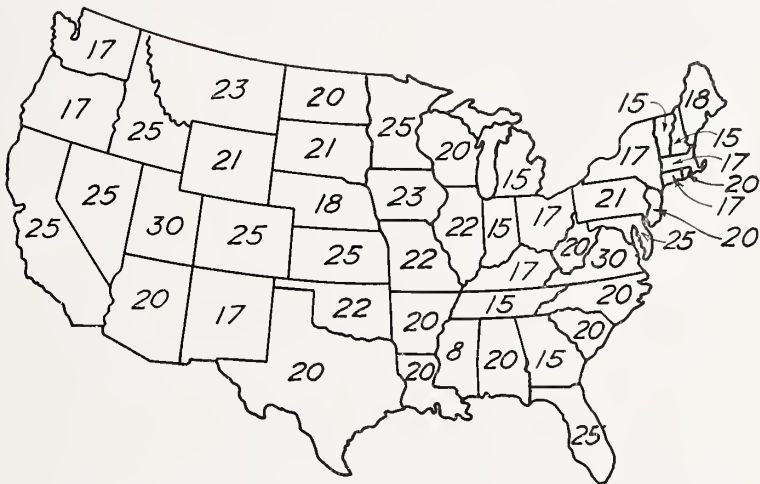


FIGURE 2.—Reported life of wood shingles, in years, averaged for each State.



FIGURE 3.—Reported life of asphalt shingles, in years, averaged for each State.

service life is longest, such as certain types of metal, slate, and cement-asbestos.

The data reported for wood shingles do not indicate any marked differences in the life of wood shingles in different locations.

IV. UNSUITED ROOFING MATERIALS

List roofing materials considered unsuited in your district because of climatic conditions, and briefly list climatic conditions.

No replies were given to this question in 45 percent of the questionnaires. The others listed one or more materials which they considered unsuitable for roofing in their district because of some prevailing climatic condition, a total of 111 items being included in this list. The results are summarized on a percentage basis in figure 4.

Climatic conditions listed as restrictions in the use of specific roofing material were as follows: Strong winds, hail, extremes of temperature, heat, fog, salt air, and industrial atmospheres. Materials reported as unsuited under each of these headings were:

Strong winds: Slate, tile, asphalt-prepared roll roofings and shingles, and metal roofings.

Hail: Slate, tile, asphalt-prepared roll roofings and shingles, and cement-asbestos shingles.

Extremes of temperature: Tile, metal roofings, and asphalt shingles.

Heat: Asphalt-prepared roll roofings and shingles, wood shingles, and built-up roofing.

Fog, salt air, or industrial atmospheres: Metal roofing.

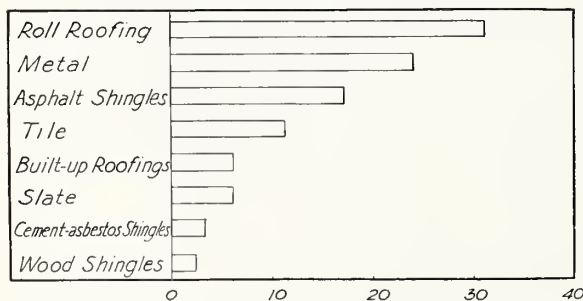


FIGURE 4.—Percentage of materials reported as unsuited in certain climates.

V. RESTRICTED ROOFING MATERIALS

1. BY LOCAL REGULATIONS

List roofing material whose use is restricted by local regulations.

Replies from 41 States and the District of Columbia, representing 66 percent of the total replies, indicate that the use of wood shingles was restricted within fire districts of urban areas.

2. BY PROHIBITIVE FREIGHT RATES

List roofing materials whose use is restricted in your district because of prohibitive freight rates.

Fifty-four percent of the replies state that the use of one or more of the conventional roofing materials is restricted within their district because of prohibitive freight rates. Four materials were mentioned a total of 128 times. The results are summarized on a percentage basis in figure 5. Of these, slate, tile,

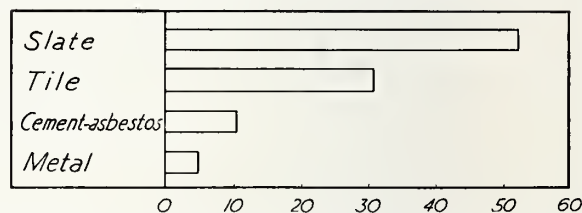


FIGURE 5.—Percentage of materials reported as restricted by prohibitive freight rates in certain locations.

and cement-asbestos material constitute 94 percent of the total. These are all of the heavy rigid type and transportation costs would be important factors in determining their use in locations somewhat distant from the source of supply.

3. OTHER ROOFING MATERIAL NOT USED

List roofing material not used in your district and probable reason for same.

Approximately 50 percent of the replies listed one or more materials not used in their district. Eight materials were mentioned a total of 111 times. The relative percentage of each is shown in figure 6.

The principal reasons given for the nonuse of some of the materials include: High initial cost of slate, tile, cement-asbestos shingles, copper, or terne roofing; high construction costs

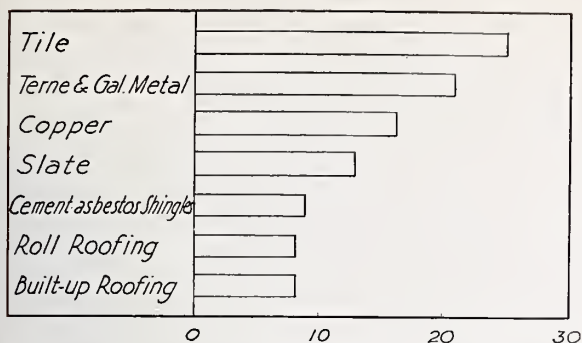


FIGURE 6.—Percentage of materials reported as being unused in certain districts.

due to the excessive weights of slate or tile; appearance of metal or asphalt-prepared roll roofings; high maintenance costs of tile, metal, or built-up roofing; lack of adaptability of metallic roofing to the design of the structure; and limitation of built-up roofing to relatively flat pitches.

VI. CUSTOMARY ROOFING PRACTICES

Are the following practices customary in your district?

1. Use of ridge roll on wood-shingle roofs.
2. Use of ridge roll on slate shingle-roofs.
3. Use of beveled wood strip on reroofing over wood shingles.
4. Use of roll roofing on overhang at eaves of asphalt-shingle roofs.
5. Use of sheet metal on overhang at eaves of other roofs.
6. Use of saturated felt under asphalt shingles in new construction.
7. Use of saturated felt under asphalt shingles over an old roof.

8. Are gutters and downspouts ever eliminated?
9. Are snow guards used?

The reports are summarized on a percentage basis in figure 7.

VII. VALLEY MATERIAL

List type of valley material generally used with the various types of roofing.

The replies to this question

are summarized on a percentage basis in table 1. They indicate that the chief materials used for valleys on the various roofings are:

Slate—copper.

Wood shingles—galvanized metal or terne.

Tile—copper.

Asphalt shingles—roll roofing or galvanized metal.

Cement asbestos shingles—copper or galvanized metal.

TABLE 1.—Types of valley material used with various kinds of roofing materials

Roofing material	Valley material, average percentages reported					
	Copper	Terne	Galvanized metal	Roll roofing	Metal ¹	Miscellaneous
Slate	75	10	9	—	5	1
Wood shingles	10	33	47	—	5	5
Tile	68	7	19	—	3	3
Asphalt shingles	4	15	23	56	1	1
Cement-asbestos shingles	44	13	34	—	7	2

¹ Unclassified.

VIII. FLASHINGS, GUTTERS, AND DOWNSPOUTS

List the approximate percentage in use and approximate years of service before replacement of flashings, gutters, and downspouts.

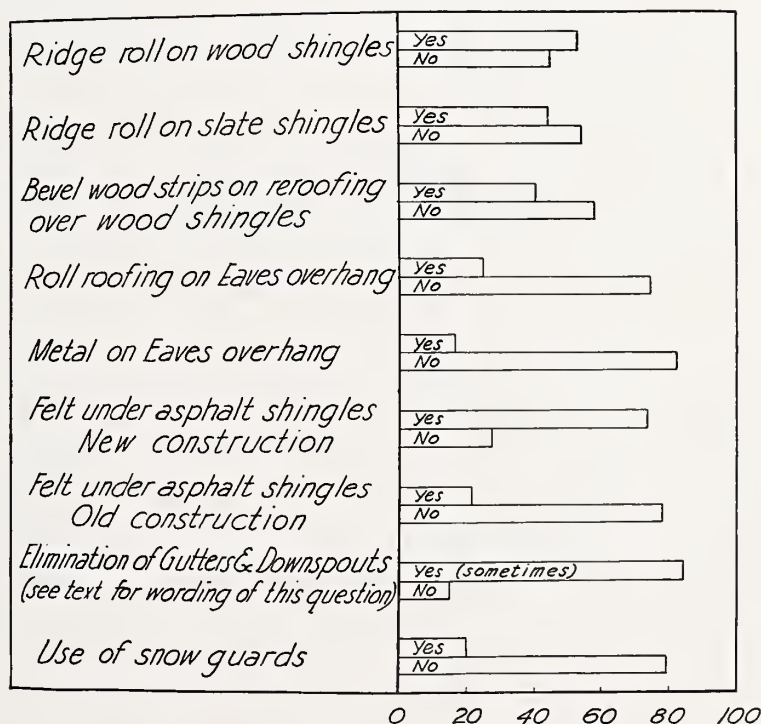


FIGURE 7.—Percentage of replies covering roofing practices.

The combined and averaged data obtained in answer to this question are summarized in table 2. These figures are to be considered as general, since wide fluctuations in service behavior of metal flashings, gutters, and downspouts may exist within a given district, depending upon the corrosive conditions of the prevailing atmosphere in which the particular article is exposed, as well as on the effectiveness of protective coatings such as paint.

TABLE 2.—*Summary of data on flashings, gutters, and downspouts*

	Average of replies	Life
	Percent	Years
<i>Flashings:</i>		
Galvanized	57	19
Terne	31	18
Copper	12	44
<i>Gutters:</i>		
Galvanized	75	17
Copper	10	43
Wood	7	20
<i>Downspouts:</i>		
Galvanized	84	17
Copper	11	44

IX. PREMATURE FAILURES

In your opinion which of the following items cause premature roof failures in your district?

- (1) Faulty design.
- (2) Faulty construction.
- (3) Failure of material.
- (4) Failure of flashings.
- (5) Severe weather conditions.

This question was contained only in those questionnaires submitted to one agency. The results are summarized in figure 8. It appears from these data that no one factor can be considered as prominently responsible for roof

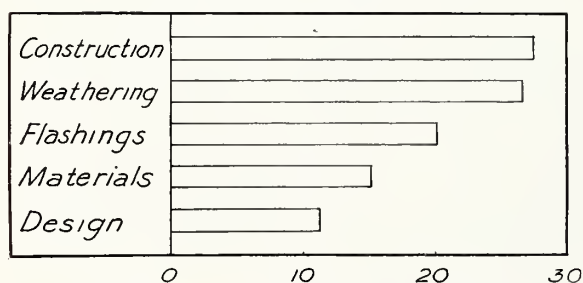


FIGURE 8.—*Percentage of replies covering roofing failures.*

failures. Poor construction and severe weathering conditions, in the opinion of those answering the questionnaire, constitute over 50 percent of the premature roof failures.

X. ROOFING NAILS

List the type of nails generally used with slate, wood shingles, tile, asphalt shingles, and cement-asbestos shingles.

This question was contained only in the questionnaires submitted to one agency.

A summary of the replies to this question is presented in table 3.

TABLE 3.—*Type of nail used with various kinds of roofing material*

Roofing material	Type of nail, average percentages reported				
	Copper	Galvanized	Blue steel	Cement-coated	Miscellaneous ¹
Slate	70	26			4
Wood shingles		81	8	6	2
Tile	65	32		1	2
Asphalt shingles		70	5	5	
Cement-asbestos shingles	63	30		2	5

¹ Lead coated, zinc, etc.

XI. USE OF NEW TYPES OF ROOFING MATERIALS

Indicate by a check in the proper column the extent of use of the roofing material listed.

This question was contained only in the questionnaire submitted to one agency.

The columns were headed "no use, slight use, moderate use, and wide use." The following materials were listed:

1. Crimped copper shingles.
2. Other metal shingles.
3. Metal tile, copper or galvanized.
4. 10-ounce copper sheet.
5. 3- or 4-ounce reinforced copper.
6. Shingle tiles (light weight).
7. Portland cement shingles.
8. Thick asphalt mastic shingles.
9. Copper-bound asphalt shingles.

The percentage of checks in the various columns for these materials is summarized in table 4.

TABLE 4.—*Use of new roofing materials*

Roofing material	Percentage of replies		
	No use	Slight use	Moderate or wide use
Crimped copper shingles	85	15	-----
Other metal shingles	57	38	5
Metal tiles	60	37	3
10-oz copper	66	34	-----
3-oz copper	71	27	2
Shingle tiles	32	50	18
Cement shingles	38	46	16
Thick mastic shingles	10	39	* 51
Copper-bound shingles	75	20	5

* Replies apparently confused with so-called thick-butt shingles made on a felt base.

XII. RECAPITULATION

This report summarizes the results of the replies to a questionnaire submitted to the Home Owners' Loan Corporation and the Federal Housing Administration. A number of interesting and important generalizations based on the results of the questionnaire are:

1. In general, wood shingles were reported as the predominating roofing material in the Western States and asphalt shingles in the Eastern States. The Mississippi River divides the country roughly into two sections with respect to the use of these two materials.

2. A much longer life obtains for asphalt shingles in the northern section of this country

than in the south. Variations in the reported life of wood shingles indicate little effect from geographic location.

3. From the standpoint of prevailing climatic conditions, no single roofing material can be considered as entirely suitable in all sections of the country.

4. The use of wood shingles is usually restricted within the fire districts of urban areas in many States.

5. High transportation costs limit the use of heavy rigid roofing materials in locations somewhat distant from the source of supply.

6. Copper, galvanized-metal, terne, and asphalt-prepared roll roofing are the principal materials used for valley construction.

7. Copper or galvanized nails are generally used with most types of roofings.

8. No one factor can be considered as prominently responsible for roof failures. Poor construction of roofs and severe weathering of materials constitute more than 50 percent of premature roof failures.

9. New materials which have appeared for roofing purposes within recent years have, as yet, but slight use.

WASHINGTON, May 21, 1940.

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