

STANDING SEAM METAL ROOFING:

The Next Big Disaster in the Roofing Industry?

By Richard L. Cook, Jr., RRC, RWC, RRO, CCS, CCCA, LEED AP

I interviewed with a school district several years ago for an open-end contract for roof consulting services. At the conclusion of our typical presentation, one of the board members asked my opinion of metal roofing, and specifically, "slope conversions." At the time, I was not aware that their intent was to install slope-conversion metal roofs to all of their existing schools. I made the statement that "standing seam metal roofs" would be the next major disaster in the roofing industry, that the details are critical, and the ability to "fix" these roofs after construction can be difficult. I then tried to explain the problem is not the product or system, but the need for knowledge of these systems from the manufacturer, design professional, roofing contractor, and other subcontractors. This could not be accomplished within the remaining 45 seconds of the interview, and we obviously were not selected for the project. A valuable lesson was learned. Do not make bold, firm statements on an issue without adequate opportunity to explain your position.

Why then the outrageous title of this article? To give myself the opportunity to explain that with proper knowledge and guidelines, standing seam metal roofing is a valuable option for many owners, and many common problems can be easily eliminated.

We have completed numerous investiga-

tions of metal roof systems, the majority of which were less than five years old and had numerous leaks. Often the reported leaks disappeared for a period of time after "repairs" had been completed, then reappeared at a later date. The focus of our investigations was not for litigation, which we refrain from whenever possible, but to identify the problems and provide potential long-term solutions.

In this evolution, we have developed a design checklist intended to eliminate the majority of problems before they happen.

METAL ROOFING DESIGN CHECKLIST

1. A roof design should obviously meet the applicable code requirements (these are minimum standards). Please note the previous three model codes and the International Building Code 2000 and 2003 have made some significant changes in regard to roofing. Also realize the definitions within the code may not parallel industry standards. (See Figure 1.)

MECHANICAL EQUIPMENT SCREEN. A partially enclosed rooftop structure used to aesthetically conceal heating, ventilating and air conditioning (HVAC) electrical or mechanical equipment from view.

METAL ROOF PANEL. An interlocking metal sheet having a minimum installed weather exposure of 3 square feet (.279 m²) per sheet.

METAL ROOF SHINGLE. An interlocking metal sheet having an installed weather exposure less than 3 square feet (.279 m²) per sheet.

MODIFIED BITUMEN ROOF COVERING. One or more layers of polymer-modified asphalt sheets. The sheet materials shall be fully adhered or mechanically attached to the substrate or held in place with an approved ballast layer.

PENTHOUSE. An enclosed, unoccupied structure above the roof of a building, other than a tank, tower, spire, dome, cupola,

Figure 1 - IBC definition.

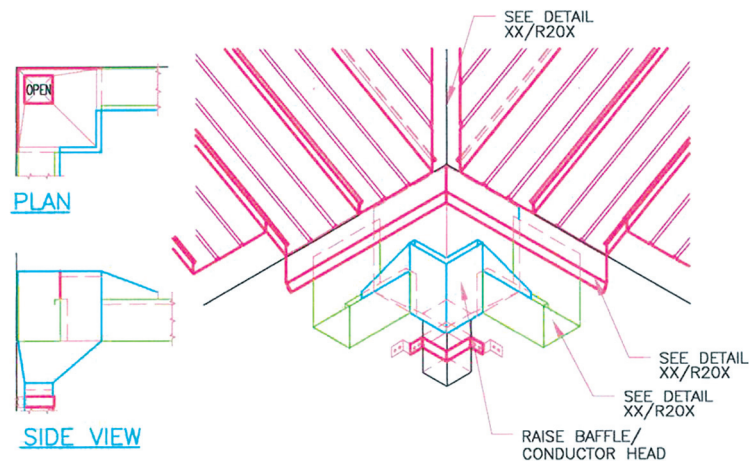
2. As a starting point, the following industry standards contain good, generic construction requirements and detail recommendations:
 - a. *The Roofing and Waterproofing Manual 5th Edition*, National Roofing Contractors Association (NRCA), *Architectural Sheet Metal Manual*, Sheet Metal & Air Conditioning Contractors' National Association, Inc. (SMACNA), and *Metal Roofing Systems Design Manual*, Metal Building Manufacturers Association (MBMA).
 - b. As a minimum, the *NRCA Roofing and Waterproofing Manual, 5th Edition* and the

Standing Seam Metal Roofing (SSMR) Construction Details for both architectural and structural systems should be the basis for all design development. Specific, custom details will still be required for unique or special penetrations and project-specific terminations.

- c. As a minimum, recommend adding the following to your general notes and specifications:

“All clarifications or additional information needed shall be in accordance with the criteria and details of the *NRCA Roofing and Waterproofing Manual* and the *Architectural Sheet Metal Manual*. Any deviation from the specified or indicated requirements shall be submitted for approval by the designer or owner’s representative prior to installation.”

3. Exposed fasteners in the flat of the roof panel, although commonly accepted or allowed by the manufacturer, should be avoided to the greatest extent possible. Exceptions do exist, especially in high wind zones.
4. The *SMACNA Architectural Sheet Metal Manual, 6th Edition*, is a good source for details and criteria for various sheet metal systems and components but requires specific needs to be identified for the job since various configurations exist for different components and are typically recommended versus required.
5. Do not write specifications that rely on or allow the manufacturer to determine the acceptability of a condition or the details to be used. The specifier’s design (details) should establish the minimum requirements. Proprietary specifications for contractors, suppliers, or manufacturers are also not recommended; neither are open specifications that everyone meets (i.e., typical ASTM specifications).
6. Clearly show sections of construction requirements for the roof assembly, including structural framing, deck, insulation, underlayment systems, and the transition



NOTES:

1. SEAM AND PANEL PROFILES MAY VARY BASED ON APPROVED SUBMITTALS.
2. SPECIFIC FASTENING REQUIREMENTS ARE NOT INDICATED ON DETAIL, SHALL BE IN ACCORDANCE WITH CONTRACT REQUIREMENTS AND APPROVED SUBMITTALS.
3. UNDERLAYMENT SYSTEM IN ACCORDANCE WITH CONTRACT REQUIREMENTS.

GUTTER INTERIOR CORNER BAFFLE / CONDUCTOR HEAD

Figure 2 – Gutter interior corner baffle/ conductor head.

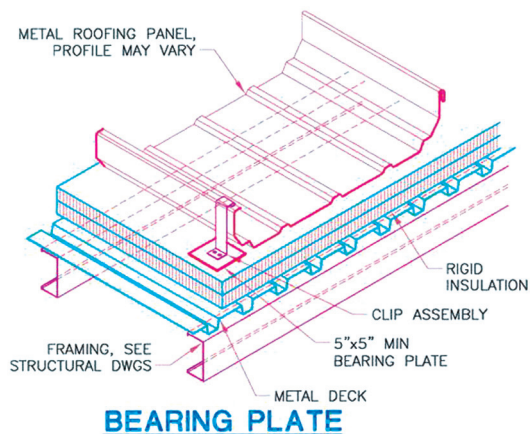
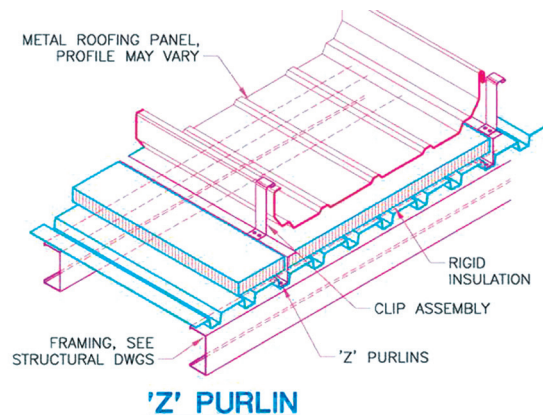


Figure 3 – “Z” purlin/bearing plate (clip assemblies).

7. Metal does not leak; the penetrations and terminations do. For this reason, specific custom details will still be required for penetrations and terminations. Exposed sealants are

- a good indicator that improper details are being used.
8. Provide a new roof plan. Identify slopes and indicate all penetrations and terminations. Provide applicable details and references for the pene-

trations and terminations. Isometric details are preferred.

9. For roof replacements and slope conversions, provide an "Existing Roof Plan," identifying existing assemblies and locations of penetrations and terminations. Indicate which penetrations are to be abandoned and show on the "New Roof Plan" which penetrations are to extend through the SSMR.
10. For roof replacements and slope conversions, coordinate the "Existing Roof Plan" and "New Roof Plan" with the structural specifications and drawings.
11. The drainage design of metal roof systems must address the typical sizing of gutters and downspouts, but must also address problems unique to these types of systems (see Figure 2).
 - a. The location and size of the gutter must compensate for the slope of the roof so that the gutter is not overshot or overloaded in individual locations.

A common problem is at valleys where the standing seam



Photo 1 – Drainage deficiency on a one-year-old project.

configuration directs water to valleys and overshoots or overloads gutters at these locations. Valleys may need baffles on the

outer edge at the gutters. At larger roof areas or longer valleys, a conductor or collector head may also be incorporated

Specifire?



Why not consider a zero flame, zero heat roofing system with the highest fire rating in the world.

Decothane® - our state-of-the-art roofing membrane is cold fluid applied. No torches, boilers, hot air or hot gas guns are used; eliminating the risk of fire breaking out both during and post application.

Decothane is the **only roofing product** available on the market **successfully tested to:**

- Factory Mutual Approval
- BS 467: Part 3
- DD ENV 1187: 2002
 - Test Method 1
 - Test Method 2
 - Test Method 3

If you would like to know more, give us a call today at **888-635-5228**



Liquid Plastics Inc

79 Bradley Street
Middletown, CT 06457

Tel: 888-635-5228

Fax: 860-613-2689

web: www.liquidplasticsinc.com

e-mail: info@liquidplasticsinc.com





Photo 2 – Improper valley detail and termination.

into the gutter system (see Figure 3).

b. Downspout sizes and locations must also consider drainage at “the worst case locations” and gutter expansion joint locations. Due to the standing seams, a large area of roof drainage can be directed to a single location. (See Photo 1.)

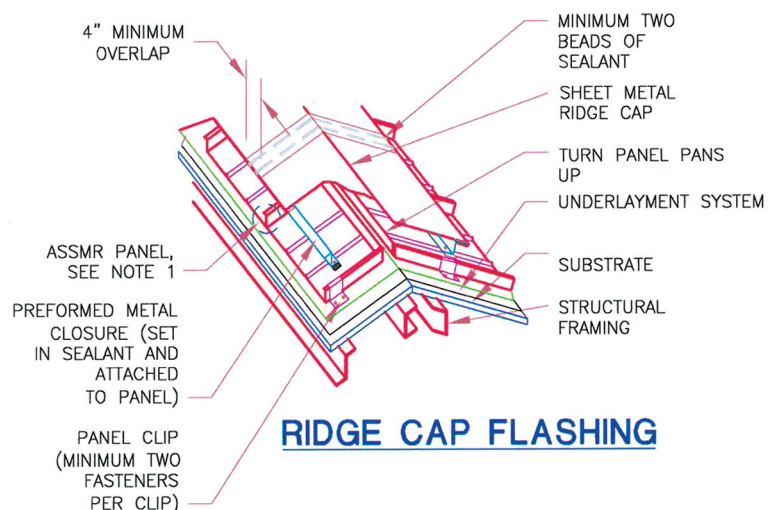
12. The low end of a valley should not terminate into a wall or at a corner. It must extend at least one foot beyond the corner to permit proper detailing and sufficient drainage. This conflicts with typical structural design/detailing. An inverted “V” or diverter is recommended in the valley (see Photo 2.)

13. Two types of metal roof systems are most commonly used commercially today: Architectural Standing Seam Metal Roofs (ASSMR) and Structural Standing Seam Metal Roofs (SSSMR). Significant differences exist in the supporting structures, materials, profiles, insulation, installation, and details of the systems. Hybrids of these two types also exist, causing further confusion. Also, metal roof systems are often proprietary in some respect, and selecting and specifying systems takes effort and research.

14. All SSSMR should ensure positive drainage with a minimum finished one-quarter-inch-per-foot slope, per industry standards. (ADC Engineering, Inc. recommends a minimum 1:12.) Architectural SSMR typically requires a minimum 3:12 slope. (ADC Engineering, Inc. recommends a 4:12.)

15. Structural or non-structural metal roof systems designed over rigid board insulation (polyisocyanurate) and metal decks are unique. This configuration is becoming common in the industry, but there are limited data available for wind and fire ratings and detailing.

Figure 4 – Ridge cap flashing (double closure).



Two common but different attachment methods also exist: (1) a “Z” purlin that rests in the bottom of the rib opening of the metal deck and matches the thickness of the insulation; or (2) a metal-bearing plate that sits on the insulation, the clip assembly sits on the bearing plate, and two long fasteners attach through the insulation into the metal deck (see Figure 4).

In either case, the availability of adequate testing of these assemblies is the issue, and the level of uplift performance they have achieved must be coordinated.

The specified type of metal (commonly aluminum, Galvalume®, or galvanized steel), the gauge, the panel profile, and the width of the panel will also affect the wind rating of the metal roof system.

16. Panel gauges and profiles can also significantly affect performance, flashing compatibility, wind resistance, oil canning, and structural compatibilities, not just aesthetics.

17. Design requirements for wind uplift are addressed by: (1) completing calculations based on the appropriate design standard (i.e., ASCE 7 or the applicable code); and (2) determining the increased uplift forces at the various corner and perimeter locations.

Actual uplift testing based on the specific standard (UL, FM, ASTM E-1592, etc.) must also be completed for a similar assembly including the type, gauge, profile, and seam configuration.

The design professional must then

make a determination that the specific assembly can meet the specific uplift forces based on a clearly defined attachment method for the panel in the field, corner, and perimeter locations.

Although the design requirements and uplift testing provide limited information specific to flashing, appropriate requirements must be incorporated into the various termination details (i.e., eave, rake, hips, ridges, etc.) for these forces and must be shown in the design and submittal process.

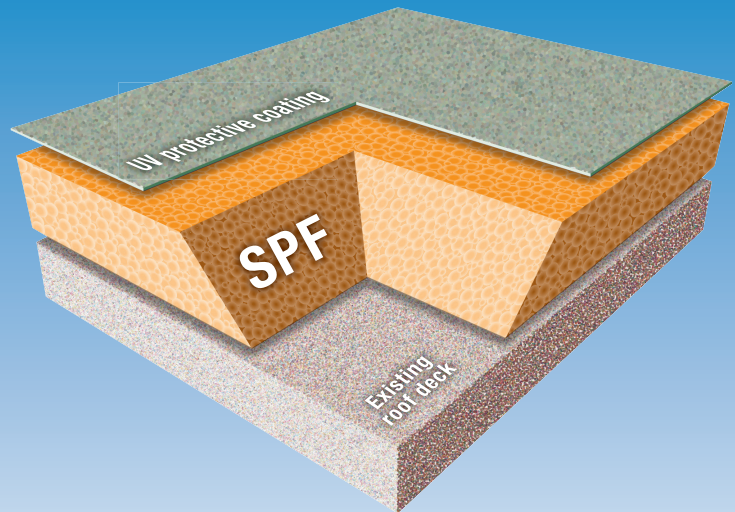
18. All roof systems experience varying uplift forces at corners and perimeter. Ensure that the design and submittals clearly identify boundaries of the perimeter and corners and how the increased attachment occurs at these locations. Secondary framing is often in these locations. Also be aware of the restrictions on wind speeds with warranties for metal roof systems. Requirements for thermal calculations are needed to determine the anticipated movement and to allow this movement within the detailing of penetrations and terminations.
 - a. The type of clip and its positioning are critical to provide the ability for movement.
 - b. The state of expansion of the metal during application affects the installation and detailing.
 - c. The point of fixation varies in the industry. Some fix the panel at the eave, others fix the panel at the ridge, and on occasion it is fixed at a midpoint. This will affect the wind uplift resistance and detailing.
19. Additional or secondary steel framing are always a controversial issue. Numerous benefits are gained by providing these members around the perimeter of buildings and at various penetrations. In re-roofing applications, the existing structure often requires additional framing at perimeters. Do not recommend eliminating these members without proper research and coordination.
20. All ridge and hip closures should have redundancy within the detail. Panels should have end dams and a closure detail to provide long-term performance. This is a common

problem area, especially on lower slopes (see *Figure 5*).

21. Penetrations through roofs should consider the location of the standing seams and the width of the panel to ensure that the penetration occurs in the flat portion of the panel and that adequate drainage can occur around the penetration. As noted above, the size at the opening around the penetration must allow for thermal movement (see *Photo 3*).
22. Oil canning is not a uniformly defined term in the roofing industry,

and the level of acceptable oil canning is always a difficult problem to resolve in the field. Establishing a level of acceptance prior to construction based on a similar project or mock-up within the contract is an option to consider.

The type of metal, slope of the roof, color, width of panel, and panel configuration are design items that can have an effect on the degree of oil canning. Storage, placement, and installation methods can also have a significant effect, as can the coil



LOWEST COST RE-ROOFING 95% OF THE TIME

Spray polyurethane foam beat the price of all other options on 95% of BASF re-roofing projects. Why? Because it installed directly onto existing substrate: zero tear-off, zero landfill fees and zero downtime. Much lower maintenance and repair costs and greater energy efficiency add up to even more savings for the lowest lifecycle cost in low-slope roofing.

Helping Make
Buildings Better™


The Chemical Company

SPF roofing offers the lowest lifecycle cost.
Get proof at www.basf.com/proof
or call 1-800-547-4004

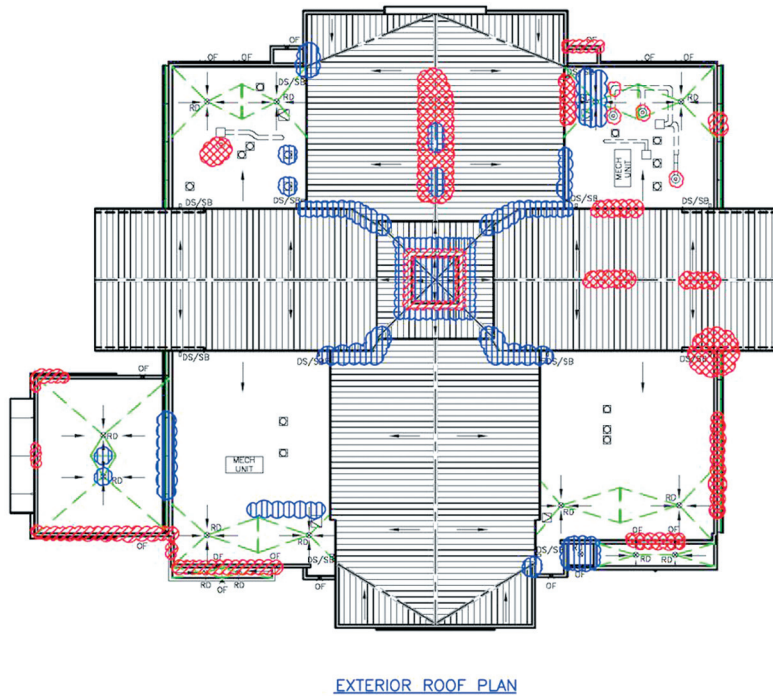


Figure 5 –
Deficiency
roof plan.

stock and roll forming methods (especially smaller, on-site units).

23. Factory color finishes can pose several problems: (Note that painted Galvalume® is AZ50 vs. uncoated AZ55. Many specs wrongly call for AZ55 with Kynar finish.)
 - a. Submittals seldom provide the required test data for the various color finish tests, especially with federal guide specifications.
 - b. Warranties do not provide protection that the finish will perform in line with the specified tests. As always, warranties have substantial exclusions and are written for the benefit of the manufacturer, not to protect the owner.
 - c. Also be aware, there is a “shell game” as to who is responsible for what — the panel manufacturer, the coating manufacturer, the coil coater, or the coil metal manufacturer.
 - d. Note that many warranties do not cover projects in coastal environments or certain types of facilities (i.e., residential, condominiums, etc.)
24. Manufacturers’ warranties should be based on the owner’s requirements. Warranties do not protect owners; they limit liabilities of the manufacturers. Do not make deci-

sions in regard to the roofing system, its details, or variations based on a warranty being provided. Also, all jobs should require an independent two-year contractor warranty as a minimum.

25. Two types of insulation are commonly installed directly under a SSMR System.
 - a. Batt (fiberglass) insulation is commonly used under SSMR systems. A common issue is the decreased insulation R-value at structural members where the insulation is compressed. This is

also a potential condensation area.

- b. Rigid board insulation is used below both architectural and SSMR. Available testing of these assemblies, noted previously, must be confirmed. Also, thermal efficiency should consider the thermal bridging created by the clip assembly and fasteners and gaps in the insulation, especially at “z” purlins.
26. Rigid board insulation should be installed in at least two layers with joints staggered between layers for most roofing systems. Insulation should be thick enough to span rib openings on metal deck and fall within minimum and maximum thickness limitations of FM or UL as applicable.
 - a. Clip assemblies and attachments can affect the ability to provide two layers of insulation.
 - b. Maximum thickness of insulation can affect the uplift resistance of the clip attachment.
 27. The heights of penetrations, parapet walls, and insulation must be considered and addressed, especially perimeter conditions and penetrations such as roof-mounted equipment.
 28. Use crickets and diverters to direct water away from penetrations. As a minimum, provide two times the primary slope to ensure resulting surfaces drain properly. Also consider the size of penetrations and the metal panel widths.



Photo 3 – Classic improper penetration flashing.



fiberology.

Elvaloy® and the intelligent way to use it. A little Elvaloy can help make any membrane more flexible and durable. But only FiberTite® is proven to contain the right amount of Elvaloy. A perfected blend that was developed over 25 years ago and that we still use today. That's why FiberTite was used to set the ASTM D6754-02 industry standard for high performance membranes that use Elvaloy to achieve durability and weatherability. And, why only FiberTite can boast that better than 99% of their roofing systems ever installed are still performing. To learn about the proper use of Elvaloy in our Intelligent Roofing Solutions™ call 800-927-8578, ext. 1335.



trustfibertite.com



Photo 4 – Significant condensation within ridge cap.

- 29. Do not use interior built-in gutters or built-in downspout systems unless unavoidable. When used, incorporate waterproof liners and plan for regular inspections and maintenance.
- 30. Vapor retarders or barriers may be required within some roof assemblies based on geographic location and interior humidity levels (see Photo 4).
- 31. Counterflashings should include pre-fabricated inside and outside corners, two-piece arrangements, and hemmed edges. Coordinate or merge metal roof specifications and sheet metal specification requirements and materials.
- 32. Coordinate lightning arrestor systems, photoelectric sensors, fire alarm transmitters, antennas, and other unique penetrations by showing them on the roof plan and providing appropriate details for attachment and penetration through the specific roof system.
- 33. A minimum distance of twelve inches between all penetrations and terminations should be maintained for proper flashing. Penetrations should occur in the middle (in between the standing seams) of a panel, or if wider than an individual panel cricket, incorporated into the detail.

- 34. Minimize penetrations to the greatest extent possible.
 - a. Use round shapes to construct equipment supports and avoid use of pitch pans. For lower sloped metal roofs, the equipment supports should be a minimum of 14 inches high, but not less than shown in the table below. Note that these are guidelines and must be varied based on the slope of the roof.

WIDTH OF EQUIPMENT	HEIGHT OF LEGS (ROUND PIPE PREFERRED)
Up to 25"	14"
25" to 37"	18"
37" to 49"	24"
49" to 61"	30"
61" and wider	48"

- 35. If milestone or full-time quality assurance services are planned for a project, early involvement (i.e., during the design process) by the consulting firm can provide numerous benefits. Recommend the consulting firm conduct pre-roofing conference meetings as the highest priority and then milestone inspections during the early stages of the project.

Inspections made after problems occur or at the end of the project focus on defining what can be accepted versus providing a quality roof system.

CONCLUSION

The above checklist will bore some and infuriate others, but hopefully it will provide some insight and information for most readers. It was not intended to answer all questions or to discuss all of the problems with standing seam metal roofs, but outline many of the common plights and shortcomings.

The viewpoint is intended to be generic and objective from a design professional perspective. ©

ADDITIONAL SOURCES OF INFORMATION

1. *Architectural Sheet Metal Manual*, 6th Edition, Sheet Metal & Air Conditioning National Association (SMACNA), 1993.
2. *Manual for Inspection and Maintenance of Low-Sloped Structural Metal Panel Roof Assemblies*, National Roofing Contractors Association, 2002.
3. Newman, Alexander, *Metal Building Systems Design and Specifications*, 1997.
4. *Metal Roofing Systems Design (First Edition)*, Metal Building Manufacturers Association for the Metal Roofing Systems Industry, 2000.
5. *The NRCA Roofing and Waterproofing Manual*, Fifth Edition, National Roofing Contractors Association.
6. Haddock, Rob, *Metal Roofing From A to Z*.

Richard L. Cook Jr., RRC, RWC, RRO

Richard L. Cook Jr., RRC, RWC, RRO, is a principal of ADC Engineering Inc., Hanahan, SC. Rick has authored numerous papers on the subject of roofing systems and wind-related damages. He has presented several papers at national symposia and conferences, including the American Society of Civil Engineers, the Construction Specifications Institute, RCI, and the Federal Construction Committee in Washington, D.C. Cook has also presented dozens of papers at local and regional meetings and conferences related to roofing and waterproofing in the construction industry.



China Growth Affecting U.S. Construction Prices

The exponential increase in demand for construction materials in China has affected prices worldwide, impacting U.S. materials costs, according to *Construction Executive* magazine. In the middle of the tenth phase of its 50-Year Plan, China consumes 25% of the world's steel supply and 40% of its cement supply. China, a large producer of steel, has redirected previously exported steel to fill its own domestic demand and reduced the material's availability on the open market. U.S. tariffs on imported steel were removed in 2004, but rising domestic demand keeps prices high.

According to a study done by *Engineering News Record* in September 2004, reinforcing bar prices had risen 45.2% in the U.S. between September 2003 and September 2004. During the same period, lumber prices rose 28.8%; structural steel, 25.7%; plywood, 21.5%; ready-mix concrete, 2.8%; and cement, 2.5%.

China's gross domestic product (GDP) increased by 9.1% in 2003. Its GDP is expected to reach \$1.5 trillion in 2004 and \$1.61 trillion in 2005, with the gross value of its construction industry reaching \$522 billion in 2005.

— *Construction Executive and Professional Roofing*

Survey Shows Maintenance Breakdown

A survey recently published in *Roofing Contractor* magazine of over 1,500 professionals responsible for commercial properties revealed some interesting responses. One question asked who performs scheduled maintenance on the roof. Answers were: 44% internal; 44% contractor; and 12% roof consultant.

Copies of the survey are available for purchase at www.roofingcontractor.com.

— *Roofing Contractor*

TEENS RESTRICTED IN ROOFING

The U.S. Department of Labor (DOL) issued its final ruling on the Fair Labor Standards Act's child labor standards in the Dec. 16, 2004, Federal Register.

A provision was added prohibiting workers under 18 years old from "all work on or about a roof, including work performed upon or in close proximity to a roof." Previously, youths were banned from all roofing occupations but not from working on or near them. Youths in a roofing apprenticeship or student-learner program are exempt from the ban.

— U.S. Dept. of Labor