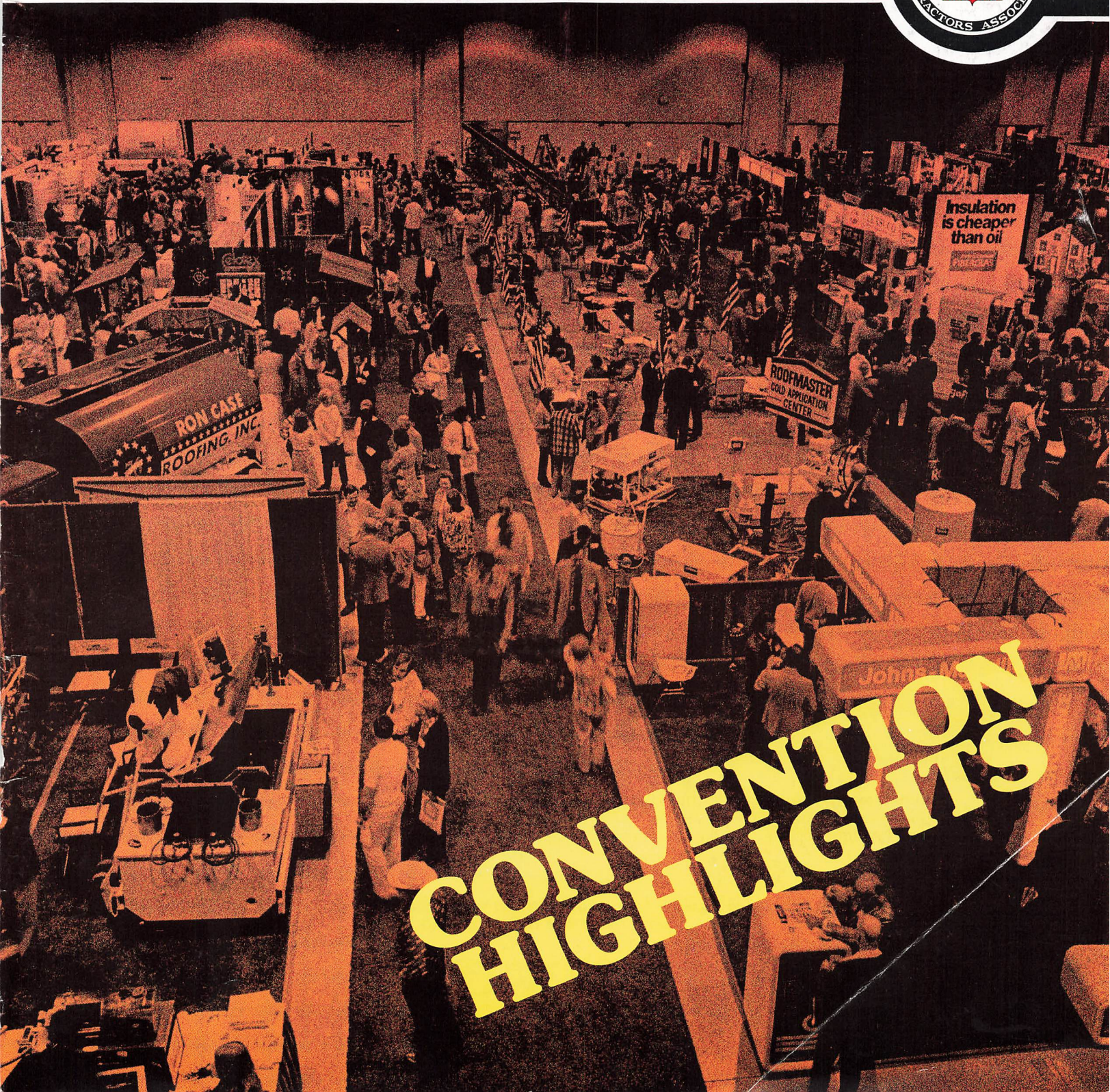


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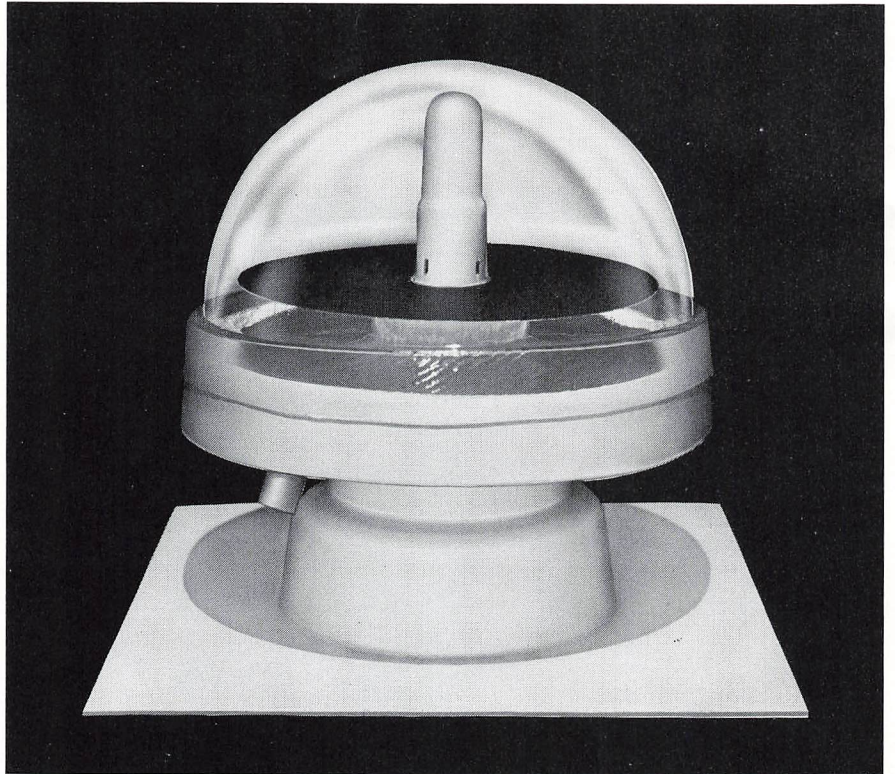
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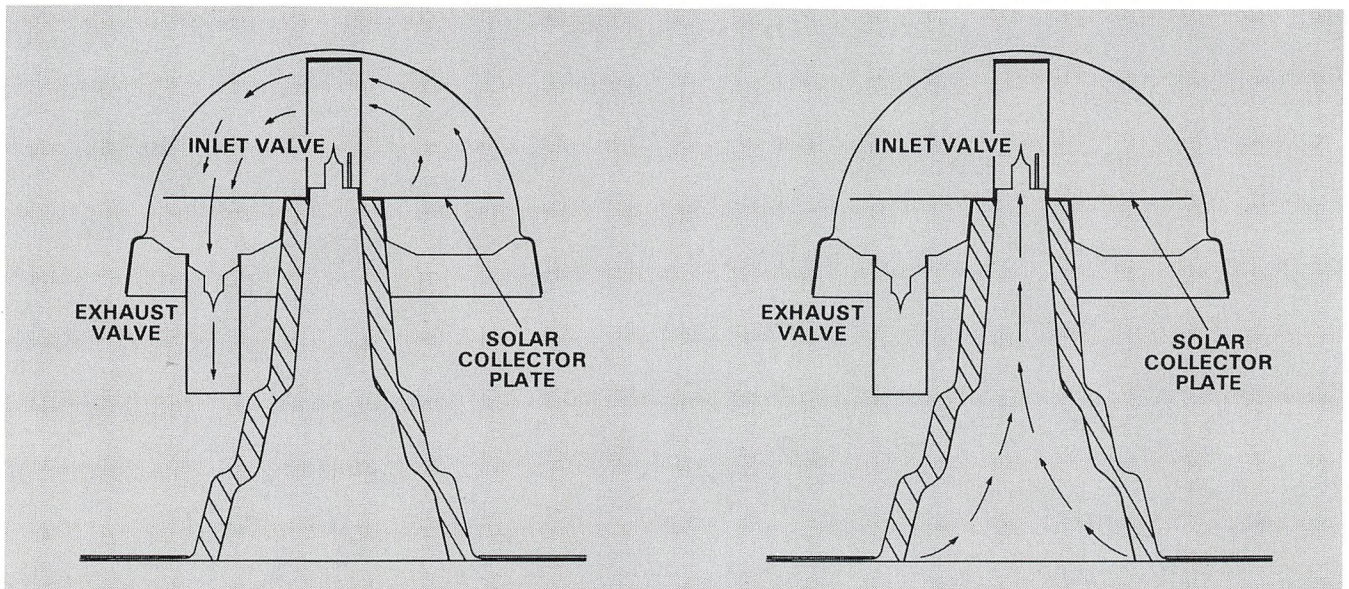
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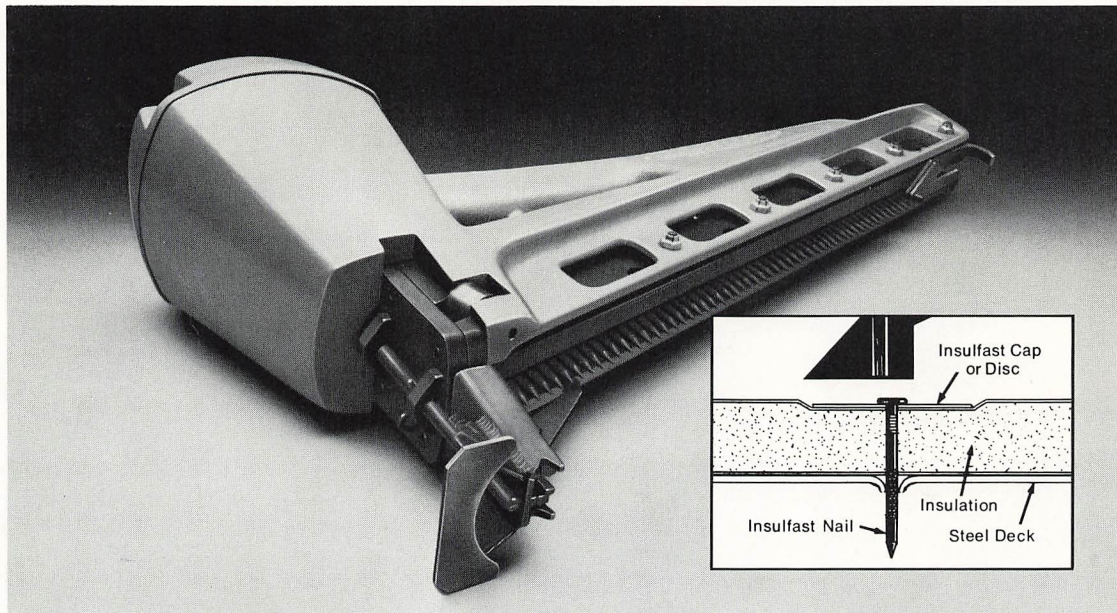
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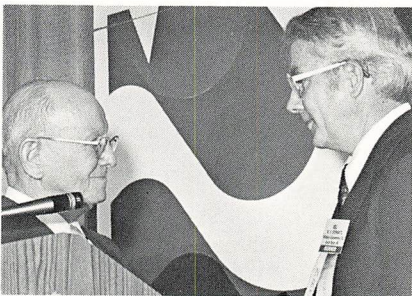
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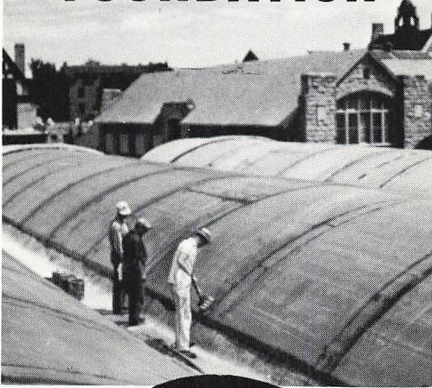


*Convention Highlights
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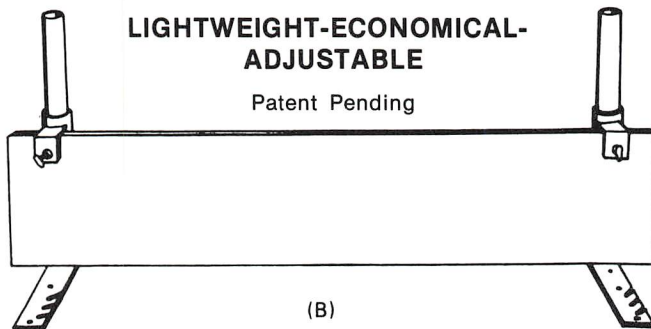
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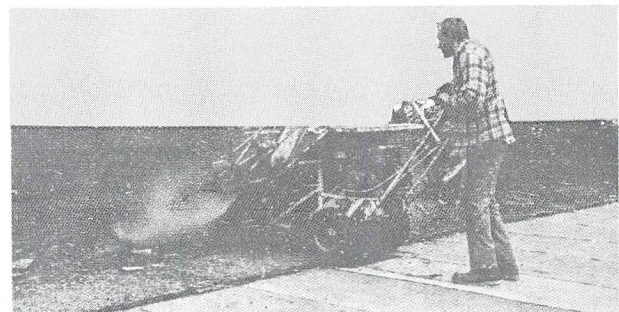


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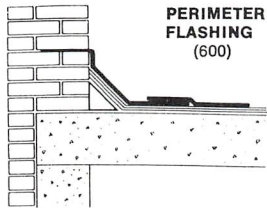
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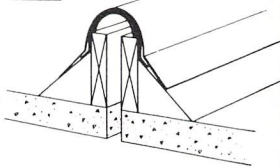
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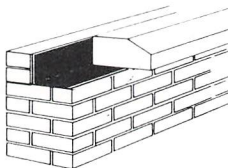
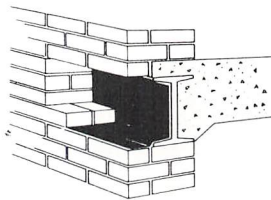
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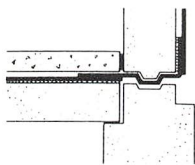
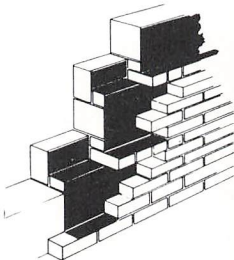


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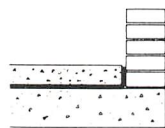


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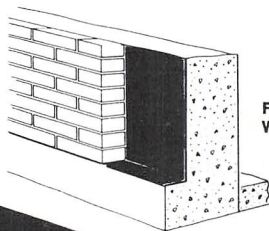
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Comment

What has NRCA done for you lately?

Depending upon your viewpoint, this issue will appear to be either a hodgepodge of unrelated articles, or as a conglomeration of newsworthy features, displaying the variety and complexity of our industry. With your indulgence, we prefer the latter.

We prefer it because there is so much of importance going on in the roofing industry today that your attention must be widespread, and NRCA's activities must be diversified. Consider:

The NRCA Convention held recently in Phoenix was the largest ever - in terms of both total attendance and exhibitor participation. Some highlights of the Convention are included in this issue.

The latest report prepared by the National Bureau of Standards' Center for Building Technology was inspired, in part, by action taken by NRCA's technical committees. Bob Mathey and Walt Rossiter's study on roof temperatures and insulation is timely and important.

The NRCA Roof Deck Contractor program is scarcely two years old, yet we are presenting in this issue the fifth article in our series on roof decks - this one on steel decks by John Gundel.

Many NRCA members will be sitting at the bargaining table in the weeks ahead. NRCA, through its membership in the Council of Construction Employers, has been working behind the scenes to make bargaining more balanced and realistic. You'll find the reports of CCE President Harry Taylor and Chairman Bob Linck to be thought-provoking.

Project Pinpoint has been gathering momentum for two years, and now stands as the most complete source for information on roofing jobs and failures in the country. You may be jolted by some of the results - others have been.

The common denominator is: awareness. Important changes are taking place in our industry - some good, others not so good - almost on a daily basis. What has NRCA done for you lately? Read on.....



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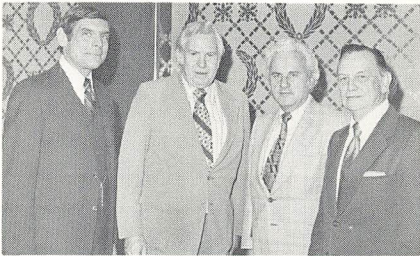
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Ideas, notes and random thoughts



Greeting the Secretary of Labor at a recent meeting of the Board of Directors of the Council of Construction Employers were, from left, CCE Board Chairman Bob Linck, Secretary of Labor W.J. Usery, Jr., CCE Vice Chairman Joseph Sansone, and CCE President Harry Taylor.

Business losses to crime now exceed \$20 billion a year, the Bank of America found in recent study. But this amount, accounted for by statistics, may only be the tip of the iceberg, since so many crimes go unreported. Said a spokesman: "A small company is 35 times as likely to become the victim of crime as the business with receipts of \$5 million or more."

For What It's Worth: The average yearly cost of collecting garbage per family in New York City is \$209.

Dodge Optimistic: The latest update of Dodge/Sweet's Construction Outlook anticipates a total con-

struction contract value in 1976 of \$102.5 billion, an increase of 12% over last year. Dodge attributes almost all of the increase to housing. In addition, composition of the nonresidential building market is expected to change, with institutional construction receding and commercial work gaining strength, and general manufacturing building taking up some of the slack produced by declining energy-related manufacturing projects.

Quotable: "Am I embarrassed to speak for a less-than-perfect democracy? Not one bit. Find me a better one. We are still the kind of country most people in the world would like to be"--Daniel Patrick Moynihan, former U.S. ambassador to the United Nations.

1976 Dues must be received by June 1 in order to keep your membership in force. Most dues are in -- but if you're one of the few who haven't yet paid, please do so today.

The Biggest Business of All: Spending by Federal, state, and local governments now accounts for more than a third of the total value of the nation's goods and services, which amounts to \$1.4 trillion a year.

According to Secretary of the Treasury William Simon, government spending will account for 60% of all spending in 25 years.

Another Attendance Record: Final attendance count for the Phoenix Convention was 2514, up 169 from last year's previous high. Thanks to all those who helped make it successful.

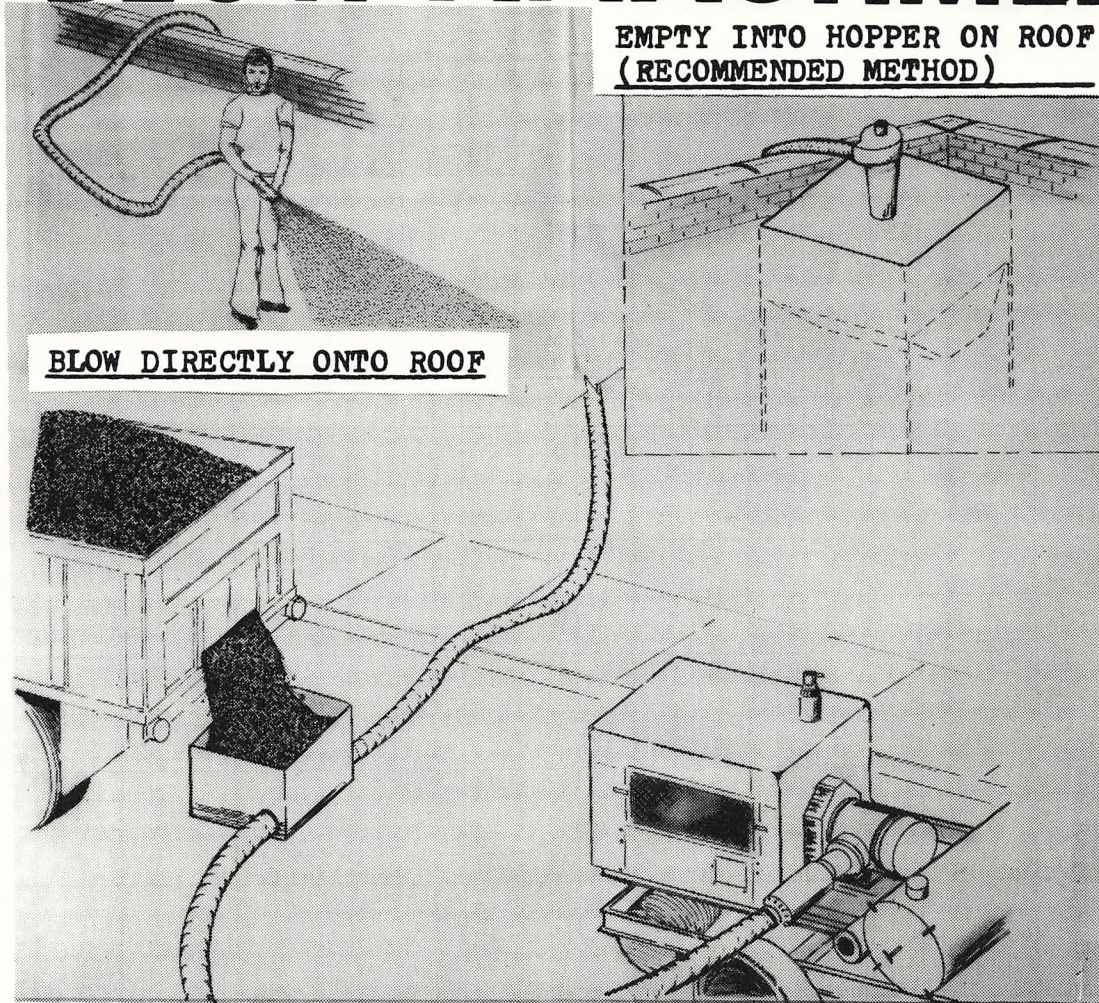
Sad But True: A decade and \$1 billion later, according to a General Accounting Office study, a federal program to improve reading ability of poor children is anything but a smashing success. The funds were appropriated under the Secondary Education Act of 1965. The GAO, after reviewing the program in 15 school districts in 14 states, found 60% of the pupils fell further behind their age group in reading ability, 6% showed no change, and 35% made some progress. GAO pronounced the program's value as "debatable."

And Finally: The United States Postal Service returned a letter properly addressed to Mr. Winston Blount in Montgomery, Alabama -- marked "addressee unknown." Mr. Blount is a former Postmaster General of the United States.





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... MORE ON

Gentlemen:

Reference Jan. 1976 issue, featuring Gypsum Concrete Roof Decks, by David L. Magnusen, there are several controversial items mentioned that I believe the writer should clarify.

At the last two conferences sponsored by NRCA at the National Bureau of Standards, I questioned the speakers on the accuracy of the 'U' value of lightweight concrete structures, i.e., "How soon after the gypsum concrete is poured, can we hope to obtain published 'U' values?" Most of the data as I recall states that this value is reached upon achieving oven dry conditions (200°F). From information I have seen in various papers over the years, the deck temperatures should measure a maximum of 85° above ambient temperature, therefore the Phila. area (and I assume everyone in the 40° latitude) can at best reach temperatures of approximately 185°F.

Unfortunately the conference speakers glossed over the question with several unsatisfactory answers. Therefore, I would personally welcome an answer from Mr. Magnusen.

Insofar as the statement made that "Poured gypsum roof decks can be poured in sub-freezing and sub-zero temperatures", I respectfully challenge the practicability of a successful roofing application under these conditions. The hydration process constantly emits water at the deck surface and ambient conditions will determine whether the water condenses into a liquid or a solid. Normal roofing operations require an early morning start and I submit that our experience indicates the presence of moisture or ice in the morning hours, for several days after the gypsum has been poured. The only way roofing operations might begin, would be in the mid-day, when moderating temperatures would completely evaporate all signs of moisture.

The statement "roof covering may be applied as soon as practicable after it (the gypsum) has been poured" may be considered highly controversial; for on new construction where gypsum finds it's major usage, the temperatures above the roof are normally higher than below the deck where the area is unheated, etc. This will cause continuous moisture migration to the topside of the deck. Please note, that anything that will cause continuous water formation to the underside of the roofing membrane must be treated with caution—for this same moisture can certainly accelerate the destruction of the membrane.

Mention is made of the decks designed to dry from the underside. My question to the writer is—"how effective is this design, when there is proof developed by the MRCA (c/o Paul Morris), that moderate percentages of uncombined water exists in sample cores of roofing ten to twelve years old?". Also, during summertime temperatures vapor will migrate to the warm or topside of the deck, whereas in the winter the reverse would be true. It seems to me that the water molecule is in a state of limbo, traveling up and down within the deck, awaiting the right conditions to permanently remove itself from the mass.

Another point that might be discussed or elaborated on, would be the minimum thickness required by gypsum decks particularly above the sub-purlins. On decks having no insulation it is apparent that the top fibres of the steel purlin will be subject to colder temperatures because of it's proximity to the ambient air. Therefore, I believe traces of condensation are caused by the warmer fibres of the bottom of the steel sub-purlins and the cooler upper fibres may likely interact with adjoining moisture in the concrete mass. This can become fairly visible on a smooth roof deck membrane, where lighter shades outline the purlins. Whether or not this apparition is a result of condensation, I do not know...but it might be an area that the NRCA might want to investigate to learn if the membrane has been somehow affected.

To aid in eliminating the moisture inherent in gypsum decks, I firmly advocate the ventilation of these systems, not only from below, but from the top, i.e. via vented base sheets, vented perimeter nailer, vent stacks and any other means to relieve the pressure of the moisture built-up within the deck.

Mr. Magnusen mentions various items such as techniques to compensate for expansion and contraction; nailing of the base sheet; expansion joints at a maximum of 200' intervals, roof intersections, etc. These are most important recommendations which should be predominately featured in gypsum advertising. Please note that as early as five years ago many roofing manufacturers detailed in their specifications a solidly mopped base sheet to gypsum decks which by direct attachment reflected the stresses of the gypsum deck particularly in the areas above the purlins.

NRCA should be grateful to Mr. Magnusen for his informative article and I welcome his comments on the aforementioned questions.

Very truly yours,
Sidney Kane, P.E.
S. Kane & Son, Inc.
Philadelphia, PA.

GYPSUM . . .

Mr. Magnuson replies:

Thank you for the opportunity of replying to Mr. Sydney Kane's letter concerning my article on Gypsum Concrete Roof Decks. I would also like to express my thanks to Mr. Kane for his comments and questions which bring up interesting points not thoroughly covered in the article.

"How soon after the gypsum concrete is poured, can we hope to obtain published 'U' values?" As indicated in the phrase just prior to it in the letter, the question apparently concerns lightweight insulating concrete fill rather than poured gypsum concrete decks. Elevated temperatures are not necessary to effect drying in poured gypsum roof deck construction. In poured gypsum roof decks, the gypsum concrete is poured over a vapor-pervious formboard, thus permitting drying through the formboard over the entire deck area. The rate of drying varies, of course, with the conditions prevailing during this period. Under average or typical conditions, the construction will be essentially dry by the end of the first heating season. Obviously, adverse drying conditions could delay drying considerably.

"How effective is this design . . . ?" The above paragraph would also apply to this question wherein the MRCA study by Paul Morris is referenced. This study pertains to lightweight concrete insulating fill over corrugated steel centering and is in no way relevant to poured gypsum roof deck construction.

"Poured gypsum roof decks can be poured in sub-freezing and even in sub-zero temperatures . . ." This is not necessarily a recommendation, but a statement of fact. Certainly it is more desirable to install both the roof deck and the roofing in moderate temperatures. However, the construction rate of some projects brings them to a point where all or part of the deck and roofing must be applied in winter months or construction progress is halted. In such cases, the decision is often that of proceeding under something less than the most favorable conditions.

"Roof covering may be applied as soon as practicable after it (the gypsum) has been poured." Admittedly, free water contained within the poured gypsum slab may condense on the underside of the base felt but such condensation occurs over other types of deck as well and, to my understanding is the reason for a coated base sheet being specified for use here rather than a saturated sheet. For a nailed application where there is purposely no bond established between the base felt and the deck, and it is known that water vapor in or under the deck will at some time migrate to, and condense on, the cold underside of the membrane, is such water or ice or frost any more or less significant than a layer of comparable thickness on top of the deck at the time of roofing?

Condensation will occur on the underside of the base felt with any number of roof constructions. Water vapor will migrate to the cold underside of a roof covering just as the vapor from uncovered foods left in a refrigerator will migrate to the colder refrigerator coils. The source of moisture may be from the deck construction itself, extraneous moisture trapped within the construction at the time of application, or vapor from within the occupied portion of the building finding its way to the membrane through a vapor pervious deck and/or through violations of the vapor barrier.

". . . ventilation . . . not only from below, but from the top . . ." While we have no objection to venting from the top side, we believe it to be totally unnecessary for poured gypsum roof deck construction where drying is adequately effected through the formboard. We would, however, be opposed to top venting being mandatory with this construction since it would needlessly add cost to a system which has proven itself through over 50 years of excellent performance and wide acceptance.

Minimum Thickness of Gypsum Above Sub-purlins. The phenomenon that causes the location of the sub-purlins to sometimes be discernable on the top surface of a smooth surface roof covering would seem to be the same as that which reveals the location of lath, studs, joists, and nails in exterior wall construction, a phenomenon frequently referred to as "photographing", "telegraphing", "Shadowing" or "thermal precipitation". I am not aware of it having any deleterious effect upon roofing any more than it would have upon interior surfaces. Where it occurs on painted walls, the pattern disappears with washing of the walls with no known or visible harmful effect upon the paint.

". . . Important recommendations should be predominately featured in gypsum advertising." Recommendations for the nailed application of the roof covering and the location of expansion joints along with other recommendations and considerations appear in our literature under the heading, "Notes to Architect", which immediately precede our standard specifications. The two referenced recommendations have been in effect for the more than twenty years that I have been associated with gypsum roof deck construction.

I hope that the above has satisfactorily answered the questions and comments presented. If not, I would be most pleased to reply to any points that I may have missed or misunderstood.



THE FIRST YEAR

by Edwin C. Mertz
NRCA Technical Services Manager

This is a summary of the information presented at the Phoenix Convention. It is important to realize that PINPOINT is **not** a project operating within a rigid set of limits, with a well-defined goal and a single objective. It is something at once more difficult to define and of vastly greater potential value.

PINPOINT is a pool of data, a mass of answers waiting for someone to ask a question. As a result it is meaningless to try and "review" the program. This article can only indicate some of the uses to which the data can be put.

PROJECT PINPOINT is now celebrating its first birthday. We have received about 1500 sets of data describing existing jobs, both newly completed projects and problem jobs. This constitutes, by the standards of the industry, a huge pool of data from which to extract information regarding practice and performance. Merely collecting the information and counting the numbers is a beginning, but the true value of the information bank lies in its availability as a source of basic data, important to other programs and in other areas.

The accompanying illustrations indicate three basic ways in which PINPOINT can be used.

A. Baseline Data: From the reports regarding newly-completed projects (new construction plus renovation) it is possible to retrieve data which show the frequency with which various types of materials are used, that is, to describe current practice in the materials area. The first three figures illustrate this use.

- Figure 1 gives the distribution of various deck types. Without going into great detail, this figure shows that metal decks are the most popular, with wood a strong second. Between the two, they account for some 63% of the decks reported. The unexpectedly high percentage of wood decks might be thought to be the result of a geographical bias in favor of the West Coast area. A check of the number of reports against NRCA membership by state, indicates that this is not so, and the data is more or less geographically random.
- Figure 2 - This graph displays the same sort of information regarding the distribution of insulation types. The interesting item here is the fact that some 35% of construction does not have added insulation.

Considering the industry's interest in energy matters, it is of further interest to establish the insulating value of this group of decks. Making some reasonable assumptions about deck thickness, the "average uninsulated" deck has an R-Value of about 3.0.

- Figure 3 - Looking at similar data on membrane type distribution, the results are as might be expected, 15# asphalt organic and asphalt asbestos felts account for some 60% of the projects reported.

B. Problem Data: It is also possible to use PINPOINT information to establish the characteristics of job failures. Figures 4 and 5 give several examples of this use.

- Figure 4 - In this case the frequency of failure types is shown. Not surprisingly blisters and splits account for almost 85% of failure mechanisms.

- Figure 5 - This illustrates the average age at which "problem" jobs require attention, or become "problems". It is noteworthy that over half of the problems occur between three and ten years, and that the frequency of problems is roughly even over the first three years. The low value for roofs older than ten years is probably partly the result of the fact that beyond some age the roof is considered to have fulfilled its purpose and is not a "problem" job.

C. Combined Data: It is in this area that PINPOINT is most valuable. It is desirable to know what kinds of roof are being built. It is equally desirable to know what kinds of roof are causing problems. But it is really significant to be able to compare the two. For example, if a given system accounts for 30% of the problem reports, it would immediately seem that the system is suspect. However, if an examination of the Baseline Data show that the identical system represents 45% of the projects being built, then it performing substantially better than the average, and the assessment of performance is substantially more valid. Figures 6 and 7 demonstrate this use of the data.

- Figure 6 - This figure demonstrates the performance of systems in terms of the number of membrane plies. The significant fact is that systems of fewer than 3 plies account for only 28% of the projects but roughly twice that percentage of the problems. The data is significant enough to cause concern about the service of roofs with less than 3 plies. This performance must be taken into account in any life-cycle costing.
- Figure 7 - In this case, we are dealing with various methods of deck fastening as performance criteria. The shaded bars represent the percentage of problems while the colored bars represent the percentage of projects. As can be seen the performance is average, except in two cases, loose-laid and hot-mopped attachment. Rather surprisingly, loose-laid materials create only half as many problems as might be expected, while hot-mopped systems seem to be involved in some 15% more problems than their usage would predict. This may reflect the fact that blistering accounts for more than half of all problems, a situation which favors loose-laid sheets.

PINPOINT is one-year old, but is, hopefully growing. Our data base of 1500 reports is, as was said earlier, impressive in terms of previous data banks. However, it is not nearly as good as it can be. The more data we have, the more certain we can be of the truth of our conclusions. PINPOINT is **not** a one-shot operation. It **will** continue. You should continue to report Problem Jobs. (If you need more forms, **please** let us know.)

You will shortly be asked to furnish Baseline Data covering jobs completed in June. PLEASE take the small amount of time and effort required to complete and return the forms. Our ability to serve you in this area is completely dependent on your willingness to supply us with the information. Our goal is to double the number of reports in 1976. Our prospects of fulfilling that goal is up to YOU.

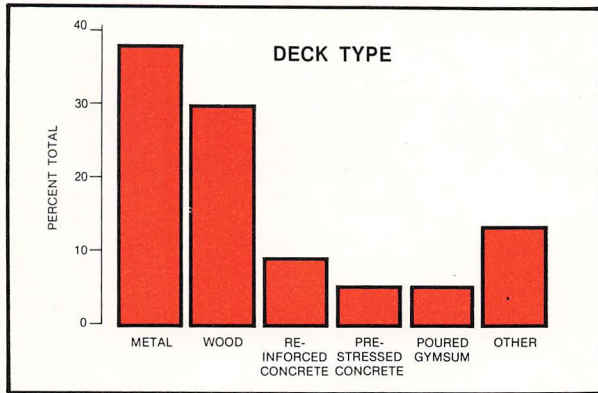


FIG. 1

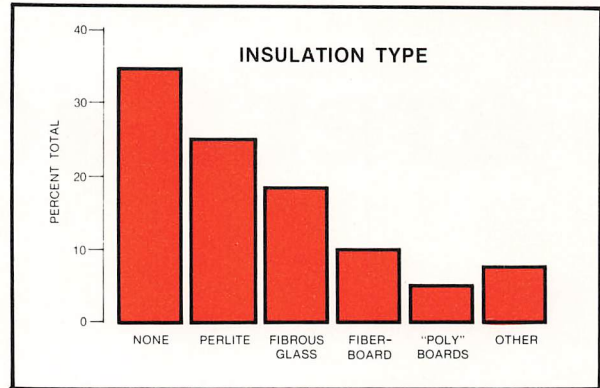


FIG. 2

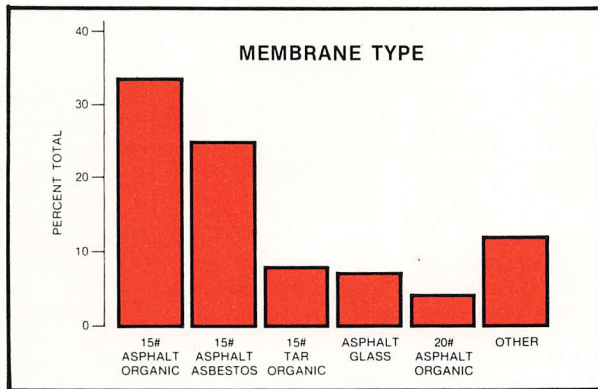


FIG. 3

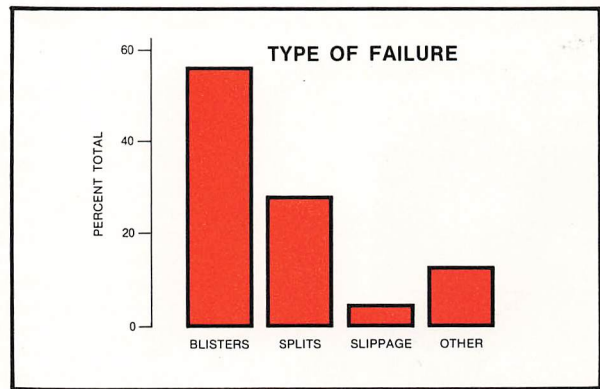


FIG. 4

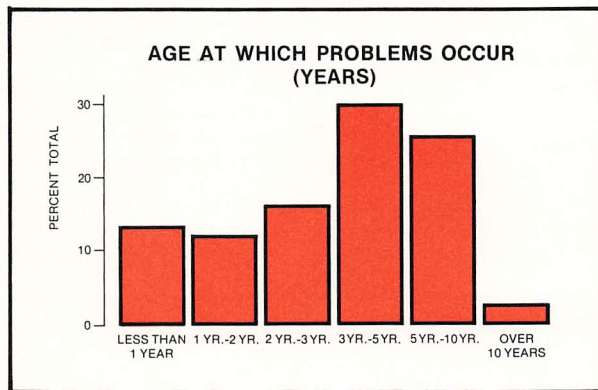


FIG. 5

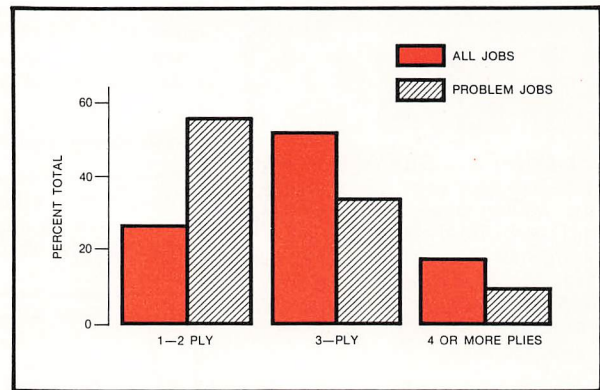


FIG. 6

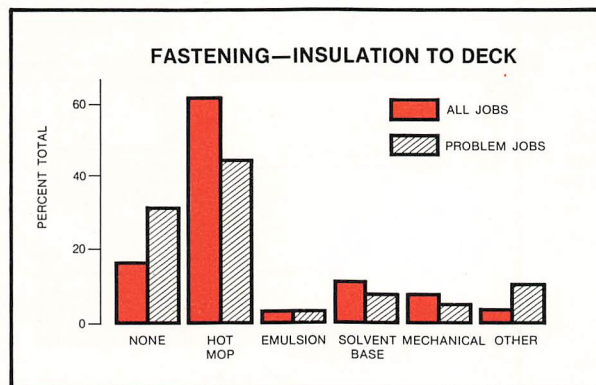


FIG. 7



STEEL ROOF DECK

by John A. Gundel



Editor's Note: Mr. Gundel has been closely associated with the steel deck industry, having been employed by a national producer for 33 years. Following his retirement in 1974 he assumed the position of managing director of the Steel Deck Institute [SDI] and continues to serve this association at the present time.

There is no historic record which tells us who spawned the revolutionary idea of using steel sheeting in place of the traditional material, T & G lumber; nor do we know exactly when the first installation of steel deck was made. However, it is fairly certain that the generic term "Steel Roof Deck" was unknown prior to 1920. In view of this fact, it is nothing short of amazing that the product of this young industry was able to earn the popularity which it enjoys today.

Material

As the name implies, we are concerned with the steel types which are used in deck production.

In the early days manufacturers

bought Hot Rolled Sheets cut to lengths which fit their forming equipment. This steel was not very satisfactory because the surfaces were covered with mill scale and often rather severely pitted, which made cleaning and painting quite a problem.

When Cold Rolled Steel became available a much improved end product could be offered. The producer now buys steel in large coils of 10 tons or more, closely controlled at the mill in regard to: (a) uniform thickness, (b) chemical analysis, and (c) physical properties. These characteristics are governed by material standards that provide specific range limits and tolerances, if any, to which the steel has to be made and ordered.

Engineering and Production

Engineers employed by manufacturers engaged in production of sheet metal goods were no strangers to the task of determining required tooling and

designing a shape with integrated stiffening members. However, the development of conformations embodying the best features in performance, pleasing design and economy was not so easily accomplished. The men concerned with this problem felt that an exchange of ideas and the establishment of basic design guide lines would benefit the industry. They proceeded on this premise and formed an association in 1939, naming it the "Steel Roof Deck Industry Technical Committee". This organization has remained in existence through the years, albeit under different names, and is now called the "Steel Deck Institute".

Initially, most manufacturers offered only one conformation which was made from 20 or 18 ga. steel (see Figure 1). The depth ranged between 1½" and 2". The formed width was usually in 6" multiples starting with a single flute 6" wide to a five flute width of 30". The lengths were limited by the size of the

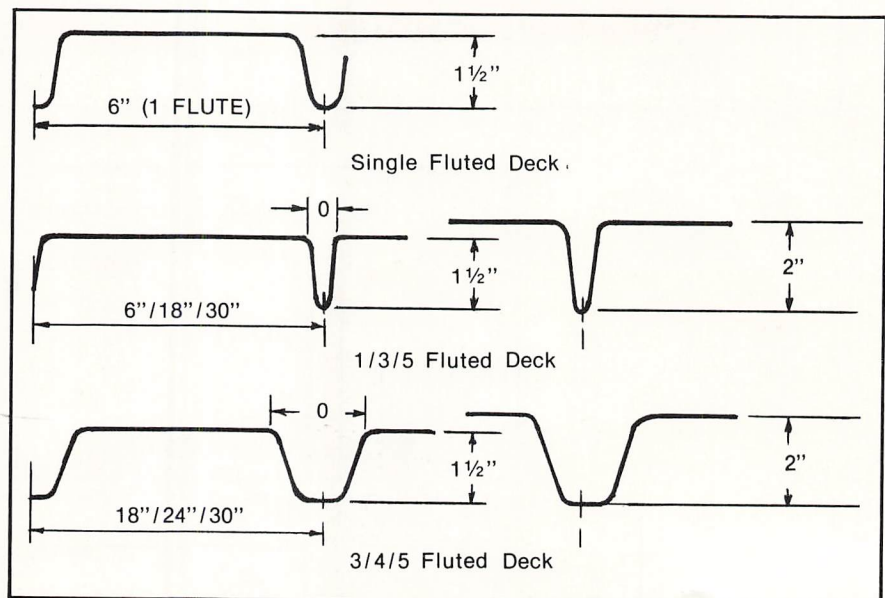
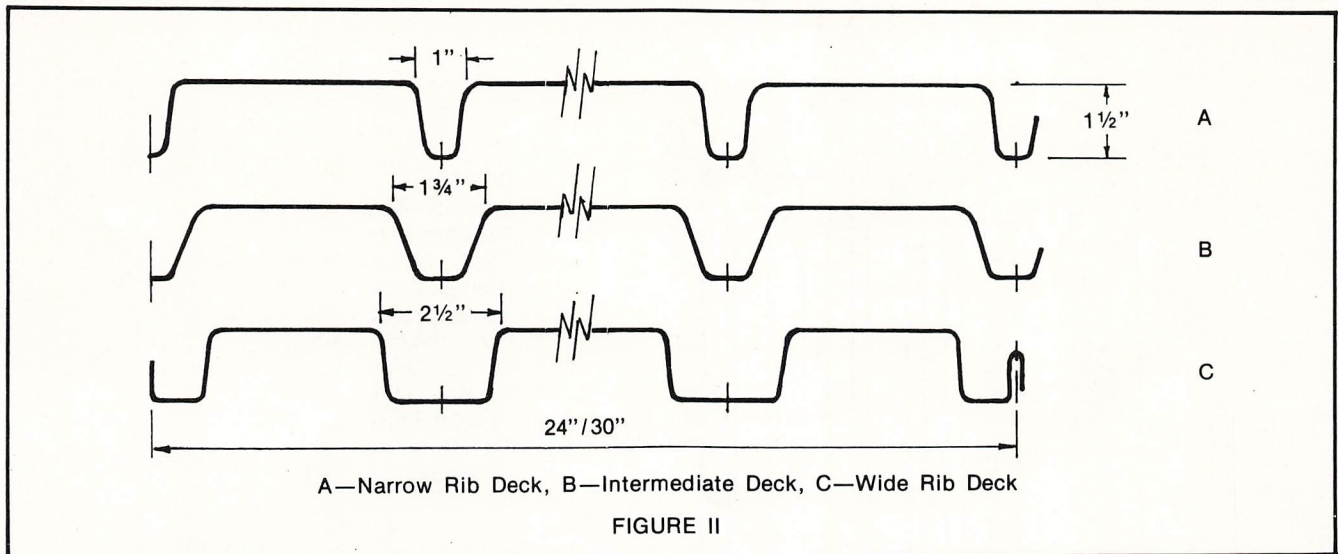


FIGURE 1

STEEL ROOF DECK



press brake which the individual production departments used as the forming equipment—generally 12 feet or shorter.

The opening at the top of ribs, Dimension "O", ranged from 1/4" to 2". This wide difference resulted in one of the first problems. The deck sheet with the narrow rib opening was structurally much weaker than the sheet with the greater rib opening. On the other hand, a 1/2" thick insulation board (which was

in those days the commonly specified requirement on industrial plant construction) presented no problem when installed over tight ribbed deck, but would break when spanning over the large rib opening. In cooperation with roofing manufacturers, these standards for built-up roofs were established: Narrow Rib Deck having a rib opening of 1" or less can be insulated with 1/2" thickness. Intermediate Rib Deck having a rib opening of 1 3/4" maximum

requires a 1" thick insulation. Wide Rib Deck having a rib opening of 2 1/2" maximum requires a 1" thick insulation plus a 1/2" thick layer with joints broken.

The three configurations shown in Figure II represent the roof deck product line which most manufacturers can furnish. The available metal thicknesses range between 22 ga. and 16 ga.; the finish may be painted or galvanized.

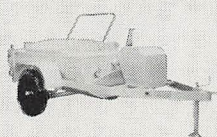
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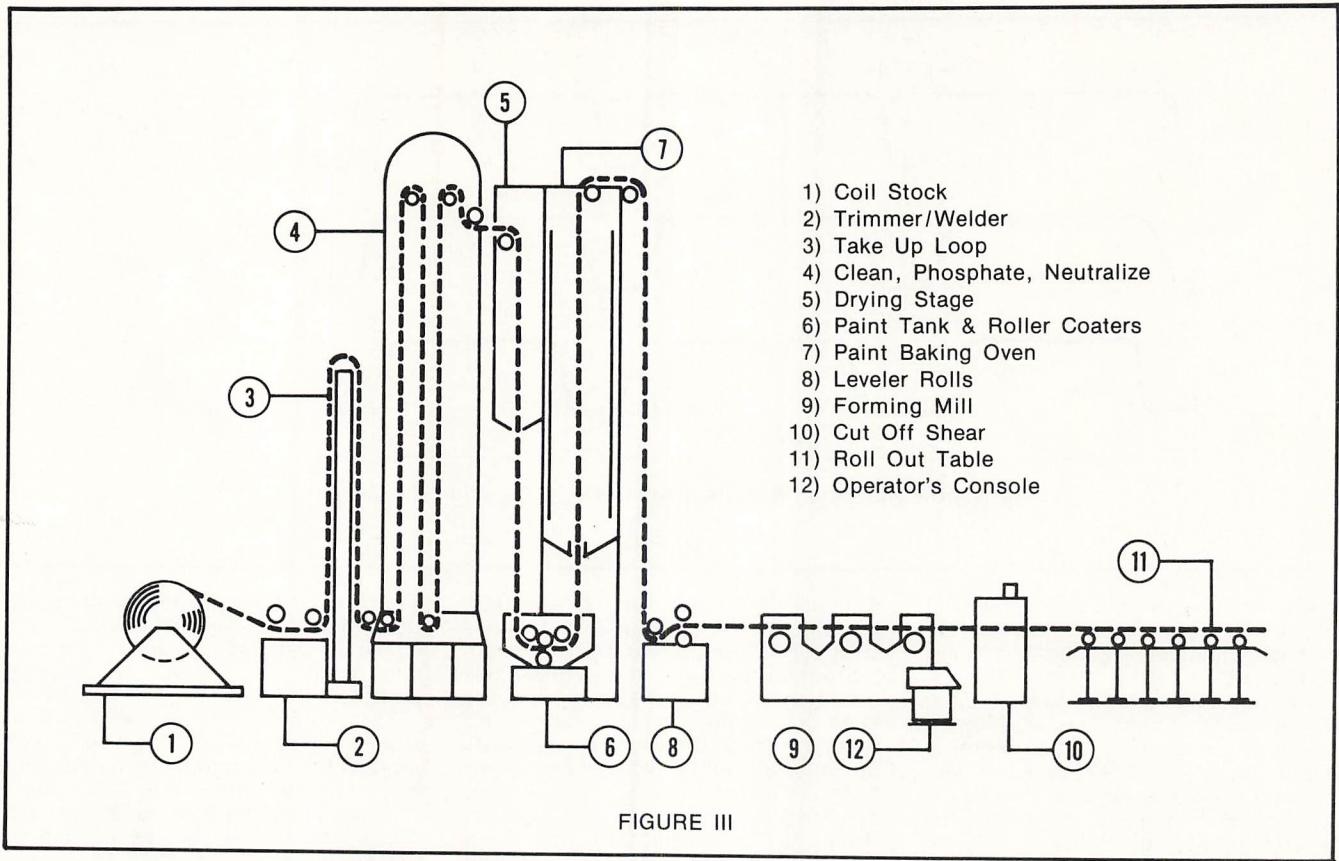


FIGURE III

Modern equipment is designed for continuous operation. A typical production line is illustrated in Figure III.

The coil stock is fed through the cleaning solution, receives a rust inhibitive coating followed by a neutralizer rinse, and, after the drying stage, is painted through roller coaters. The final step consists of an oven bake which produces a hard, abrasion-resisting finish. On some equipment the finishing and forming operations are integrated as described above. An alternate procedure separates these two processes so that the painted steel bands are recoiled and put in stock for later use.

The entire operation can be controlled by the man who is stationed at the console. Here, he dials the running speed which is faster for the lighter metal gauges and slower for heavier thicknesses. He sets the machine to produce the requisitioned number of pieces and the shear to cut them off at required lengths.

The packing crew takes over, marks the formed sheets in a manner that indicates to the erector at the job site to which roof area he should take the bundles.

Due to the continuous production process and the availability of coils, roof deck sheets could be furnished in infinite lengths. This, however, would hardly be practical if for no other reason than that of handling overlong sheets at a job site. Virtually all producers will furnish lengths up to 40 ft. maximum.

This size or any length combination that adds up to 40 ft. coincides with over-the-road truck displacement limits, as well as that of Piggy-Back trailers or loading dimensions of common gondola rail cars.

Considering the three configurations illustrated in Figure II as "Basic Types", their modifications are the "Acoustic" (Fig. IV) and "Cellular" types. The latter are of less concern to the Roof Deck

and is absorbed into the fiberglass batten strips which fill the rib voids.

Application

Excepting orders which are furnished in accordance with the buyer's own Material List (giving specific numbers and sizes of deck sheets), nearly all producers maintain engineering facilities which provide layout drawings. On these are indicated where

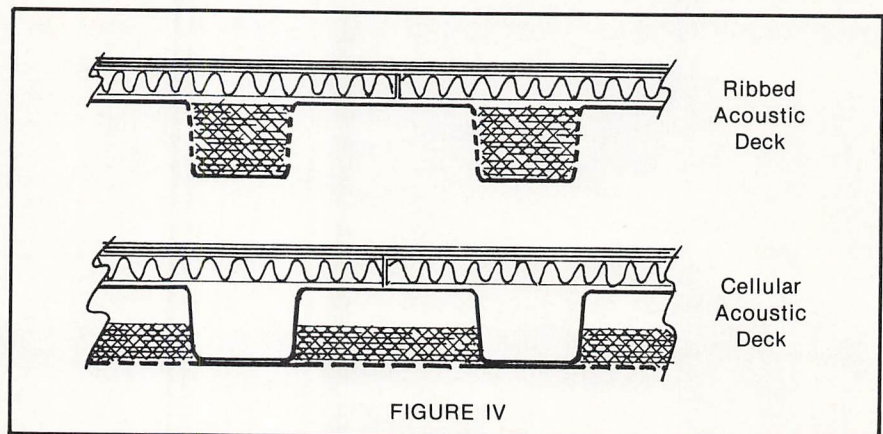


FIGURE IV

concept, being used primarily in floor systems. However, acoustic deck has become quite popular and has proven itself as an effective noise reducing material. Rows of small holes are punched in a staggered pattern through the vertical flanges of ribs. Instead of reverberating from a solid surface, the noise escapes through the perforations

certain sheets and accessory items are to be placed with direction marks noting how installation should proceed. For further clarification, if necessary, the drawings will show details of unusual conditions as well as pertinent notes for the convenience of or as assistance to the contractor.

Upon arrival at the job site, a look at

STEEL ROOF DECK

the bundle and sheet markings which correspond to identical markings on layout drawings tells the erector to which roof area he should hoist the bundles. The sheets are then placed progressively from the starting point and fastened to the supporting members as specified. The attachment is generally accomplished through arc welding. Because a comparatively thin metal has to be fused to a much thicker steel member, proper equipment and workman's skill play a large part in the soundness of this operation. The finished weld should closely resemble a rivet. It should have good penetration into the supporting steel and anchor the deck sheet with an overlapping head as illustrated in Figure V. To get this result, three factors are important: (1) the welding rod diameter should range from 3/32" to 1/4"; (2) the heat setting should be between 120 and 180 amps; (3) the ground connection to the generator should be within 150 ft. of the work area.

Heavier welding rods and higher heat settings will melt or burn the thinner deck sheet metal to an extent that the head of the weld does not overlap into the steel surrounding the hole. A ground connection which has to travel over a long distance through painted and bolted structural members influences the arc to a degree that the welder experiences what is called arc blow, which undercuts the metal and results in a similar condition as described above.

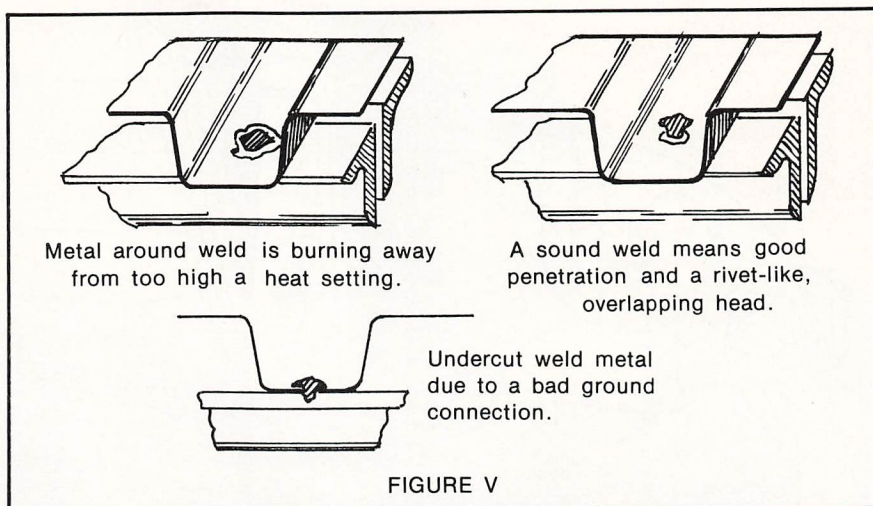


FIGURE V

Summary

Steel Roof Deck is set apart from other materials commonly used in roof systems because of its unique characteristics:

(a) It is in effect a structural member which performs not only the function of supporting insulation, felt and gravel, but can be used as the shear resisting roof member in diaphragm construction.

(b) It has the highest weight to carrying capacity ratio of any roof material on the market. This allows the designer to reduce the sizes of

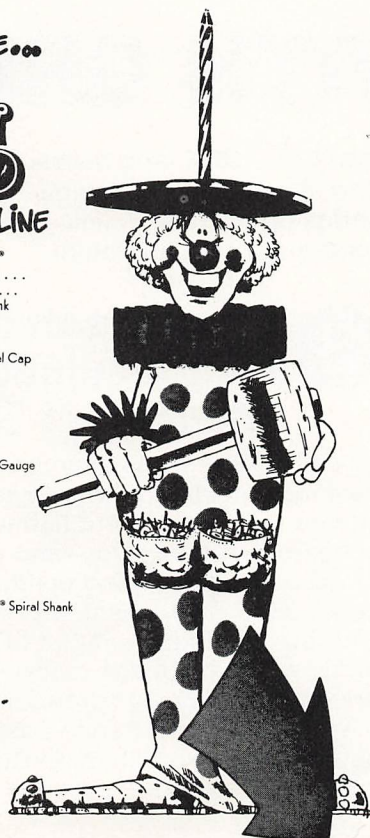
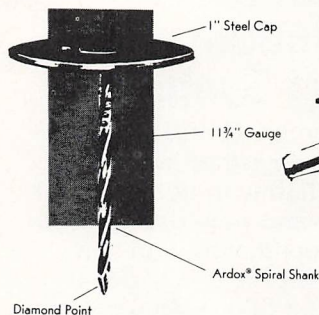
structural members such as reinforcing and columns which, in turn, result in savings to the owner.

(c) Steel Roof Deck is impervious to climatic conditions which means that job progress can proceed as long as workmen can cope with the weather.

(d) Steel Roof Deck per se is a non-combustible material. When combined in roof systems with products having combustible ratings, such assemblies can be fire-proofed if designed in accordance with requirements contained in U.L. (Underwriter's Laboratories), or F.M. (Factory Mutual) Fire Resistance Design criteria.

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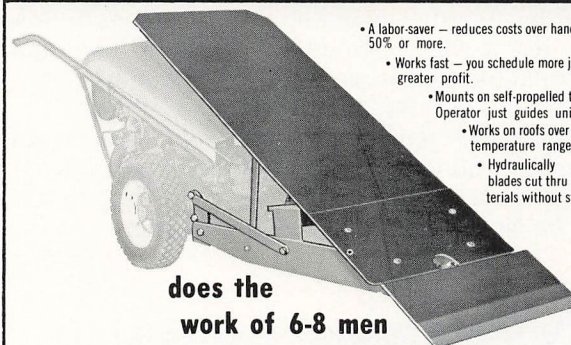


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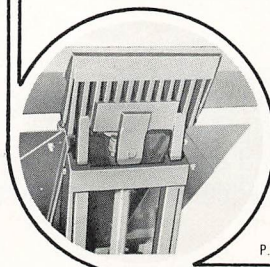
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News from affiliates

Bay Area (Cal.)

A combined effort on the part of organized labor and the Associated Roofing Contractors of the Bay Area Counties, Inc. has resulted in the appointment of a manpower director representing the association in the 10-county area it serves. Appointed in October, the new educator-administrator is Richard L. Bender, who has been given the task of upgrading the skills of all roofing personnel.

"Union craftsmen working for our association contractors are currently the best trained in the roofing industry," says John T. Banister, executive director of the association. "Keeping it that way dictates continuing effort to attract, train, and retain the very highest caliber of men available. What's more, there are closely related matters such as the work of our Joint Examination Boards, journeymen training and re-training, and safety instruction, which need constant upgrading."

Bender holds a California Life Teaching Credential in the industrial arts field. He also has solid background in business management and engineering. In addition to having been a teacher, he has been actively employed in construction.

Florida

Three roofing contractors were professionally certified recently by the Florida Roofing, Sheet Metal and Air Conditioning Contractors Association, INC. (FRSA). Successfully completing a battery of tests leading to the title of Certified Professional Roofing Contractor (CPRC) were Robert Dove, Sr., of Tallahassee; John J. Reaves, Jr., of Jacksonville; and George E. Mimbs of Bradenton.

FRSA is preparing for its 54th Annual Convention and Trade Exposition, to be held June 2-5 at the Americana Hotel in Bal Harbour. Many of the Convention Activities will be geared to the celebration of the nation's bicentennial. Educational sessions will feature a presentation entitled: "How the Statewide Building Code Will Affect You."

For more information and registration, contact FRSA, PO Drawer 988, Lakeland, Fla. 33802.

Miami Valley (Ohio)

The Sheet Metal & Roofing Contractors Association of the Miami Valley held its annual meeting in January and elected Byron Hackney of Valley Sheet Metal Works, Inc., Middletown, Ohio, President for 1976. Other officers elected were:

Daniel Kerber *First Vice President*
 Thomas Buddle *Second Vice President*

Arthur Scurlock *Treasurer*
 Lou Taylor *Sheet Metal Director*
 Karl Rigg *Roofing Director*

San Bernardino (Cal.)

The Roofing Contractors Association of San Bernardino & Riverside Counties recently elected new officers and directors as follows:

Gordon Sutton *President*
 C.A. Miller *Vice President*
 Harry Wilson *Secretary-Treasurer*
 Warren Lyon *Director*
 Frank Roberts *Director*

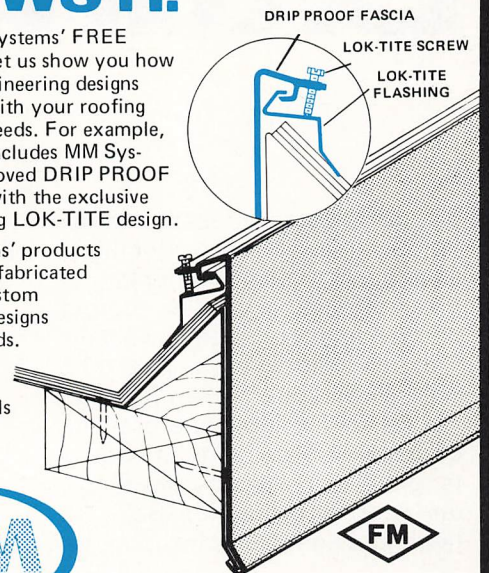
Western States

The Western States Roofing Contractors Association announces that its Annual Convention will be held June 24-27 in Seattle, Washington. A reconvened meeting on a Princess cruise to Alaska is scheduled for June 29 to July 7. For further information, contact WSRCA, 11401 E. Valley Blvd., El Monte, Cal. 91731. ☪ ● ☪

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CONVENTION REPORT

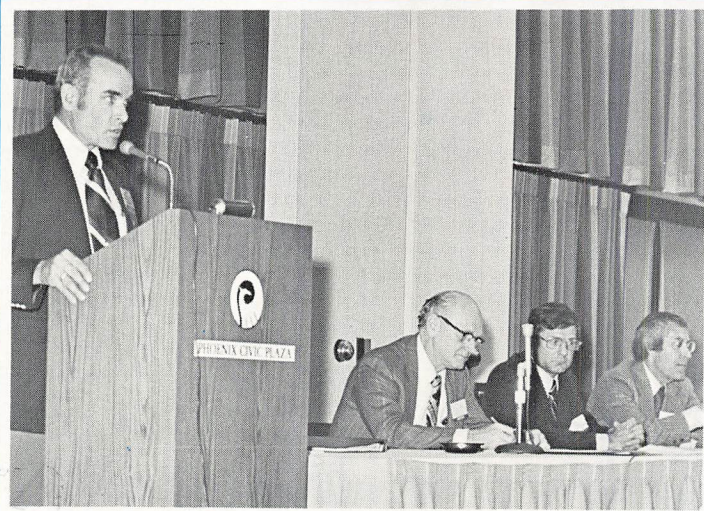
The following pages contain just some of the week's activities.....



1
Mayor Margaret Hance welcomes the NRCA Convention to Phoenix.

2
The Opening Lunch featured a special Bicentennial salute by the Orpheus Male Chorus of Phoenix....

3
....and a keynote address by former Massachusetts governor Endicott Peabody.



5

6



4



7

8

Over 100 exhibitors filled over 185 booths in the largest display of roofing equipment and materials ever held. 4

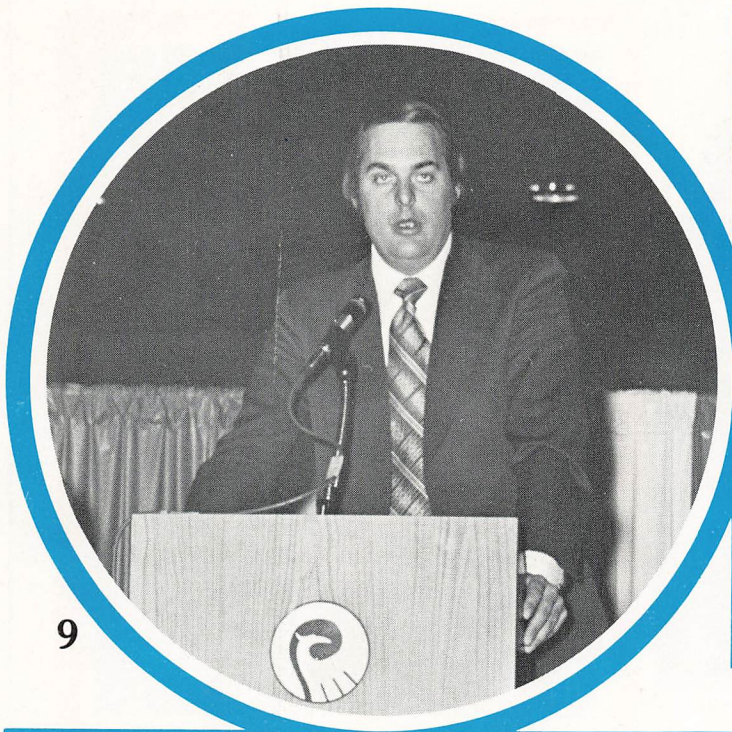
Discussing the impact of energy conservation on building design are, from left, NRCA's John Bradford, ASHRAE's Rod Kirkwood, NBS' Jack Snell, and AIA's Carl Bradley. 5

The Awards Luncheon was well attended.... 6

....and Ted Cohn captured the audience with his thought-provoking talk. 7

The Roof Deck Contractors workshop featured [from left] Dick Zimmerman, Don McNamara, George Stephenson, Bob Milanese, and John Bonitz. 8

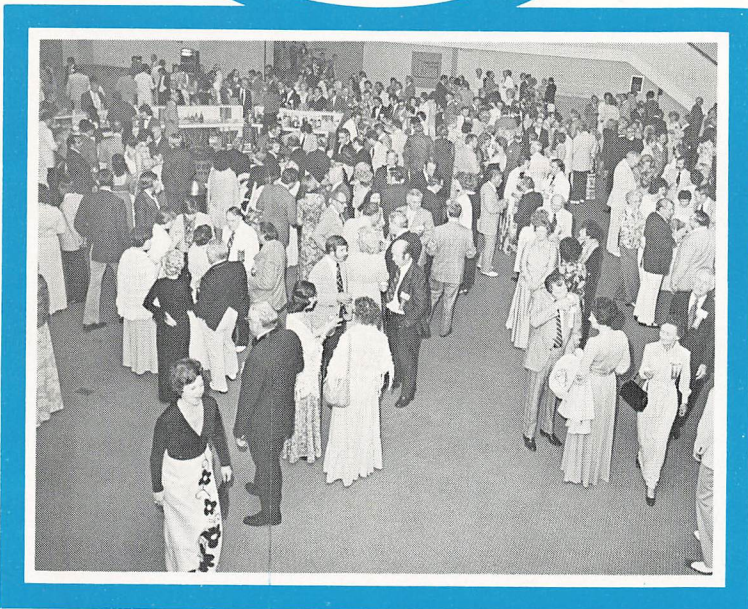




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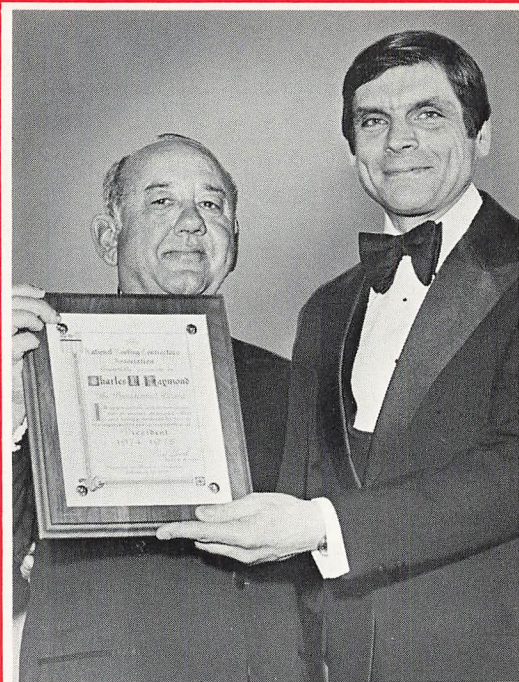
9 NRCA's new Washington representative, Bill Bergman, spoke at the Member Breakfast.

10 Past President Charlie Raymond, right, thanks Vice President-elect Dick Willis for his service as a Director.

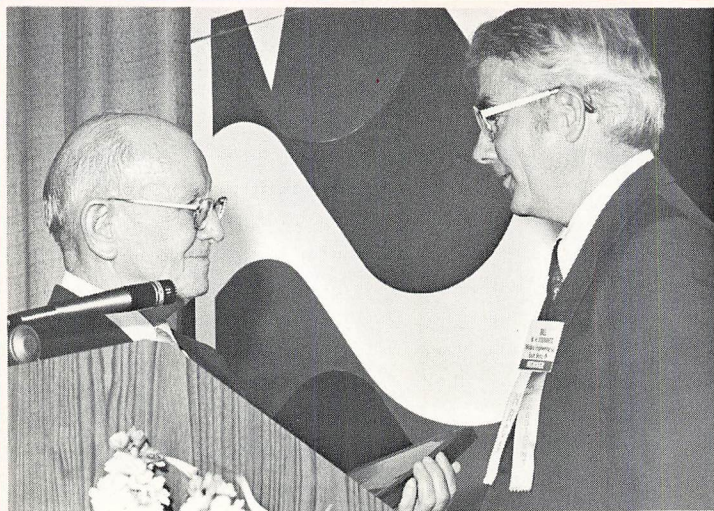
11 Howard Pyle, President Emeritus of the National Safety Council and former Governor of Arizona, presents the NSC Association Award to NRCA President Bob Linck.

12 Hundreds of Banquet-goers enjoy cocktails in the Civic Plaza Lobby.

16

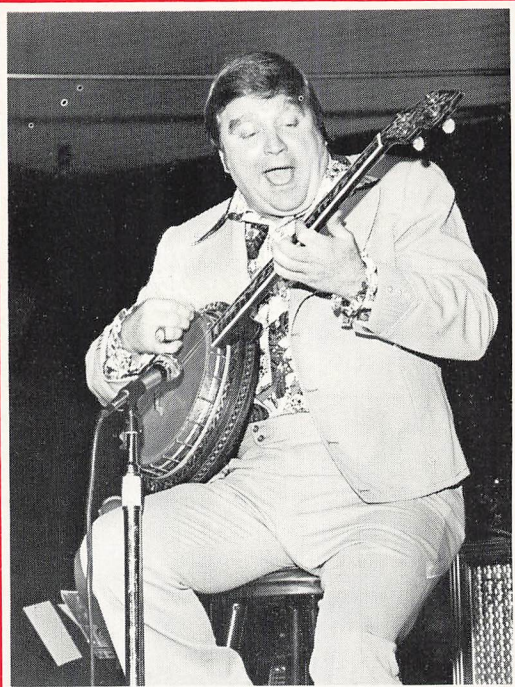


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13 Senior Vice President-elect Roy Martin MC'd the Annual Banquet, which featured.....

15 Joe Hall's presentation of the J.A. Piper Award to William R. Steinmetz,

14entertainment by Glenn Ash,

16and Charlie Raymond receiving his Presidential Plaque from Bob Linck.

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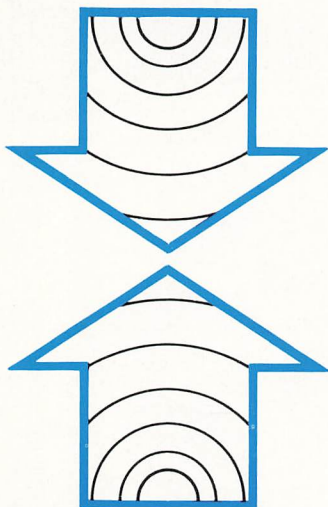
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EFFECT OF INSULATION ON THE SURFACE TEMPERATURE OF ROOF MEMBRANES

by Walter J. Rossiter, Jr. and Robert G. Mathey

ABSTRACT

The surface temperatures of black, gray and white roofs were calculated for various thicknesses of insulation located between the membrane and roof deck. The calculations were performed using a steady-state heat balance equation to illustrate the increase in roof surface temperatures due to solar radiation.

The calculations indicate that the first increment, about 1 inch (25 mm),^{1/} of insulation causes a significant rise in the roof surface temperature due to solar radiation. Increasing the amount of insulation about this first increment to greater thicknesses does not appreciably increase the roof surface temperature.

Keywords: Built-up roofing; insulation; performance; radiative cooling; roofing; solar heating; surface temperature.

1. INTRODUCTION

It has been reported that increased amounts of insulation between the roof deck and the membrane will shorten roof life (1-3)^{2/}. The concern is that roofs with greater amounts of insulation will be subjected to greater extremes in temperature. The reasons stated for lessening roof life were accelerated aging due to higher roof temperatures in the summer and larger contractive forces caused by thermal shock in the winter. Earlier research at the National Bureau of Standards (NBS) (4) showed that bituminous membranes placed over the insulation develop higher temperatures on sunny days than membranes placed directly on the deck. On clear nights membranes over insulation can be considerably colder than those that are not insulated. This may have significance in the winter when ambient temperatures are low.

Increased amounts of insulation (lower U-values) are now specified for roofs in many cases because of the need for energy conservation. Buildings are among the largest energy consumers in the United States and use approximately one-third of the total consumption (5). Much of this energy can be conserved by decreasing the energy consumption of buildings. One of the important methods of accomplishing this is by increasing the amount of insulation. It is noted that approximately 70% of currently constructed low-sloped roofs are insulated (6).

Research is needed to determine the effect of insulation on roof performance. At present, criteria are not available to evaluate the performance of roofing systems which contain increased amounts of insulation necessary to obtain lower U-values. Many factors regarding insulation should be considered in evaluating roof performance. These factors include mechanical properties such as impact resistance, compressive strength, punching shear resistance, cohesive strength and flexural strength; dimensional stability including warping and length changes; coefficient of thermal

expansion; moisture effects including absorption and permeability; adhesion between roofing components; durability; installation procedures; flammability; and thermal conductivity.

This paper shows that increasing the amount of insulation over that normally used in an insulated built-up roofing system will not cause a significant increase or decrease in the roof membrane temperature. Calculations and illustrations are presented as examples that give membrane temperatures for thicknesses of insulation ranging from zero to five inches (0 to 127 mm).

2. BACKGROUND

In a 1963 National Bureau of Standards Technical Note, Cullen reported temperature data on some built-up roofing systems which were exposed to solar heating and radiative cooling (4). Solar heating is the process whereby the temperature of a surface rises above ambient air temperature as the surface absorbs solar radiation. Radiative cooling is the process whereby the temperature of a surface drops below ambient air temperature as the surface exchanges long-wave radiation with the cold night sky. Cullen's data showed that in the summer built-up roofing membranes set on insulation may be as much as 80°F (44°C) hotter than ambient air temperature. He also reported that during a winter night a membrane placed over insulation may be 20°F (11°C) cooler than ambient air. The magnitude of the solar heating or radiative cooling was considered dependent upon a number of factors including mass, density and thermal properties of the substrate under the membrane, the absorptance or emissivity of the membrane surface, and atmospheric conditions. The paper did not discuss the magnitude of solar heating or radiative cooling as a function of the amount of insulation or of the U-value of the test specimen.

The information presented in this NBS Technical Note (4) may be subject to some misinterpretation regarding the magnitude of temperature extremes of membranes placed over greater amounts of insulation. The temperature of the membrane is affected by the thickness of the insulation up to a certain point. Beyond this thickness the effect on surface temperature is insignificant. This is demonstrated herein by examining the physical process which occurs when a roof is exposed to solar radiation. Temperatures of building exterior surfaces exposed to solar radiation have been discussed in the literature (7-9).

3. HEAT TRANSFER THROUGH FLAT ROOFING SYSTEMS

Heat transfer concepts, as defined by the ASHRAE Handbook of Fundamentals (10), are given in table 1. These concepts are also defined and discussed in a roofing trade publication (11). The important term to be considered in this discussion is the U-value or overall coefficient of heat transmission (thermal transmittance).

There are two ways of increasing the thermal efficiency (lowering the U-value) of a roofing system. One method is to

1/ Numbers in parentheses are in units of the metric system, formally called the International System of Units [SI].

2/ Numbers in brackets refer to references in Section 6

FIGURES AND TABLES START ON PAGE 32

EFFECT OF INSULATION

use a more efficient insulation (lower k-factor), and the other is to increase the thickness of the insulation. Using presently available roof insulation the k-factor is limited and therefore a roof with a low U-value, for example 0.05 to 0.10 Btu/h ft² °F (0.28 to 0.57 W/m²K), cannot be achieved with the thickness of insulation normally used. This leads to the only remaining option for lowering the U-value; namely, increasing the thickness of the insulation. A list of k-factors for the most common roofing insulations is given in table 2.

Figure 1 shows schematically the physical processes which occur when a roof is exposed to sunlight (radiant energy). A portion of the sunlight incident on the roof is absorbed, part is reflected. As some of the sunlight or radiant energy is absorbed, the temperature of the roof surface rises. This energy is dissipated by three processes, conduction, convection and re-radiation. The better the roof is able to dissipate the energy through these three processes, the less the temperature of the roof surface will rise. Adding insulation to the roof reduces the amount of heat dissipated by conduction. Consequently, a roof membrane over insulation will be hotter than if it were placed directly on a deck. As the amount of heat dissipated through conduction is reduced, the heat dissipated through convection is increased. Therefore, the temperature of the membrane will not continue to increase significantly as more insulation is added to the roof.

The absorptance of radiant energy and dissipation of heat energy can be expressed mathematically. The law of conservation of energy states that energy can neither be created nor destroyed. Thus, for a steady-state condition all the sunlight energy absorbed by the roof must be dissipated by conduction, convection and re-radiation, as given in the following equation.

Absorbed Energy = Heat Losses (Conduction + Convection + re-radiation)

This is called a heat balance equation. For a steady-state condition, it is mathematically expressed as follows (15):

$$\alpha I = U (t_s - t_i) + h_o (t_s - t_o) + \epsilon \Delta R \quad (1)$$

where

α = absorptance of the roof for solar radiation

I = total solar radiation incident on the roof, Btu/h ft² (W/m²)

U = coefficient of heat transmission of the roof, not including outside surface conductance, Btu/h ft² °F (W/m²K)

t_s = surface temperature, °F (°C)

t_i = inside air temperature, °F (°C)

h_o = coefficient of heat transfer by convection and long-wave length radiation to the surroundings (not including the sky) at the outer surface, 1/ Btu/h ft² °F (W/m²K)

t_o = outside air temperature, °F (°C)

ϵ = hemispherical emittance of the surface

ΔR = the net long-wave radiation to the sky, Btu/h ft² (W/m²)

The above equation includes the two terms which are of interest to this discussion, namely, the U-value and the surface temperature. After selecting values for the other

FIGURES AND TABLES START ON PAGE 32

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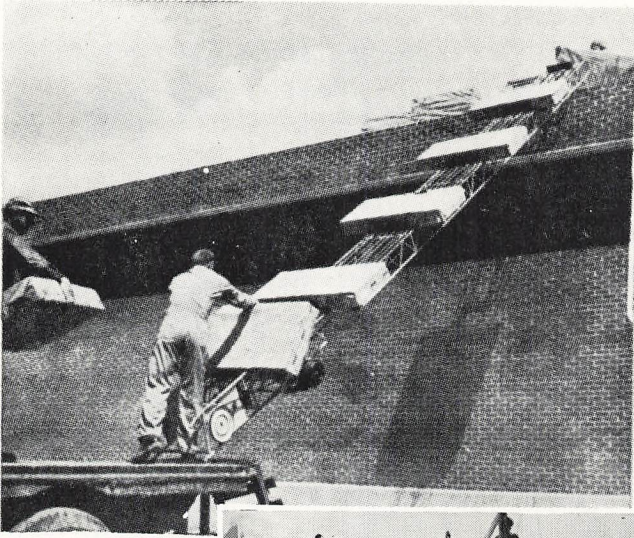


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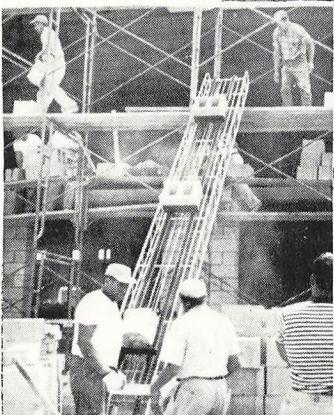
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parameters, the surface temperature of the roof was calculated as a function of the U-value. Table 3 lists three sets of values for the parameters in equation (1) which were used in the calculations. These values represent environmental conditions on a hot, sunny, summer day where the outside air temperature is 95°F (35°C), the inside air temperature is 72°F (22°C) and the wind is 5-10 miles per hour (2-4 m/s) at the roof level. Each set differs from the others only in the value of the absorptance of the roof surface. Values of absorptance correspond to black, gray and white surfaces.

A simple roof structure, chosen as a basis for the calculation of roof surface temperatures in this paper, is shown in figure 2. The roof consists of a metal deck, insulation and a built-up roofing membrane. The thickness and k-factor of the roof insulation were varied. The total thermal resistance of this roof, R_{total} , as shown in figure 2, is 1.25 h ft² °F/Btu (0.22 m² K/W) plus the thermal resistance of the insulation. R_i .

$$R_{total} = 1.25 + R_i \quad (2)$$

Using equation (2) and the relationship $U = 1/R_{total}$, the U-value of this roof was calculated as a function of the thickness of the insulation. Tables 4, 5 and 6 give U-values of the roof for k-factors of the insulations of 0.17, 0.24, and 0.36 Btu/h ft² °F/in (0.024, 0.035 and 0.052 W/m K) respectively.

Substituting these U-values and the values of the parameters given in table 3 in the heat balance equation (equation 1), the surface temperatures of the roof were calculated as a function of the thickness of the insulation. Tables 4, 5 and 6 show the results of these calculations for black, gray and white roofs having insulation with various k-factors. The results of these calculations are illustrated graphically in figure 3.

4. DISCUSSION

The surface temperature calculations outlined in the preceding section were based on heat transfer design values and some realistic values of parameters included in the heat balance equation (equation 1). It is emphasized that these values of surface temperature were not determined experimentally. However, the calculated values can be used to illustrate the effect of increasing amounts of insulation on the temperature extremes of the roofing membrane. The theoretical calculations of surface temperatures for steady-state conditions were based on physical principles which are well established (15).

Three different colored roof surfaces were considered in the calculations. As expected, the calculated values shown in figure 3 indicated that a black surface exposed to sunlight becomes hotter than a gray surface and the gray surface is hotter than a white surface. In all three cases, even when there is no insulation in the roof system, the surface temperature is greater than the selected ambient temperature of 95°F (35°C). If the roof is capable of absorbing solar radiation, its surface will in general heat up.

It can also be seen in figure 3 that when insulation is added between the membrane and the deck, the roof surface temperature rises. However, only the first inch (25 mm) or so of insulation causes a significant rise in the surface temperature. As an example, 1 inch (25 mm) of insulation placed under the black surfaced roof causes an increase of about 11°F (6°C). For the black surfaced roof, increasing the insulation thickness from 1 to 5 inches (25 to 127 mm) only results in an increase of the surface temperature of about 2 to 4°F (1 to 2°C) depending on the k-factor of the insulation.

The k-factor for a given thickness of the insulation had very little effect upon the surface temperature, as shown in figure 3. As the k-factor decreases, the surface temperature approaches its maximum temperature at a slightly faster rate.

Figure 3 is included to show the effect of the thickness of insulation on surface temperatures because this is an important concern of the roofing industry. A measure of the thermal efficiency of roofing system is its U-value and not the thickness of insulation. Figure 4 shows the surface temperature of the black, gray and white roofs as a function of the U-value in the range 0.0 to 0.38 Btu/h ft² °F (0.0 to 2.2

W/m²K). This is the range of interest when discussing insulated roofs. Before the energy crisis and the need to conserve energy, most insulated roofs had design U-values of about 0.15 to 0.20 Btu/h ft² °F (0.85 to 1.1 W/m² K). Now, some specifications are requiring U-values as low as 0.05 Btu/h ft² °F (0.28 W/m² K). Of course, a U-value of 0.0 (infinite thickness of insulation) is impossible since it means that the roof transmits no heat. However, a U-value of 0.0 can be used to show theoretically the maximum temperature of the roof surface for a given environmental condition (tables 4, 5 and 6).

Figure 4 shows that decreasing the U-value from 0.20 to 0.05 Btu/h ft² °F (1.1 to 0.28 W/m² K) has a minimum effect on the surface temperatures of the black, gray and white roofs. For the black roof, the increase in surface temperature for this range of U-values is only 3°F (2°C). For the other two roofs, it is even less.

The surface temperature calculations have been performed for a steady-state condition. Under this condition the rate of energy absorbed by the roof is dissipated at an equal rate. Steady-state condition is in general never attained for heat transfer through a roof system. Steady-state condition is approached when a low density insulation having a low heat capacity is located between the membrane and the deck. The surface temperature calculations are more complicated for a non-steady-state condition, and are beyond the scope of this paper. In general, the surface temperature of a membrane will not be as high when it is placed on a high heat capacity material as compared to a low heat capacity material having the same U-value. There is a thermal lag as a high heat capacity material takes time to store thermal energy.

It is interesting to note Cullen (4) reported that roof surface temperatures attained by black surfaced membranes over concrete and wood on a summer day in Washington, DC were 120 and 145°F (49 and 63°C) respectively. This difference in the maximum membrane temperatures of 25°F (14°C) indicates from the experimental results that the heat capacity of uninsulated decks effects the surface temperature of

applied membranes.

The heat balance equation (equation 1) can also be used to show the effect of radiative cooling on the surface temperature as a function of the U-value. The magnitude of radiative cooling is greatest on clear still nights when the roof is receiving negligible radiation from the sky. Calculations of surface temperatures are not shown since they are similar to those for solar heating. In general, increasing the thickness of insulation (decreasing the U-value) above the amount normally used causes little decrease in the temperature of the surface of the roof due to radiative cooling.

5. SUMMARY AND CONCLUSIONS

The surface temperatures of black, gray and white roofs were calculated for various thicknesses of insulation located between the membrane and the deck. The calculations were performed using a steady-state heat balance equation to illustrate the increase in roof surface temperature due to solar radiation. The values of the parameters used to solve this equation represented environmental conditions of a hot, sunny, summer day where the outside temperature was 95°F (35°C), the inside temperature was 72°F (22°C) and the wind was 5-10 miles per hour (2-4 m/s) at the roof level.

The calculations indicate that the first increment, about 1 inch (25 mm), of insulation causes a significant rise in the roof surface temperature due to solar radiation. Increasing the amount of insulation above this first increment to greater thicknesses does not appreciably increase the roof surface temperature.

This paper deals only with the surface temperature of roofs containing various amounts of insulation. As pointed out in the paper, the authors believe that research is needed to determine the effect of insulation on roof performance. Criteria are needed to enable the evaluation of the performance of roofing systems which contain increased amounts of insulation necessary to obtain lower U-values.

FIGURES AND TABLES START ON PAGE 32

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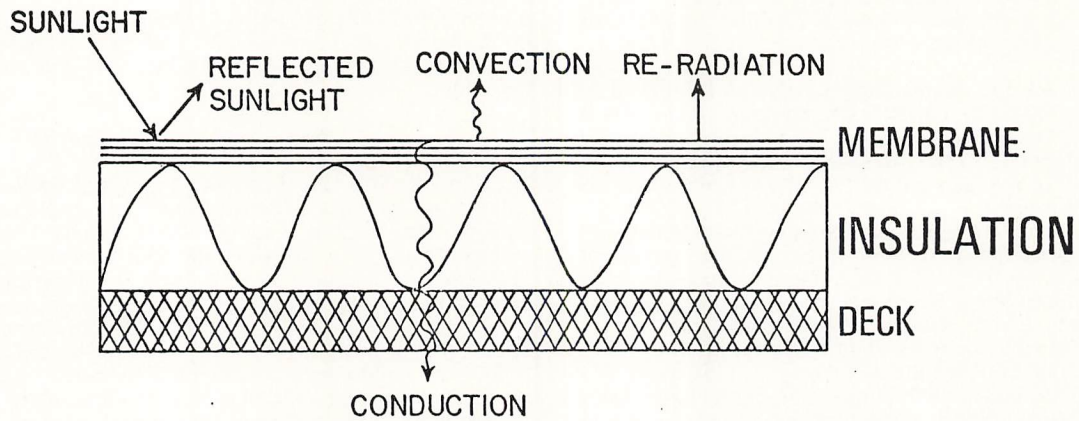
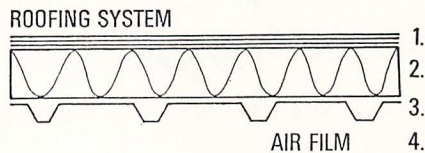


FIGURE 1. THE PHYSICAL PROCESSES WHICH OCCUR WHEN A ROOF IS EXPOSED TO SOLAR RADIATION.



COMPONENT	RESISTANCE, R
1. BUR Membrane	0.33
2. Insulation	R_i
3. Metal Deck	0.00
4. Air Film, Heat Flow Downward	0.92

TOTAL THERMAL RESISTANCE: $R_{TOTAL} = 1.25 + R_i$

FIGURE 2. THE TOTAL THERMAL RESISTANCE OF THE ROOF STRUCTURE USED IN THE SURFACE TEMPERATURE CALCULATIONS.

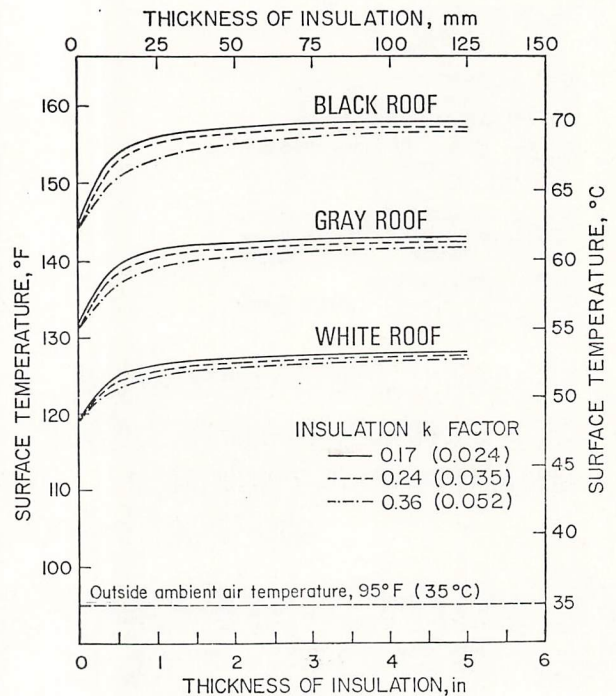


FIGURE 3. SURFACE TEMPERATURE OF THE ROOF MEMBRANE AS A FUNCTION OF THE AMOUNT OF INSULATION FOR THE PARAMETERS GIVEN IN TABLE 3.

EFFECT OF INSULATION

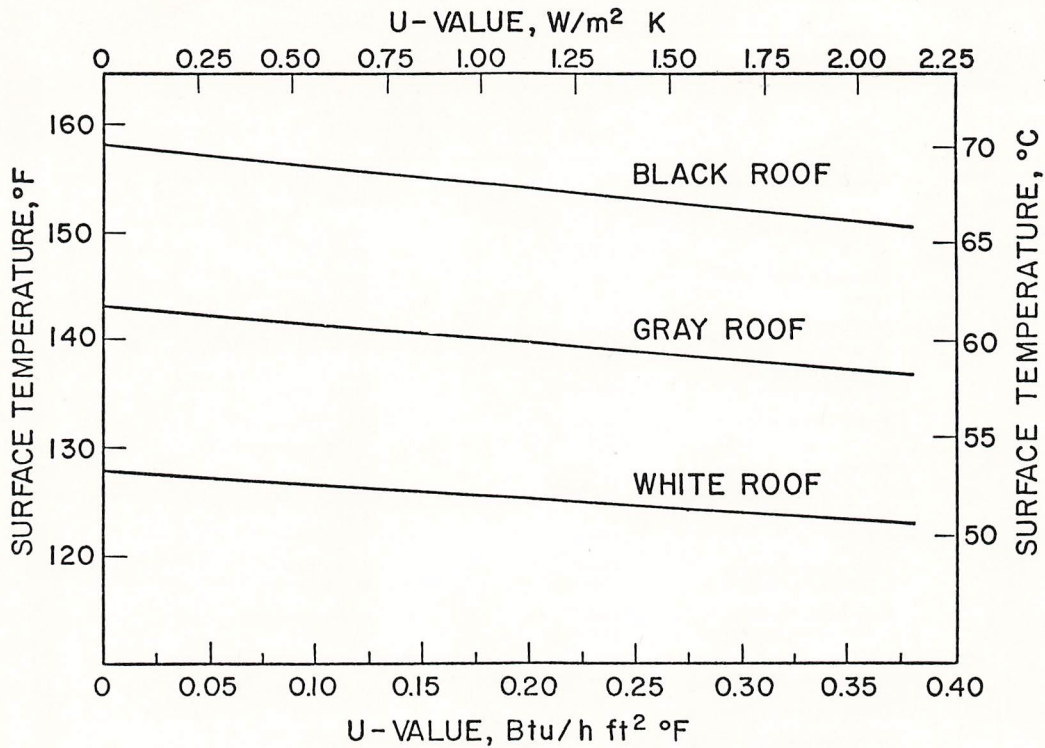


FIGURE 4. SURFACE TEMPERATURE OF THE ROOF AS A FUNCTION OF THE U-VALUE OF THE ROOFING SYSTEM FOR THE PARAMETERS GIVEN IN TABLE 3.

Table 1. Heat Transfer Concepts

Symbol	Concept	Definition	Units
k	thermal conductivity	Time rate of heat flow through a homogeneous material under steady-state conditions through unit area, per unit temperature gradient.	Btu/h ft ² °F/in (W/mK) ^{1/}
C	thermal conductance	Time rate of heat flow through a material for any thickness. C = k/n where n = thickness expressed in inches or meters.	Btu/h ft ² °F (W/m ² K)
R	thermal resistance	The reciprocal of the thermal conductance, R = 1/C.	°F h ft ² /Btu (m ² K/W)
U	overall coefficient of heat transmission (thermal transmittance)	The reciprocal of the summation of the resistance of each material in a wall, roof, floor or ceiling plus the surface conductance on both sides. U = 1/R _{total}	Btu/h ft ² °F (W/m ² K)

^{1/} SI units in parenthesis

EFFECT OF INSULATION

Table 2. Thermal Conductivities of Roof Insulations

Insulation	Density	Thermal Conductivity, k ^{1/}
	lb/ft ³ (kg/m ³) ^{2/}	Btu/h ft ² °F/in (W/mK) ^{2/}
Foamed urethane ^{3/}	1.5-2.5 (24-40)	0.16 (0.9)
Glass fiberboard ^{2/}	4-9 (64-144)	0.25 (1.4)
Extruded polystyrene ^{2/}	1.8 (29)	0.25 (1.4)
Cork board ^{4/}	6.5-8 (104-128)	0.28 (1.6)
Mineral fiberboard ^{2/}	16-17 (256-272)	0.34 (1.9)
Wood fiberboard ^{5/}	15-22 (240-352)	0.36 (2.0)
Perlite aggregate board ^{5/}	11 (176)	0.38 (2.2)
Cellular glass ^{3/}	9 (144)	0.40 (2.3)
Lightweight concrete, Perlite aggregate ^{4/}	20-40 (320-641)	0.70-1.15 (4.0-6.5)
Lightweight concrete, Vermiculite aggregate ^{3/}	20-40 (320-641)	0.70-1.15 (4.0-6.5)

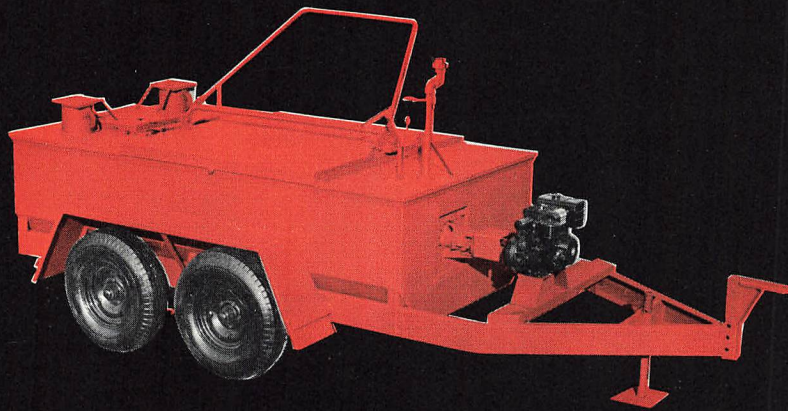
^{1/} Tabulated values are for a mean temperature of 75°F (24°C).

^{2/} SI units in parenthesis.

^{3/} Values from the ASHRAE Handbook of Fundamentals, 1972 edition [12].

^{4/} Values from the ASHRAE Handbook of Fundamentals, 1967 edition [13].

^{5/} Values from the Manual of Built-Up Roof Systems [14].



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Table 3. Parameters Used in the Heat Balance Equation for Calculating the Surface Temperature as a Function of U-value

Parameter	Units	Case I Black Surface	Case II Gray Surface	Case III White Surface
α ^{1/}		0.9	0.7	0.5
I ^{2/}	Btu/h ft ² (W/m ²)	300 (945)	300 (945)	300 (945)
t_i	°F (°C)	72 (22)	72 (22)	72 (22)
h_o ^{3/}	Btu/h ft ² °F (W/m ² K)	4 (23)	4 (23)	4 (23)
t_o	°F (°C)	95 (35)	95 (35)	95 (35)
ϵ ^{4/}	-	0.9	0.9	0.9
ΔR ^{5/}	Btu/h ft ² (W/m ²)	20 (63)	20 (63)	20 (63)

^{1/} Values from reference [4], page 7.

^{2/} This value is typical for a horizontal surface on a sunny summer day at noontime at 40° northern latitude.

^{3/} Value from the ASHRAE Handbook of Fundamentals [16]. This value represents a wind velocity of 5-10 miles per hour (2-4 m/s) across the surface.

^{4/} Value from the CRC Handbook of Materials Science [17]. Value is for a non-metallic surface.

^{5/} Value from ASHRAE Handbook of Fundamentals [15]. Value is for a horizontal surface.



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EFFECT OF INSULATION

Table 5. Calculated Surface Temperature of the Roof as a Function of the Thickness of the Insulation, $k = 0.24$ (0.035)

Thickness of Insulation in (mm)	U-value ^{1/} Btu/h ft ² °F (W/m ² K)	Surface Temperature of the Roof, °F (°C)		
		Case I, black	Case II, Gray	Case III, White
0	0.80 (4.5)	143.7 (62.1)	131.2 (55.1)	118.7 (48.2)
0.5 (13)	0.30 (1.7)	152.0 (66.7)	138.0 (58.9)	124.1 (51.2)
1.0 (25)	0.18 (1.0)	154.3 (67.9)	139.9 (59.9)	125.6 (52.0)
1.5 (38)	0.13 (0.74)	155.3 (68.5)	140.8 (60.4)	126.2 (52.3)
2.0 (51)	0.10 (0.57)	155.9 (68.8)	141.3 (60.7)	126.6 (52.6)
2.5 (64)	0.086 (0.49)	156.2 (69.0)	141.5 (60.8)	126.8 (52.7)
3.0 (76)	0.072 (0.41)	156.5 (69.2)	141.7 (60.9)	127.0 (52.8)
3.5 (89)	0.064 (0.36)	156.7 (69.3)	141.9 (61.1)	127.1 (52.8)
4.0 (102)	0.055 (0.31)	156.8 (69.3)	142.0 (61.1)	127.2 (52.9)
4.5 (114)	0.049 (0.28)	157.0 (69.4)	142.1 (61.2)	127.3 (52.9)
5.0 (127)	0.045 (0.26)	157.0 (69.4)	142.2 (61.2)	127.4 (53.0)
∞	0.0	158.0 (70.0)	143.0 (61.7)	128.0 (53.3)

^{1/} U-value of the hypothetical roof system shown in Figure 2. The U-value does not include the thermal resistance of the air at the outside surface of the roof.

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EFFECT OF INSULATION

Table 6. Calculated Surface Temperature of the Roof as a Function of the Thickness of the Insulation, $k = 0.36$ (0.052)

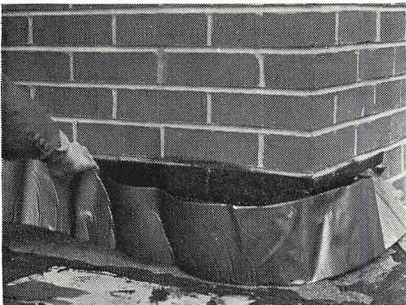
Thickness of Insulation in (mm)	U-value ^{1/} Btu/h ft ² °F (W/m ² K)	Surface Temperature of the Roof, °F (°C)		
		Case I, Black	Case II, Gray	Case III, White
0	0.80 (4.5)	143.7 (62.1)	131.2 (55.1)	118.7 (48.2)
0.5 (13)	0.38 (2.2)	150.5 (65.8)	136.8 (58.2)	123.1 (50.6)
1.0 (25)	0.25 (1.4)	152.9 (67.2)	138.8 (59.3)	124.7 (51.5)
1.5 (38)	0.18 (1.0)	154.3 (67.9)	139.9 (59.9)	125.6 (52.0)
2.0 (51)	0.15 (0.85)	154.9 (68.3)	140.4 (60.2)	126.0 (52.2)
2.5 (64)	0.12 (0.68)	155.5 (68.6)	140.9 (60.5)	126.4 (52.4)
3.0 (76)	0.10 (0.57)	155.9 (68.8)	141.3 (60.7)	126.6 (52.6)
3.5 (89)	0.091 (0.52)	156.1 (68.9)	141.4 (60.8)	126.8 (52.7)
4.0 (102)	0.081 (0.46)	156.3 (69.1)	141.6 (60.9)	126.9 (52.7)
4.5 (114)	0.073 (0.41)	156.5 (69.2)	141.7 (60.9)	127.0 (52.8)
5.0 (127)	0.066 (0.37)	156.6 (69.2)	141.8 (61.0)	127.1 (52.8)
∞	0.0	158.0 (70.0)	143.0 (61.7)	128.0 (53.3)

^{1/} U-value of the hypothetical roof system shown in Figure 2. The U-value does not include the thermal resistance of the air at the outside surface of the roof.

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SUPPLY CONTRACTS: Confirmation of oral purchase orders

Reaching an oral agreement over the telephone is an acceptable manner for a contractor to begin his contractual relations with a supplier, but the contractor who does not properly follow up an oral agreement by obtaining effective written evidence of the contract treads on thin ice. As a practical matter, the supplier and contractor often find that they disagree as to what are the actual terms of the oral contract, and even sometimes disagree about whether the contract has been entered into at all. Then, if the misunderstandings cause problems serious enough to cause one of the parties to consider going to court to enforce his version of the contract, he often discovers that the law makes the oral contract unenforceable. In the words of an old maxim, "an oral contract is not worth the paper it is written on."

The statutory provisions that make many supply contracts unenforceable are found in the Uniform Commercial Code, since a supply contract, in contrast to a construction contract, is for the sale of goods. UCC Section 2-201(1) provides that in general a contract for the sale of goods for the price of \$500.00 or more is not enforceable unless (1) there is some writing sufficient to indicate that a contract for sale has been made between the parties; and (2) the writing is signed by the party against whom enforcement is sought. Thus, there must be some memorandum indicating that the contract does indeed exist, and it must be authenticated in some way by the party against whom the contract is to be enforced. The memorandum may not necessarily be the contract itself, but may merely be evidence of the existence of a contract.

Whenever you conclude an oral agreement with a supplier, you should follow the special procedure provided by UCC Section 2-201(2) to establish the enforceability of the oral contract. This procedure requires sending a letter of con-

firmation and a purchase order to the supplier within a reasonable time of the making of the agreement. Upon its receipt by the supplier, an enforceable contract results unless he sends written notice of rejection of the terms contained in the letter of confirmation within ten days. Section 2-201(2) thus provides for the self-executing memoranda to prove the existence of a contract even though it is not signed by the other party. Obviously, it is to your advantage to include as completely as possible the terms of the agreement in order to facilitate proof of the terms if necessary.

Within certain limits, additional terms may be included in the letter of confirmation not discussed over the telephone. These additional terms will become part of the contract unless they materially alter the contract or the supplier objects to the terms. The letter may also state that there is no contract unless such terms are accepted by the supplier, so that the signed letter of confirmation will not be used to prove the existence of a contract which does not include the additional terms desired. Of course, if the supplier sends you a letter of confirmation, the shoe is on the other foot. You then have the burden of objecting to the terms of the letter of confirmation, including any additional terms not discussed over the telephone, or they will become part of the contract between you and your supplier. You should always carefully review letters from suppliers confirming telephone conversations to make sure that you have a clear understanding of the terms of the contract. If anything is unclear, send the supplier written objection to the terms of the letter within ten days of receipt.

A letter of confirmation sought to be used as a self-executing memorandum should confirm at least the following aspects of the purchase: (1) description of the materials or equipment, (2) quantity, price, date of delivery, and

allowable substitutions, if any. For example, immediately after an agreement is reached in a telephone conversation with a supplier, send the supplier a letter of confirmation such as the following:

This letter will serve to confirm the agreement by _____ of our company and _____ of your company, during their telephone conversation of this morning.

We have agreed to purchase and you have agreed to sell _____ (describe material and quantity) _____ at _____ (price) for use on the _____ (name of project) construction project described in this morning's telephone conversation. Delivery is to take place at the jobsite according to the following schedule: (There will be no allowable substitutions)

Enclosed are two (2) signed copies of our standard purchase order form containing the terms of our agreement which were discussed. Please sign and return one (1) copy of the purchase order.

In summary, after having negotiated an oral supply contract with the supplier, send a letter of confirmation to the supplier along with a purchase order, specifying the quantity to be supplied, the price, and other necessary information. Should the supplier fail to respond within ten days of receipt of the letter of confirmation and purchase order, you will have a supply contract according to the terms agreed upon in the telephone negotiation. Should the supplier sign and return the purchase order, you will have a supply contract based upon the terms of the purchase order.

CLAIMS FOR DELAYED PERFORMANCE

Delays caused on jobs by the general contractor or the owner can cost you money which can be and frequently is very substantial. You should be

careful to avoid waiving your rights to pursue delayed damages against the general contractor and/or owner. This means avoid signing clauses which state that the general contractor shall not be liable to the subcontractor for delays or that the contractor shall **only** be required to give the subcontractor an extension to contract performance time.

Often subcontract forms devised by general contractors contain a "no damage for delay" clause, providing that the general contractor will not be liable to the subcontractor for delays of any sort, including delays caused by the owner, the general contractor or other subcontractors. Some courts have relieved the subcontractor of this provision, holding that active interference with a subcontractor's performance of its contractual duty is not covered by a "no damage" provision. The courts have held that a "no damage" provision in a construction subcontract relieving the general contractor from liability for delays is not applicable to delays caused by active interference with the subcontractor's performance by the general contractor.

Typical of no damage for delay clauses which should not be signed is the following clause:

*Contractor shall not be liable to subcontractor for any delays caused by the owner or architect. Should the contractor delay the subcontractor's work, then, and in such event, contractor shall owe subcontractor therefore **only** for extension of time equal to the delay caused and only then if written claim for the delay is made to contractor within forty-eight (48) hours from beginning of this delay.*

This clause would bar a subcontractor's right to claim and recover his costs for delays, and the subcontractor would be entitled to an extension of contract time only in the event that he notified the general contractor within forty-eight hours after the start of the delay. This forty-eight hour restriction is an unreasonably short notification time which is intentionally calculated to foreclose the subcontractor's rights to excusable delay and damages for delay.

Many subcontracts do have a notification provision which requires

that the subcontractor notify the general contractor and/or the owner within a stipulated time after the commencement of a delay. The general conditions should also be checked for delay notice provisions since they are often incorporated into the subcontract. These notice requirements should be complied with in order to preserve the right to submit a claim for increased costs because of the delay.

Subcontracts with a specified date or time of completion can make the subcontractor extremely vulnerable to liquidated damages if delays occur. The vulnerability is the power of the general contractor to withhold liquidated damages from the progress payments or retention.

Most subcontractors are required by their contracts to make a claim for an extension of time if the project is delayed for any reason. This claim should be made in order to avoid an assessment of liquidated damages. Again, most subcontracts adopt the procedures outlined in the general contract for claiming an extension of

time.

The AGC and AIA standard subcontract forms recognize the subcontractor's right to make claims for extension of time and for damages for delays in accordance with the provisions of the general conditions. Article X (4) of the AGC Standard Form Subcontract provides:

*The subcontractor shall make all claims for extras, for extensions of time and **for damage for delays** or otherwise, promptly to the Contractor consistent with the Contract Documents.*

In addition to not waiving your right to delay damages, you should serve timely notification of your claim for delay. It is vital to the success of your claim to keep accurate records to be able to establish the cost of the delay. A job log which outlines the various delays encountered on the job and the reason therefor, coupled with accurate cost records, are invaluable aids in pursuing the claim for damages for delay.



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* Chief of Field Engineering for BAAPCD, H. C. Johnson, in sworn testimony, stated that he had observed kettles equipped with the Cleasby Loading Assembly and found them in compliance.

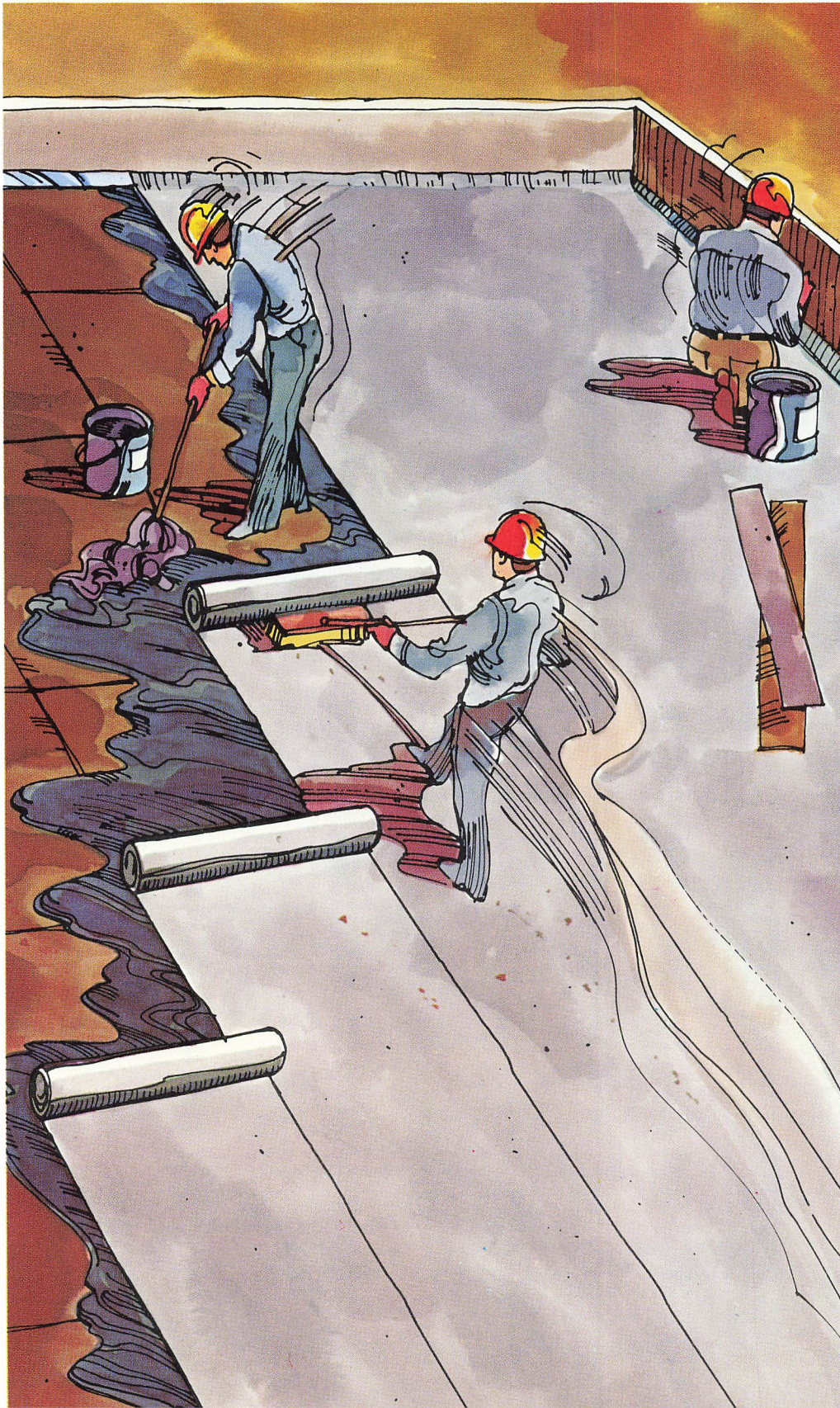
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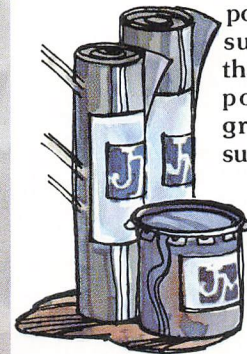
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CCE REPORT

Editor's note: NRCA is one of the ten national construction industry trade associations which comprise the Council of Construction Employers (CCE). CCE has as one of its goals the improvement of labor relations in the construction industry, and that topic has never been more timely. The observations that follow are those, first, of CCE President Harry P. Taylor, and, second, of CCE Chairman of the Board and NRCA President Robert Linck.

CONSTRUCTION NEGOTIATIONS CIRCA 1976

by Harry P. Taylor

Management must do what it can, and it can do much, to strengthen itself at the bargaining table, even under existing laws. The name of the game must be better cooperation and coordination among all of the contractor groups and their clients at all geographical levels—local, state, regional and national.

Although remedial legislation is so sorely needed, we are not apt to get it in the near future. Certainly not in this Congress. One need only to look at recently passed legislation such as Legal Aid Fund and Pension Reform, and pending legislation such as Liberalization of Workers' Compensation, Unemployment Compensation and the Minimum Wage Laws, to realize that we have not yet turned the corner and are still

fighting a defensive legislative battle. In my opinion, once the corner is turned, it will still take years to bring about a balance in the federal labor laws, but we must keep trying for more equitable legislation, while at the same time not relying on it.

Turning to Collective Bargaining in 1976, approximately 4½ million workers are covered by major collective bargaining agreements expiring or subject to wage reopeners during this calendar year. That is about double the 1975 figure. In other words, this is going to be an extremely heavy year for negotiations in industry generally. In addition to construction, major negotiations will be taking place in the automobile, trucking, electrical equipment, farm equipment, rubber, and meat packing industries. How much effect those negotiations will have on construction industry settlements is unpredictable at this time. In the construction industry up to 3,000 agreements covering possibly 2 million workers will be negotiated.

Particularly heavy concentrations of bargaining will be taking place in Arizona, California, Chicago, Detroit, Florida, Boston, Cleveland, Pittsburgh, and New York State. As usual, most agreements will be expiring on April 30th and May 31st. However, expiration dates range all the way from January 1st to December 31st. I would hope to characterize the results of such negotiations so far as "spotty." Recently some agreements have been

renewed with no increases, and in at least a few instances reductions in wages for some of the trades in some types of work have been negotiated. Such settlements have been brought about primarily because of the increase in open shop competition and the horrendous rate of unemployment. In other instances, large settlements have been made using "catch-up" as an excuse and in some cases establishing very unstabilizing rates, which will surely set a target for others to shoot at in future negotiations.

I am greatly disturbed to read and hear from time to time that even some management representatives do not believe that the current rate of increases to the building trades of 8, 9, or even 10 per cent are unstabilizing. Those kinds of increases to \$10.00 and \$15.00, even \$20.00 wage rates are, in my view, hardly stabilizing.

CCE stands ready to assist member associations and participating multi-association bargaining groups when requested to do so. Admittedly, some of the International Unions are not in the most cooperative of moods at the present time due to the veto of situs-picketing legislation, however, I believe most of them, at least, realize that a certain amount of cooperation between labor and management at the national level will be required to bring the construction industry out of its recession.

In my judgment, it is absolutely necessary that some sort of a

program at the national level be developed. It need not be legislation. When, hopefully, the current recession is over and fuller employment results, collective bargaining in our industry will return to the chaotic conditions that existed in 1969 and 1970, unless considerable improvement has been made in the collective bargaining process. Now is the time to develop and adopt such a program.

CCE's officers, appropriate committees, and staff all are addressing themselves to the problem. Of course, such a plan, to be successful, must have the endorsement and cooperation not only of management, but labor and the buying public, as well.

CHAIRMAN'S STATEMENT

by Robert Linck

Our bicentennial year is as good a time as any to stress the values, principles, and precepts which have brought this nation of ours into being—values, principles and precepts which we hold to be timeless

and universal—values, principles and precepts for which Americans have fought and which Americans have defended for more than two hundred years.

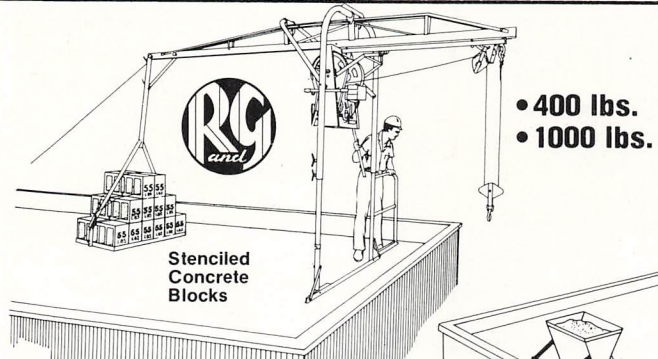
These values, principles and precepts comprise our heritage as Americans. Perhaps they can exist without America, but most certainly, America cannot exist without them. In order to preserve this incomparable American heritage each successive generation of Americans is obliged to earn again for itself that which it inherited.

It takes ever so much more than just learning about them. What it takes, in the course of each of our lives as Americans, is a certain amount of doing. Depending upon the degree of our individual burden of our responsibility to others, whether they be only a very few or a very great many, what we do, perhaps only that which we do, with respect to our heritage, stands by itself to preserve that heritage which we claim as Americans. When we do it, how, where and under what conditions, are all related—but what

we do, as responsible Americans, when it becomes obvious that something must be done, is what counts more than anything else.

As we turn to the affairs of the largest industry to be found in the United States of America, let us remember that we need to do only that which is right, not merely our best. If we can agree that we dare not to practice that which is wrong in principle, it is essential then to agree, before we start any doing, on just what is right and to determine from time to time as we get going on what is not right.

First, I do not view our undertakings as a contest to determine who is right, but rather a concerted effort to determine what is right. Second, I do not believe that anyone else in the United States of America is better able to assume the burden of responsibility that remains ours and ours alone. We cannot look to others to do for our industry what we are about to do. Third, I believe that we must strive to do now what can be done now. We can't rewrite history, but we can make those things right



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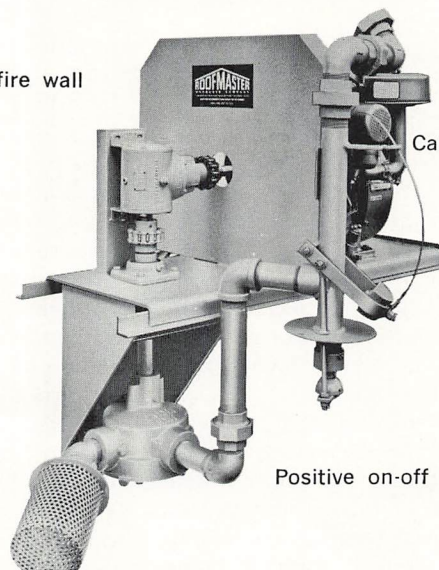
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for the future which we are able to agree have in the past been wrong or less than satisfactory.

The concept of collective bargaining is here to stay. It remains the foundation of what must be a healthy industry if America itself is to remain healthy. The process, and it is a continuing process, is not intended to determine who wins what and/or who loses what, despite our historical approach in just that vein.

When the process results in economic imbalances, sooner or later, but most definitely, at some point, the immutable laws of economics will prevail. The imbalances may reach horrendous proportions before a disaster of one sort or another ultimately will take place. It should not be anyone's goal in the collective bargaining process to produce, wittingly or unwittingly, imbalances which will be predictably counter-productive to the overall American economy.

Collective bargaining must not therefore be a "vacuum process", performed as though its fruits will never be eaten by others who are not

directly represented at each and every table.

Supremacy on any side is most unlikely to achieve results which will long stand the test of time. Supremacy which insists on translating the collective bargaining process into wins and losses is inherently defective and dangerous. Conversely, the collective bargaining process should tend always to balance the needs, wants and desires of the respective parties who must remain convinced throughout that selfish gains will most assuredly fail and that meaningful gains can be achieved without penalties.

We have been conditioned to thinking in terms of games, contests, power struggles and outright knock-em-down, drag-em-out fights—all of which stand to be won or lost. We have measured strengths and weaknesses, used timing, created moods, set traps and done all sorts of other things. We have very few rules and damn few referees. We have many teams, two sides and the makings for lots of heroes. But when it is all said and done, do we really

believe the product of the collective bargaining process ends up only in the record books? More likely, we are thinking in terms of pocketbooks and our own, at that. Who thinks of those long-term consequences when the chips are down? No more than any business can sell to dissatisfied customers for very long can we anticipate that the collective bargaining process is so sacred that bad results may be ignored.

CCE believes in the concept of coordinated bargaining. I personally am convinced that much right is being done where the process is coordinated in almost any fashion at the local level. In several instances, the results of coordinated bargaining are simply startlingly good. CCE believes that we should be encouraging the many groups who can, by their own efforts, perform the collective bargaining process in a coordinated manner. In terms of the process, coordinated bargaining may take the form of area-wide bargaining or multi-trade bargaining or both. In short, it's up to us to point the way and see to it that it happens!



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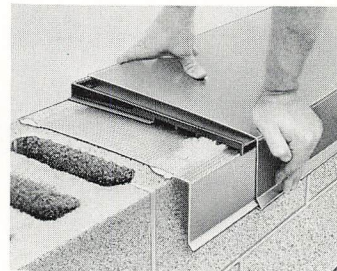
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Decks Inc.
Rolling Meadows, IL

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Diamond Roofing Co., Inc.
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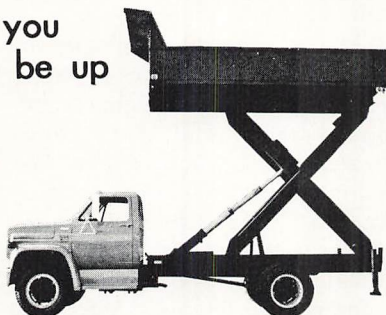
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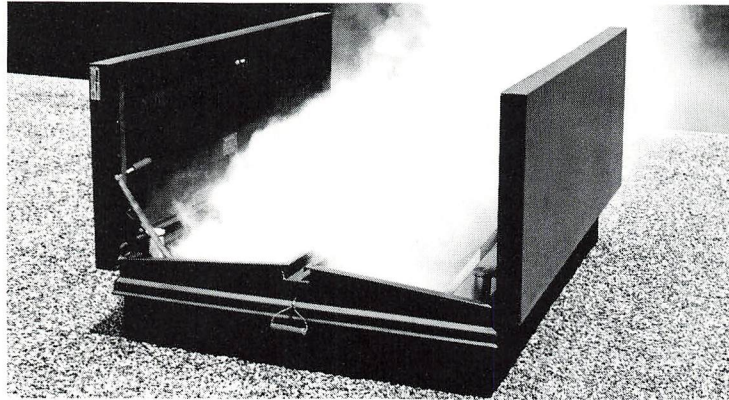
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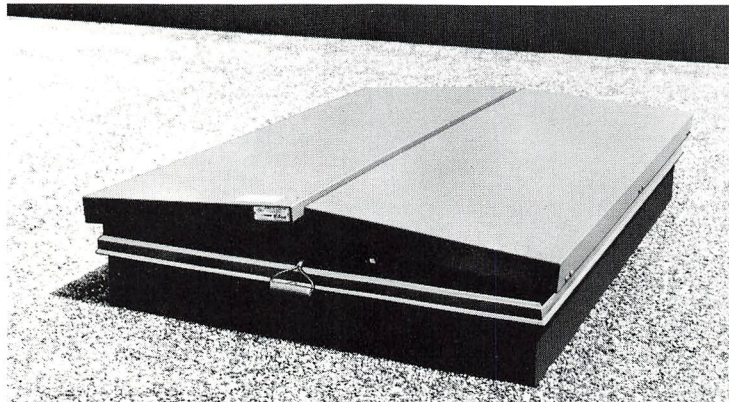
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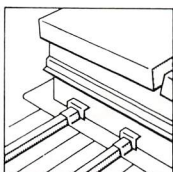


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