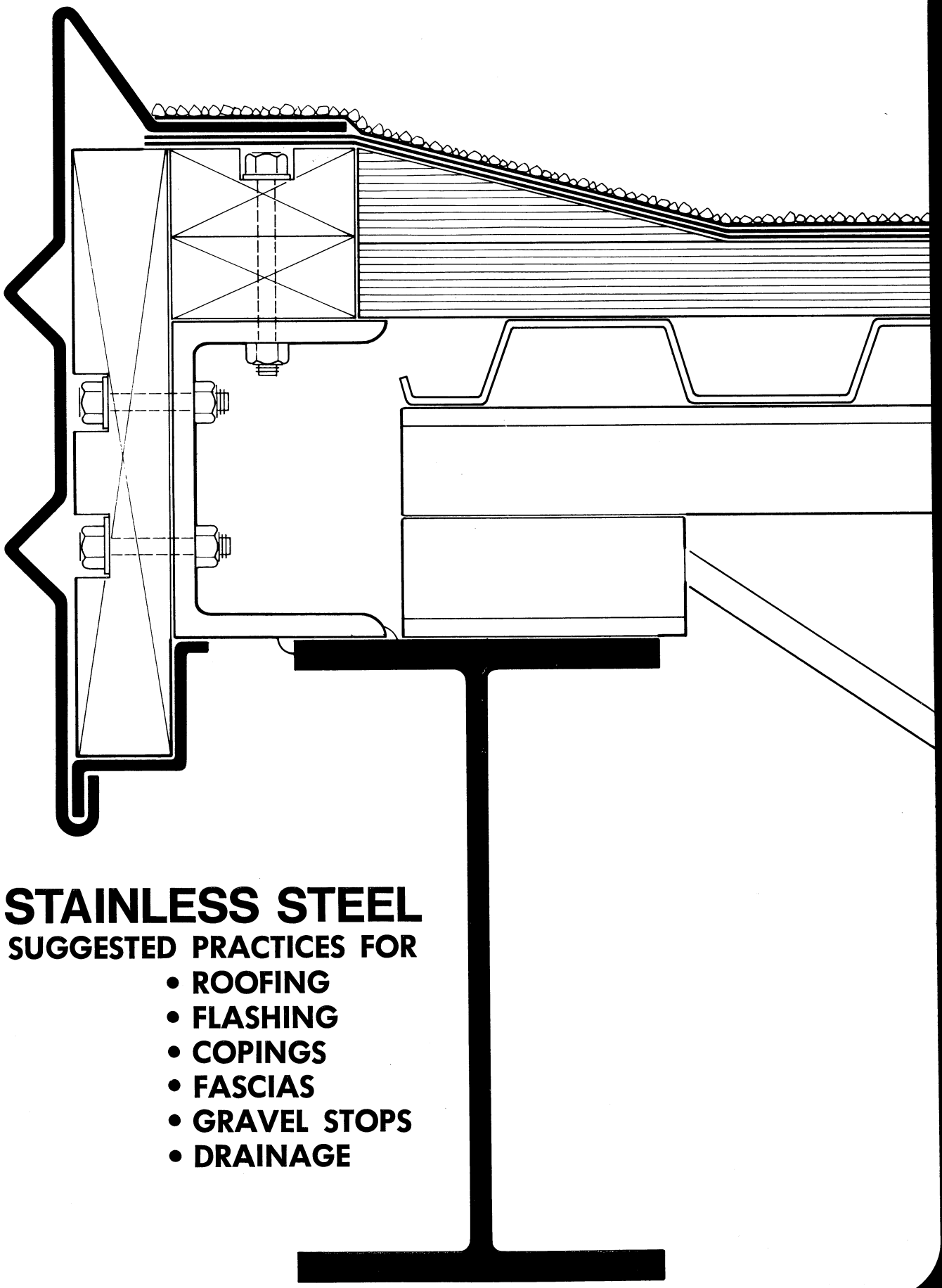


STAINLESS STEEL

SUGGESTED PRACTICES FOR

- ROOFING
- FLASHING
- COPINGS
- FASCIAS
- GRAVEL STOPS
- DRAINAGE

CONTENTS

HOW TO USE THE MANUAL

This publication supersedes the "Stainless Steel Data Manual" published in March, 1968, by the Committee of Stainless Steel Producers, American Iron and Steel Institute. It includes revised and updated information on a broad range of stainless steel moisture-protection applications.

To gain maximum value from this manual, it should be used in conjunction with the Architectural Sheet Metal Manual published by the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA). For quick reference, appropriate detail drawings in the SMACNA Manual are "keyed" by plate number to all stainless steel applications listed in Table I on pages 10 and 11 in this manual.

In preparing this manual, the Committee of Stainless Steel Producers has drawn on the experience of its members and of architects, specification writers, product manufacturers and roofing contractors. The Committee wishes to thank, in particular, the SMACNA staff for its assistance and cooperation.

It should be noted that for several applications in this manual thinner metal is indicated as compared with the SMACNA Architectural Manual. The suggestions for thinner stainless steel result from information developed in the field since the SMACNA Manual was last published in 1968, which indicates that realistic reductions in gage can be employed successfully in a variety of stainless roofing and flashing applications.

While the companies represented on the Committee do not fabricate the products mentioned or perform the work discussed in this manual, their technical sales representatives will be pleased to provide assistance on stainless steel.

PROPERTIES OF STAINLESS STEEL

Stainless steel is perhaps best-known for its esthetic value. For most roofing and flashing applications, however, functional properties and economic factors are more important. Stainless steel for such applications offers significant performance advantages to the architect and building owner:

- Stainless steel is corrosion resistant all the way through and requires no artificially applied surface coating for protection. In fact, stainless performs best when it is boldly exposed.
- Stainless steel is self-cleaning and requires little or no maintenance.
- It is not affected by the corrosive alkaline action of mortar or masonry.
- Stainless steel is compatible with and will not stain aluminum, masonry or other building materials.
- The high tensile strength and modulus of elasticity of stainless permit the safe and effective use of thinner gages than required with other metals. As a result, its installed cost is competitive with other roofing and flashing materials.
- Its thermal expansion is comparable to copper, is less than aluminum or zinc alloys and is somewhat higher than galvanized steel. (See Table II on page 12)
- Stainless is easy to form and solder—either in the shop or in the field.
- Stainless steel is a safe, fire-resistant roofing material. It has a very high melting point (2550°-2650° F) and retains its strength at elevated temperatures.
- It resists wind damage and denting and has superior resistance to metal fatigue.

STANDARD PRACTICES

The use of stainless steel for roofing, flashing and other moisture-protection applications involves no unusual techniques. However, as with all architectural metals, there are certain precautionary measures to be followed in the selection, design, fabrication and installation of stainless steel. These may vary across the country according to local experience, climatic and environmental considerations and shop practice.

CHECKLIST OF DESIGN CONSIDERATIONS

- Specify the proper stainless steel type, temper, finish and thickness for each application.
- Where appearance is important, avoid long or large, flat, unsupported sheet metal areas, to reduce chances of apparent distortion, waviness or "oil canning."
- Provide adequate drainage, particularly on so-called flat roofs, to avoid the collection and concentration of contaminants.
- Avoid drainage from unwashed iron slag roofs.
- Avoid corrosion-product wash from other metals, such as unpainted steel. While these do not harm the stainless, they are unsightly.

HOW TO SELECT STAINLESS STEEL

ALLOYS

Stainless steel is not just one metal. In fact, there are 44 stainless steels which are recognized as standard by the American Iron and Steel Institute. Chromium is the element that gives these steels their corrosion-resistant qualities, while nickel, manganese and molybdenum also contribute to corrosion resistance and/or ease of fabrication.

The four stainless steels most often specified for roofing and flashing applications are AISI Types 302, 304, 301 and 316, with Types 201 and 202 also available. All six have excellent corrosion resistance, high strength and ease of fabrication.

AISI Type 302, the original "18-8" alloy (18% chromium, 8% nickel), is most often specified for roofing, flashing and other architectural applications. Over the years, it has become known as the "all-purpose" stainless steel. **Type 202** is the general-purpose low-nickel equivalent of Type 302.

AISI Type 304 is a lower-carbon variation of Type 302 and is preferred if welded components are to be exposed to corrosive environments. For most roofing and flashing uses in normal urban and industrial atmospheres, both types are completely interchangeable and frequently are specified by the combined designation—Type 302/304.

AISI Types 301 and 201 are high-strength variations of Type 302, possessing tensile strengths above 110,000 psi in the annealed condition vs. 84,000 psi for Type 302. Because they work-harden more rapidly to still higher strength levels, Types 301 and 201 usually are specified for formed sections or shapes which require extra stiffness or extra load-bearing capacity. Typical examples include self-supporting, corrugated roofing or siding panels which are to be mechanically joined.

AISI Type 316 contains 2 to 3% molybdenum, and is more corrosion resistant than the other five stainless steels. Although higher in initial cost, Type 316 usually is preferred for long-term service in aggressive industrial, chemical and seacoast atmospheres.

TEMPER

While stainless steels are available in a variety of of tempers, most roofing and flashing applications utilize only the dead-soft, fully annealed condition; or the standard, annealed condition.

Dead-soft, fully annealed stainless steel has a nominal yield strength of 35,000 psi, has no "spring-back" and is easy to cut and form. Widely used for a majority of roofing and flashing applications, it is available in Types 301, 302, 304, and 316 from local sheet metal distributors, service centers or on direct order from the mills.

In the standard annealed condition, these stainless steels have a yield strength of about 42,000 psi. They exhibit slight "spring-back" and require over-bending in forming to achieve the desired angle or shape. Unless otherwise specified, most suppliers deliver stainless steel in the annealed condition. It is used most often where a bright finish is wanted or where a degree of extra strength is needed.

These steels also are available in harder tempers and higher strengths. For example, full-hard Type 301 has a yield strength of about 150,000 psi. However, this property is seldom used in moisture-protection applications.

SIZES

Flat-rolled products less than $\frac{3}{16}$" thick and more than $\frac{3}{8}$" wide are classified as either sheet or strip. If the width is 24 inches or more, the product is designated as sheet; if less than 24 inches, it is referred to as strip.

Both sheet and strip can be ordered in continuous coils as well as flat pieces cut to length. Some steel service centers regularly stock precut sheets.

GAGES

Because stainless steel is stronger than the traditional architectural metals, it can be used for most applications in significantly thinner gages. This particular advantage often permits stainless steel to be competitive with other architectural metals.

For example, a base flashing requiring the use of 20-oz. (.027-inch) copper can be specified in .015-inch (28-gage) stainless steel. To give some idea of cost savings involved, 100 square feet of base flashing would weigh 125 lbs. in 20-oz. copper compared to only 66 lbs. in .015-inch stainless. Therefore, stainless steel would have to cost at least twice as much per pound as copper, before the base flashing in thin-gage stainless would become more expensive on a square-foot basis. (See Table III on page 13 for gage-weight ratios for stainless steel, aluminum and copper which can be useful in determining material costs.)

Some architects and municipal, state and federal government agencies give detailed instructions

in their roofing, sheet metal and insulation specifications to avoid any confusion in thickness or weight that might occur when ordering alternate materials—such as stainless steel vs. copper. It should be recognized that such specifications vary according to the agency concerned. The New York City Housing Authority, for example, provides the following data in its General Construction Specifications:

.0125-inch (30-gage) stainless steel equivalent to 10-oz. copper or copper coated with lead.

.018-inch (26-gage) stainless steel equivalent to 16-oz. copper or copper coated with lead.

.021-inch (25-gage) stainless steel equivalent to 20-oz. copper or copper coated with lead.

.025-inch (24-gage) stainless steel equivalent to 24-oz. copper or copper coated with lead.

Stainless steel flashing stock is readily available in .012-inch (30-gage), .015-inch (28-gage) and .018-inch (26-gage). In addition, some product manufacturers have engineered flashing components using stainless steel as light as .010-inch (32-gage). These are usually special-ordered because they are ribbed or otherwise stiffened for such applications as thru-wall flashing.

Table I on pages 10 and 11 lists stainless steel gage suggestions and other design detailing information for a wide variety of roofing, flashing and rainware applications. The appropriate SMACNA Architectural Manual plate numbers are listed. This reference is provided to assist sheet metal contractors, architects, consulting engineers and municipal, state and federal specifying agencies in obtaining specific design and installation details for specific applications. In addition to data contained in the SMACNA Architectural Manual, further information on specific stainless steel moisture-protection applications can be obtained from member companies of the Committee of Stainless Steel Producers.

FINISHES

Stainless steel sheet is available in eight AISI standard mill finishes and several proprietary finishes ranging from dull matte to nearly mirror bright. Of the AISI finishes, only three are regularly used for roofing and flashing applications. Two of these are mill-rolled and one is mill-polished.

MILL-ROLLED FINISHES

AISI No. 2D is a matte, non-reflective sheet finish, which is designated as a No. 1 finish for strip. It is ideally suited for applications involving soldering because its slightly duller surface provides an excellent soldering base that does not have to be abraded for positive adhesion. It is available as standard annealed and as dead-soft, fully annealed.

In addition, the non-reflective, light gray appearance of the finish helps minimize visible waviness or "oil canning."

AISI No. 2B is a bright, moderately reflective sheet finish, which is designated as No. 2 finish for strip. It is widely used for flashing, roofing, gutters, downspouts and other exposed applications where the architect might want a reflective contrast to other architectural materials. When soldered, the surface area to be joined must be roughened to provide good solder adhesion.

MILL-POLISHED FINISHES

AISI No. 4 is the most widely used mill-polished finish used for moisture-protection applications. It has a bright appearance with a visible grain which prevents mirror reflection. Because of its attractive appearance, it is widely used for fascias and other exposed moisture-protection applications.

Another standard mill-polished finish available, but less frequently specified, is **AISI No. 3,** which has a coarser grain than a No. 4.

Special Note: On the mill-*polished* finishes, weld seams or surface imperfections can be blended inconspicuously into the surrounding area by mechanically duplicating the grit lines with the proper abrasive. To match a No. 4 finish, for example, blend-polishing should be done *with the grain* using a 150-grit abrasive.

On the mill-*rolled* finishes, however, weld seams *cannot* be blended to match the surrounding area. The weld seams *can* be polished to achieve a contrast in appearance if that effect is desired. For some components, it may be economical to use a mill-rolled finish and, after fabrication, to apply a uniform polish to all visible surfaces. It should also be noted that any of the mill-rolled finishes can be soldered or welded if the joint is not visible or if surface appearance is not an important factor.

PROPRIETARY FINISHES

In addition to the standard AISI mill finishes, most stainless steel producers offer a variety of special mill-rolled and polished finishes including matte, polished and textured. Information on these is available from the producers listed on the back page of this publication.

DESIGNING FOR FLATNESS

Surface distortion or waviness, called "oil canning", is sometimes visible, particularly in light-gage applications. When selecting gages for unbacked fascias or similar components, one or more of the following suggestions can help in significantly reducing the likelihood of such problems:

- Avoid the use of long or large, flat surfaces.
- Specify specially flattened sheets produced by stretcher- or tension-leveling. This service is available from steel companies and most steel service centers.
- Because highly reflective finishes tend to magnify surface irregularities, use non-reflective or textured finishes to mask apparent waviness and oil canning. Contouring, patterning, ribbing or fluting increase stiffness and thus help to attain visual flatness.
- Use an attachment system that permits movement between building and components without binding or buckling.
- If the design requires large, flat stainless steel panels, use a continuous backing behind the steel by laminating it to a flat, rigid material or honeycomb.

If the metal face is not backed continuously, then the lateral distance between stiffening members varies with the finish, as follows:

Finish	Width/Thickness Ratio
No. 4; other polished finishes	150 max.
No. 2D; matte finish	200 max.
Crimped; textured; patterned	200 and higher

Recommended lateral distances between formed edges, supports or stiffening ribs—when a polished finish is used—will vary with the thickness of the stainless steel, as follows:

Thickness		Lateral Distance, Inches
Inch	U.S.S. Gage	
.038	20	5.7
.031	22	4.7
.025	24	3.7
.018	26	2.7
.015	28	2.2
.012	30	1.8

Recommended lateral distances—when a No. 2D or matte finish is used—are as follows:

Thickness		Lateral Distance, Inches
Inch	U.S.S. Gage	
.038	20	7.6
.031	22	6.2
.025	24	5.0
.018	26	3.6
.015	28	3.0
.012	30	2.4

GENERAL SHOP PRACTICES

CARE DURING FABRICATION

The supplier's care in packaging should be taken as a guide as to the care required in handling the metal during fabrication. Whenever practical, the stainless steel should be stored in the package in which it was shipped. When surface finish is critical, suitable protection—strippable paper, paper interleaving, etc.—should be provided during fabrication, handling and shipping.

During layout operations, scribelines, center punch marks or other permanent layout markings should be avoided. Grease pencils are an effective alternative. For involved layouts, the original design could first be tried on galvanized steel to avoid costly mistakes with stainless. The layout bench should be clean and covered with paper or felt to avoid scratching the stainless steel surface.

During fabrication, sheets should be lifted—never dragged—to avoid scratching. To protect the stainless steel surface when using shearing machines, the hold-down clamps should be cushioned with rubber, felt or plastic, and the dies covered with masking tape.

Reasonable care should be used in bending on press brakes. The bending or forming dies should be clean. To prevent direct contact of the dies with stainless steel surfaces, some fabricators cover the bending dies with smooth surface masking tape, or place wax paper between the die and the stainless steel. Also, urethane bending dies and inserts sometimes serve to prevent metal-to-metal contact. In the case of critical finishing work, chrome plated dies may be required. To avoid contamination, do not use carbon steel sponges, carbon steel wool, or grinding wheels which have been used on carbon steel. If brushes, sponges, or steel wool are necessary, they should be made of stainless steel or nonmetallics.

During fabrication, it is important to guard against iron or steel pickup from forming dies, handling, grinding, or other sources. Such contaminants can rust, causing surface stains or discoloration.

In grinding and polishing, an "iron-free" abrasive should be purchased and used only on stainless steel. Some manufacturers keep these abrasives separate from those used on other materials and identify them as "stainless only" by a color code or other, easily recognizable means.

If a wheel, belt, or abrasive disc is used on stainless and is carelessly laid down on a carbon steel work surface while running, it will become contaminated. When sandblasting, iron-free sand should be employed and care should be taken to avoid blasting stainless with the same sand used on carbon steel.

SHOP CLEANING OF STAINLESS

Sometimes it is not possible to isolate stainless steel fabrication from that of carbon steel work. Iron or steel particles remaining on the stainless surface can ultimately cause rusting and staining problems, and therefore should be removed. One way of doing this is by washing the stainless with a solution of about 20% nitric acid in water. The acid must be flushed from the surface with copious amounts of water . . . warm water if possible.

If it is necessary to clean stainless in the shop, be sure to use clean rags which are free from grit, carbon steel shavings and abrasives.

Lubricants, oil or grease, can be easily removed with an organic solvent, such as 1,1,1—trichlorethane (Methyl chloroform). Handle this material with care; it is extremely toxic and flammable. Other proprietary cleaning compounds are also available.

STORING DURING FABRICATION

Between fabricating operations, stainless steel sheets should be placed in support frames instead of on the floor, and they should be stored away from aisles and peak traffic areas, soldering and welding operations and vapor degreasers. When possible, padded dollies and trucks should be used for storing.

JOINING

SOLDERING

Stainless steel can be soft-soldered as easily as copper, using similar equipment and procedures as used with other roofing metals. However, it is important to recognize that:

- Stainless steel conducts heat more slowly than copper, and the iron should be held in contact with the joint longer to assure solder penetration into the joint.
- Heat is concentrated at the soldering point and retained longer, therefore a cooler iron is more effective when soldering stainless.

As when soldering any metal, the parts to be joined must be thoroughly cleaned of grease, dirt or other foreign matter, using a clean rag and any good solvent. Smooth surfaces should be roughened with clean emery cloth or sandpaper—but never with ordinary steel wool.

FLUXES

Until recently, soldering of stainless steels has been restricted to the use of strong chloride-type fluxes to etch the chromium oxide film. Such chloride-type fluxes usually contain zinc or ammonium chlorides, or both, in addition to hydrochloric acid. All are highly corrosive. While these fluxes do aid in producing sound joints, discoloration and severe corrosion—sometimes to the point of perforation of the metal—can result, if the flux

residue is not neutralized and washed off after soldering.

The potential hazards resulting from corrosion problems related to insufficient removal or neutralization of chloride flux have been largely overcome through the use of a recently introduced phosphoric acid type of flux. The primary advantage of the flux is that it is active only at soldering temperatures—350 to 550° F. When cooled to ambient temperature, the phosphoric flux residue is non-corrosive to stainless steel. Therefore, neutralizing is eliminated and the soldered joint only needs to be washed with clean water.

Another advantage of the phosphoric acid flux is the fact that there are no aggressive chemical elements in the cleaning water run-off. This eliminates the danger of possible contamination and subsequent corrosion of adjoining stainless steel that is possible when cleaning chloride flux residue. It is important to remove any solder flux residue exposed to salt-laden atmospheres. Salt in the atmosphere will react with the flux residue and eventually cause corrosion. Therefore, it is suggested that care be taken to thoroughly wash off all flux residue, particularly if the installation is located in a coastal area.

Although 50-50 (half tin, half lead) solder is commonly used for soldering stainless steel, some government specifications call for the use of 60% tin and 40% lead solder. Solders of higher tin contents, up to 80%, flow better because they wet the surface more easily. They also provide a better color match with stainless steel and have less tendency to discolor as they age. Such solders usually are used for applications that are visible at close range.

Since with all metals the strength of solder is quite low, it should only be used to seal or fill a joint, but never relied upon to provide structural strength. In considering soldering, it is important to remember that lock-seam soldered joints offer greater integrity than single-lap soldered joints.

WELDING

In general, stainless steel can be welded as easily as carbon steel, but in the thin gages used for roofing and flashing applications, stainless steel is rarely welded. As in soldering, the stainless conducts heat slowly, and the heat tends to concentrate in the weld zone. Jigs or chill bars should be used to minimize distortion when welding the thinner stainless gages. Stainless also has a higher electrical resistance than does carbon steel, so lower current setting should be used. The welding rod or wire should have an alloy content that is compatible with that of the stainless being joined. This assures that the filler metal will match the parent metal both visually and in terms of corrosion resistance. Carbon rod should never be used as a substitute—its use is an invitation to early corrosion and subsequent joint failure.

If welding heat discolors the area around the weld, electro-chemical or mechanical means can be used to remove the discoloration. A rod connected to 8-24 volts AC and wetted with a 50% phosphoric acid solution removes most weld discoloration without removing metal. Weld discoloration also can be removed by grinding or buffing or by use of a mildly abrasive cleaner.

MECHANICAL FASTENING

Stainless steel fasteners should be used for all stainless steel components that are to be mechanically joined, whether in the shop or in the field. A wide variety of nails, screws, nuts, bolts, washers, rivets and other mechanical joining devices are available in AISI 300 series stainless steels for this purpose. Fasteners made from other materials, even if protected with an applied anti-corrosive coating, will eventually corrode and cause unsightly rusting and staining. Furthermore, they may eventually fail due to galvanic corrosion. Stainless steel fasteners are preferred for joining or attaching components of other metals.

PACKING FOR SHIPMENT AND CONSTRUCTION SITE STORAGE

As with other materials, proper care must be given to packing stainless steel components for shipment to the construction site if they are to arrive undamaged and ready for installation. Generally speaking, the same protective measures the supplier provided for the stainless steel—packaging and protective paper coating, etc.—can be used for fabricated architectural components when required.

Stainless steel architectural components such as fascia are often covered with strippable adhesive or plastic coatings to protect them during installation. Most of these adhesive coatings tend to harden or "set" after prolonged storage. This condition is aggravated by sunlight, extreme cold or heavy pressure which can—singly or in combination—"cure" the adhesive and make the ordinary easy-to-strip protective coating difficult and costly to remove. Therefore, all protective coatings should

be removed as soon as practical after installation. However, if these coatings harden or "set", chemical preparations are available to "lift" them without damaging the stainless. One such solution is Klean-strip Formula "A", which is applied with a paint brush. After 5 to 10 minutes, the difficult-to-remove protective coating can be removed with a wooden or plastic scraper.

PREPARATION OF ROOF DECK

In installing stainless steel roofing systems, preparation of the roof deck is the same as that required for any other metal roofing. Before applying the steel, the deck must be dry, clean and smooth. All rough spots or projections such as nail heads should be countersunk, and chips, stones and other debris should be removed. The deck should then be covered with a layer of saturated roofing felt or building paper. If roofing felt is used, it should be covered with a layer of smooth building paper to prevent its bonding to the metal deck.

SUGGESTED ROOFING AND FLASHING INSTALLATION PRACTICES

FASTENERS

As previously mentioned, stainless steel fasteners should be used for joining stainless steel components. Stainless steel nails for joining panels to roof decks should be flat-head, annular-thread, diamond-point and long enough to penetrate the backing by at least one full inch. Other fasteners, such as screws, also should penetrate the roof deck backing by a full inch.

CLEATS

Stainless steel cleats should be used to secure stainless panels to roof decks and other supporting surfaces. Cleats should be loose-locked to allow for metal expansion and contraction, and should not be of a thinner gage than the stainless being fastened. Some contractors prefer cleats that are no thinner than .018-inch (26-gage), regardless of panel gage. Typical dimensions of an individual cleat are at least 2 inches wide by 3 inches long. Secured by two nails (or screws, depending on pan size), the cleat end is then folded back over the nail heads or screw heads and malleted flat. Cleats should be spaced not more than 12 inches apart.

Continuous cleats should not exceed 10-foot lengths and should have an $\frac{1}{8}$-inch minimum gap separating the sections. Cleat sections should be fastened at least every 12 inches.

SEAMS AND JOINTS

Lock seams should finish $\frac{1}{2}$-inch wide.

Lap seams should overlap a minimum of 3 inches on vertical surfaces or built-in flashings, and a minimum of 4 inches elsewhere.

For water-proofing, seams should be soldered or filled with sealant.

PROVISION FOR EXPANSION

Expansion joints should be provided every 24 to 40 feet on continuous runs of stainless steel.

At the point of bend where the stainless turns up a wall, curve or batten, a clearance of approximately $\frac{1}{4}$-inch should be provided between the metal and the vertical surface, for metal expansion. Where the end of a gutter or gutter lining abuts a wall, a $\frac{1}{2}$-inch clearance should be allowed.

All exposed edges should be hemmed $\frac{1}{2}$-inch on the concealed side.

DISSIMILAR MATERIALS

Where dissimilar metals are in contact, adequate drainage should be provided to avoid standing water which can act as an electrolyte and promote galvanic corrosion. Also it is recommended that the metals be insulated from one another with bitumastic, paint or other inert coating.

Stainless steel can be used in contact with, or imbedded in masonry, concrete and plaster, without danger of corrosive attack.

FINAL CLEANING

When construction is completed, the stainless surfaces should be thoroughly cleaned with detergent and water to remove loose soil and dirt. Commercial cleaners, containing phosphoric or oxalic acid, can be used on stubborn deposits.

Masonry contractors are urged to utilize a non-hydrochloric-acid type masonry cleaner (such as Sure-Clean), to avoid potential corrosion. Muriatic acid spattering on the stainless steel during masonry cleanup—after the roofing contractor has completed the metal work—will cause severe surface corrosion, unless washed off immediately. In cases where the acid is trapped, the flashings will sustain local perforation and will fail as water barriers.

TABLE I

DESIGN FACTORS FOR UTILIZING STAINLESS STEEL

Application	SMACNA Manual Plate Numbers	Suggested Stainless Steel	Suggested Thicknesses Inch	USS Gage	Weight Lb./Sq. Ft.	Detail Consideration
Copings	68, 69, 70, 71, 72	302/304	.018	26	.788	.018" is suggested for coping up to 12" in width; over 12" use .025". Use .025 to .050 edge strip.
Downspouts and Leaders						
Square or Round	31, 32	301 or 302/304	.015	28	.656	
Downspout Heads	25	301 or 302/304	.015	28	.656	
Scupper Lining	26, 27, 28, 29, 30	301 or 302/304	.015	28	.656	
Downspout Straps	33, 34	301 or 302/304	.015	28	.656	
Basket Strainers	23	301 or 302/304	.062 dia. wire			
Expansion Joints						
Roof & Ridge	76, 77, 78, 79	302/304	.015	28	.656	Use at 24- to 40-foot intervals unless expansion is otherwise accommodated.
	80, 81, 82, 83	302/304				
Flashings—Exposed						
Base, Cap or Counter	49, 50, 51, 52, 53	302/304	.015	28	.656	Lap joints 3"—minimum, may be sealed. May be combined with thruwall flashing.
Chimney & Sloping Roof	62, 63, 64, 65, 66	302/304	.018	26	.788	
Roof Penetrations	58, 59, 60, 61	302/304	.015	28	.656	
Stepped	53	302/304	.015	28	.656	
Valley	54, 55	302/304	.015	28	.656	
Hip & Ridge	56, 57	302/304	.015	28	.656	
Parapet Wall Covering	73	302/304	.015	28	.656	
Flashings—Concealed						
Thruwall	46, 47, 48	302/304	.012	30	.525	Lap joints 3"—minimum.
Lintel	—	302/304	.012	30	.525	
Spandrel Beam	46, 47	302/304	.012	30	.525	Lap joints 2" and solder or seal.
Curtain Wall	—	302/304	.012	30	.525	
Gravel Stops and Fascias						
Smooth—up to 4" face	36, 37, 38, 39, 40, 41	302/304	.015 min.	28	.656	A bright finish may require a heavier gage to control "oil canning," especially in face widths over 3".
up to 5" face	36, 37, 38, 39, 40, 41	302/304	.018 min.	26	.788	
up to 6" face	36, 37, 38, 39, 40, 41	302/304	.018 min.	26	.788	
up to 7" face	36, 37, 38, 39, 40, 41	302/304	.025 min.	24	1.050	
up to 8" face	36, 37, 38, 39, 40, 41	302/304	.031 min.	22	1.313	

Stiffened—						
up to 4" face	37, 40	302/304	.015 min.	28	.656	Inside and outside corners of fascia should be mitered and welded or riveted; soldered or sealed with composition. Alternate gage is double thickness of component being attached.
up to 5" face	37, 40	302/304	.018 min.	26	.788	
up to 6" face	37, 40	302/304	.018 min.	26	.788	
up to 7" face	37, 40	302/304	.025 min.	24	1.050	
up to 8" face	37, 40	302/304	.031 min.	22	1.313	
Edge Strip—1¼" wide	41	302/304	.025	24	1.050	
Gutters						
Built-In	4, 22	301, 302/304	.015	28	.656	Lap joints 1", weld or rivet and solder
Hanging—rectangular	1, 2, 13 to 20	301, 302/304				
Girth						
up to 15"	1, 2, 3, 4	301, 302/304	.015	28	.656	Note that gage increases as size of girth increases. Use of gages thinner than those suggested is likely to result in buckling.
16 to 20"	1, 2, 3, 4	301, 302/304	.018	26	.788	
21 to 25"	1, 2, 3, 4	301, 302/304	.025	24	1.050	
26 to 30"	1, 2, 3, 4	301, 302/304	.031	22	1.313	
31 to 35"	1, 2, 3, 4	301, 302/304	.0375	20	1.575	
over 35"	1, 2, 3, 4	301, 302/304	.050	18	2.100	
Hanging—half round	3, 21	301, 302/304	.015	28	.656	Specify cold-rolled to 65,000-80,000 psi yield strength. Where thickness exceeds .018", make trail lock seam to determine feasibility of cold-rolled temper.
Hanging—ogee	3	301, 302/304	.015	28	.656	
Continuous Cleat	—	301, 302/304	.015	28	.656	
Cover Plates	23	301, 302/304	.015	28	.656	
Hangers	13 to 20	301, 302/304	.037	20	1.575	
Expansion Joints	6 to 12	301, 302/304	.015	28	.656	Space on 30"centers.
Louvers	102 to 105	301, 302/304	.018	26	.788	
Pitch Pockets w/Hem Edge			.012	30	.525	
Roofing						
Batten Seam	88, 90	302/304	.015	28	.656	.015" is suggested for 18" panel width; .018" is suggested for 24" width; and .021" is suggested for 30" width. AISI 300 Series fasteners should be used. Attach with 2" x 3" stainless cleats. Pre-tin edges before folding.
Bermuda	95, 96	302/304	.015	28	.656	
Chevron	91	302/304	.015	28	.656	
Flat Seam	84	302/304	.015	28	.656	
Mansard	92	302/304	.015	28	.656	
Ornamental	93	302/304	.015	28	.656	
Standing Seam	85, 86, 87	302/304	.015	28	.656	
Industrial Panel (metal siding and roofing)	129, 130	301, 302/304, or 316				
Scuttles	100	302/304		28	.656	
Snow Guards	123	302/304		.109 dia.wire		

TABLE II

EXPANSION PROPERTIES OF BUILDING MATERIALS

MATERIAL	TYPICAL COEFFICIENTS OF EXPANSION IN INCH PER INCH PER °F	EXPANSION IN 64ths OF AN INCH PER 100°F TEMPERATURE RISE PER 10′ LENGTH (Approx.)
		1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
STAINLESS STEEL (300 Series)	.0000096	
110 SOFT COPPER	.0000094	
110 COLD ROLLED COPPER	.0000098	
TIN	.0000117	
ALUMINUM 3003	.0000129	
LEAD	.0000150	
ZINC, ROLLED	.0000174	
ZINC ALLOY (With grain)	.0000130	
ZINC ALLOY (Across grain)	.0000098	
MONEL	.0000078	
GALVANIZED STEEL	.0000067	
STEEL	.0000067	
LIMESTONE	.0000044	
GLASS	.0000047	
MARBLE	.0000056	
SLATE	.0000058	
BRICK	.0000031	
CONCRETE	.0000078	

TABLE III

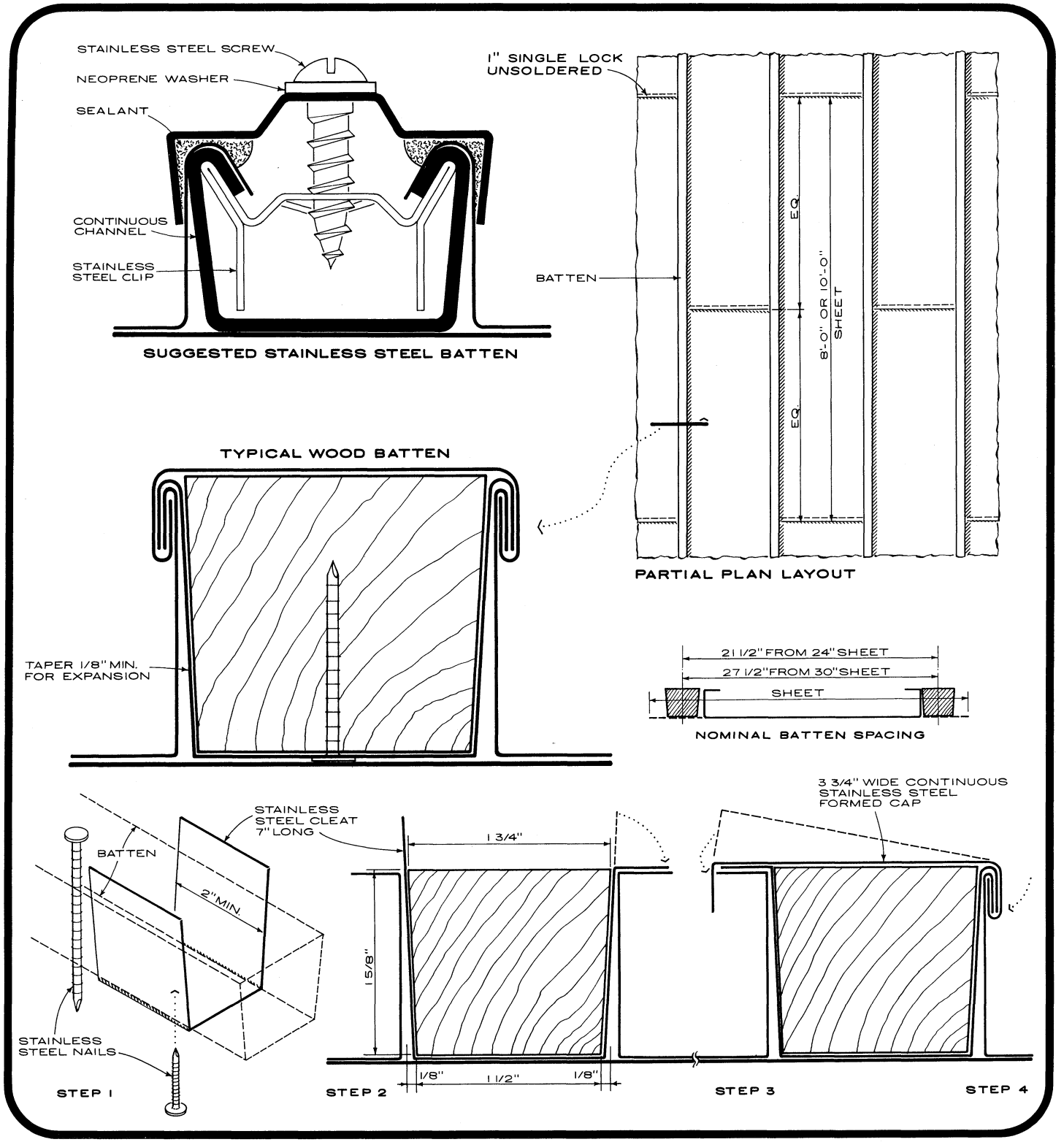
COMPARABLE THICKNESSES AND WEIGHTS OF STAINLESS STEEL, ALUMINUM AND COPPER

(Subject to variations based on mill tolerances)

STAINLESS STEEL			ALUMINUM			COPPER		
Thickness (Inch.)	Gage (U.S. Standard)	Lb. sq. ft.	Thickness (Inch.)	Gage (B&S)	Lb. sq. ft.	Thickness (Inch.)	Oz. sq. ft.	Lb. sq. ft.
.010	32	.420	.010	30	.141	.0108	8	.500
.0125	30	.525	.0126	28	.177	.0121	9	.563
						.0135	10	.625
.0156	28	.656	.0156	—	.220	.0148	11	.688
			.0179	25	.253	.0175	13	.813
.0187	26	.788						
.0219	25	.919	.020	24	.282	.021	16	1.000
.025	24	1.050	.0253	22	.352			
						.027	20	1.250
.031	22	1.313	.0313	—	.441	.032	24	1.500
.0375	20	1.575	.032	20	.451	.0337	28	1.750
			.0403	18	.563	.0431	32	2.000
			.0453	17	.100			
.050	18	2.100	.0506	16	.126			

Note that U.S. Standard Gage (stainless sheet) is not directly comparable with the B&S Gage (aluminum). A 20-gage stainless averages .0375" thick; while a 20-gage aluminum averages .032" thick; and 20-ounce copper is .027" thick. The higher strength of stainless steel permits use of thinner gages than required for aluminum or copper, which makes stainless more competitive with aluminum on a weight-to-coverage basis and provides stainless with a substantial weight saving compared to copper. For example, 100 sq. ft. of .032" aluminum will weigh about 45 pounds, .021" (16-ounce) copper will weigh about 100 pounds, and .015" stainless will weigh about 66 pounds.

BATTEN SEAM ROOFING ...Typical Design



The batten seam design provides extra rigidity to a roof membrane. Ordinarily, batten seam roofs are fabricated from Type 302/304 stainless steel. Such roofs are installed on slopes of 1½ inch per foot or greater, utilizing the following suggested minimum thicknesses: .015 inch for 18-inch wide sheets; .018 inch for 24-inch sheets; .021 inch for 30-inch wide sheets. Pans for batten seam roofs are normally pre-formed in the shop.

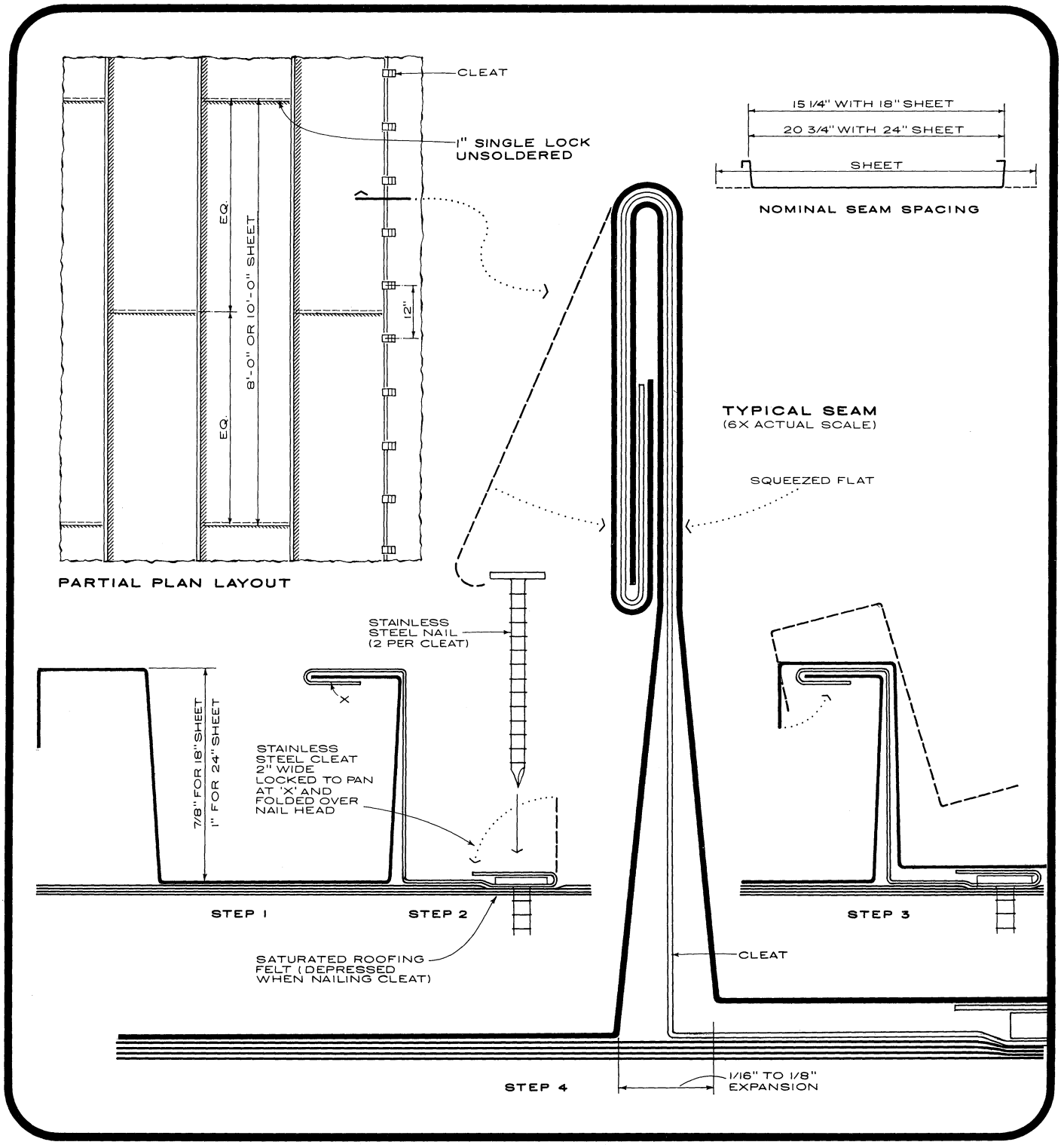
Battens are available in a choice of shapes and in both wood and metal. Wood battens are tapered at least ⅛ inch on each side to accommodate thermal movement. If rectangular battens are used, movement is accommodated by sloping the flange of the pans.

Battens are fastened to a wood or nailable roof deck with stainless steel nails, with the nail heads driven flush with the batten surface. On some decks, battens may be fastened in place with countersunk bolts.

To hold pans and batten cap, stainless steel cleats of the same thickness as the pans and not less than 2 inches wide are nailed to the bottom of the batten 16 inches on center to hold pans and batten cap. Cleats may be fastened to the side of the battens or to the top and side using a splice cleat.

It should be noted that both batten seam as well as Bermuda type roofing systems are available as prefabricated components.

STANDING SEAM ROOFING...Typical Design



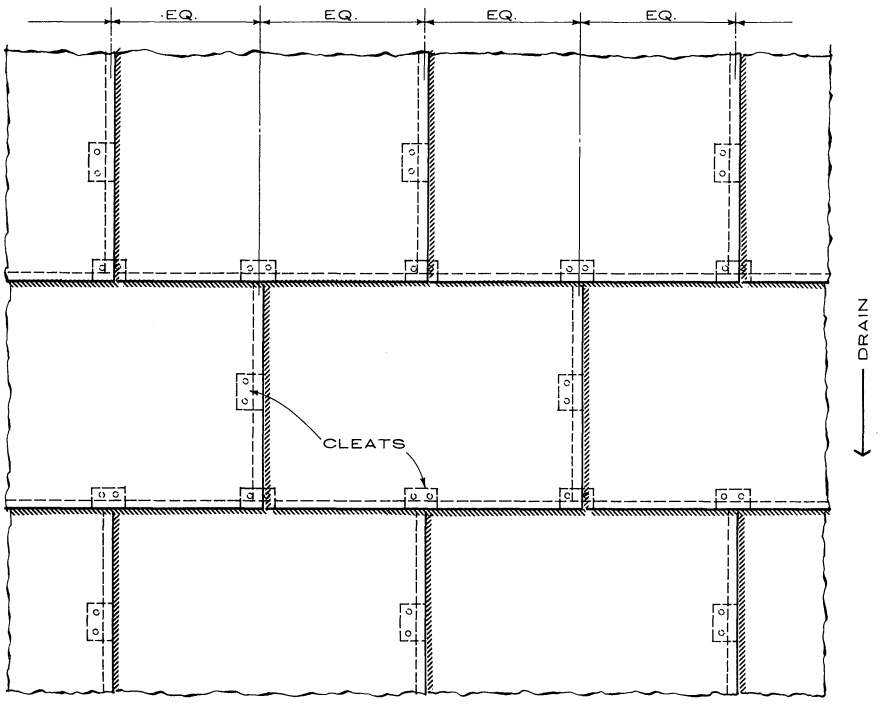
An ideal application for Type 302/304 dead soft, fully annealed stainless steel, the standing seam design is used to cover slopes of 3 inches per foot or greater. Suggested minimum thicknesses are: .015 inch for 18-inch wide sheets; .018 inch for 24-inch sheets. Pan lengths vary from 8 to 10 feet, although pans up to 60 feet long can be formed at the site when portable roll-flanging equipment is available.

To achieve economical use of stainless steel, a 7/8-inch seam height is suggested for use with 18-inch wide sheets and a 1-inch high seam is recommended for use for 24-inch stock.

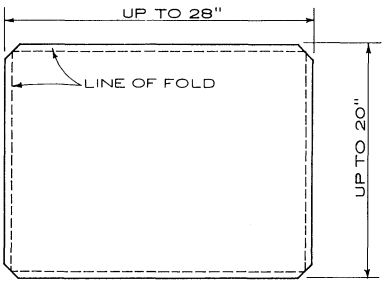
When the roof deck is a material other than wood, it is suggested that nailing strips for the cleats be installed 12 inches on center running at right angles to the seams.

Continuous, electric resistance-welded standing seam roofs are watertight at any slope. However, this joining method, which also can be applied to flat roofs, requires special portable forming and welding units.

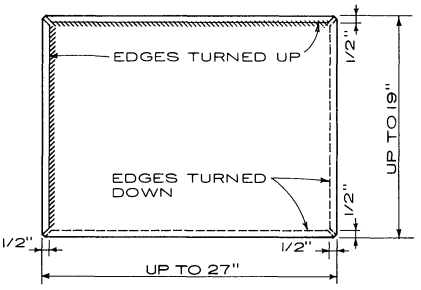
FLAT SEAM ROOFING ...Typical Designs



PARTIAL PLAN OF LAYOUT



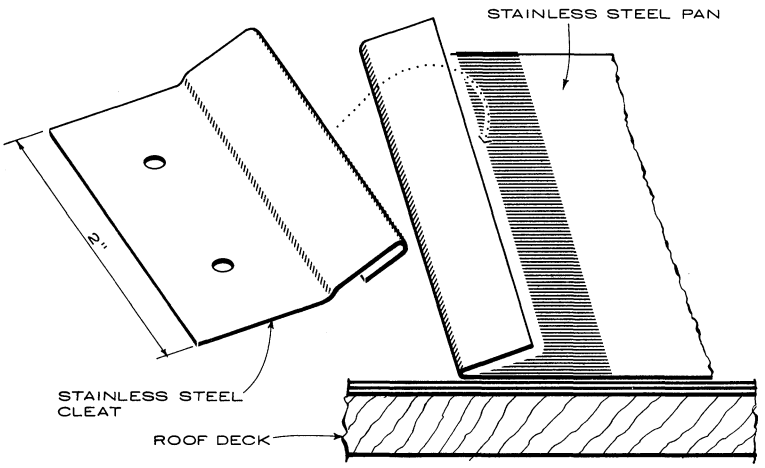
STEP 1 NOTCHED & TINNED



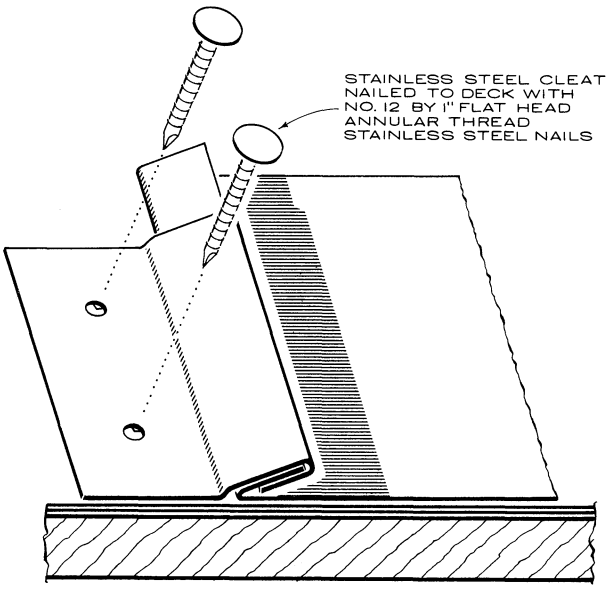
STEP 2 FOLDED INTO PAN

RECTANGULAR PATTERN

SHEETS MAY BE NOTCHED AND FOLDED IN SHOP
DIMENSIONS: 15"X 20", 16"X 18", 18"X 24" OR 20"X 28"



METHOD OF CLEATING

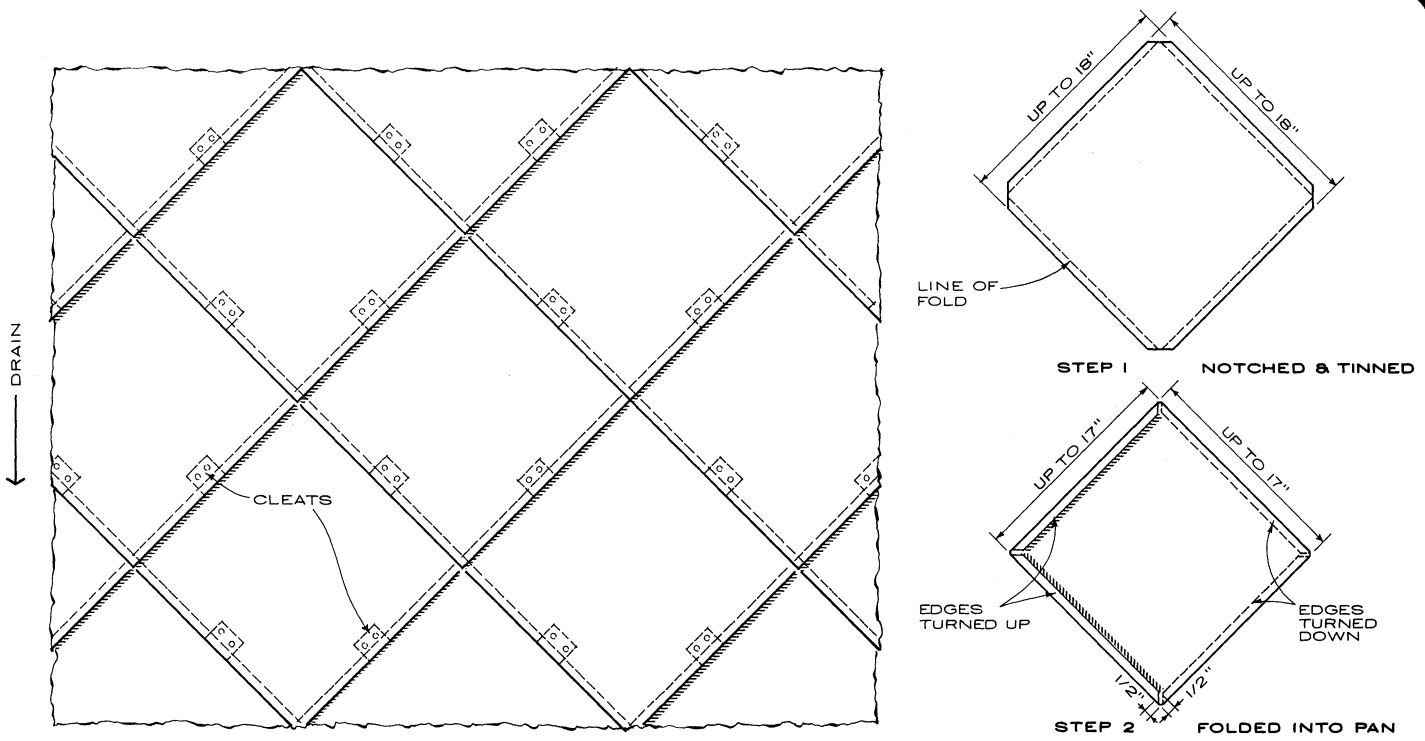


STEP 1 STEP 2

Flat seam roofing, which is installed in rectangular or diamond patterns, also utilizes Type 302/304 stainless steel in the dead-soft, fully annealed condition. The suggested minimum thickness of the steel is .015 inch, although large pans may require the use of .018 inch thickness.

The rectangular pattern, which utilizes pans 14 x 20 inches, 16 x 18 inches, 18 x 24 inches or 20 x 28 inches in size, is usually notched and folded in the shop. Such pan sizes are commonly used for roofs with a slight pitch; however, they can also be used on steep pitches, curved surfaces, canopies and small projections. For flat seam roofing installations, some pitch for drainage is required and particular care must be taken immediately after installation to clean any contaminating debris from the roof.

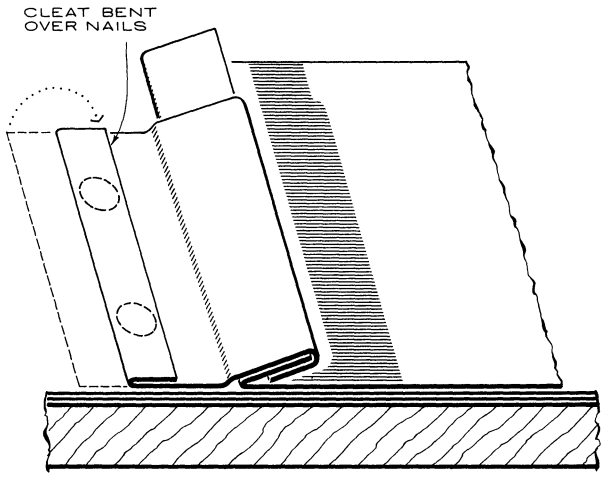
Diamond patterns, which also are notched and folded in the shop, have dimensions of 15 x 15 inches or 18 x 18 inches, depending on the size of the area to be covered. Such patterns may be used on both slightly pitched and sloping areas. The small pan size permits flexible layout on difficult areas such as spires and large diameter domes with a high degree of slope.



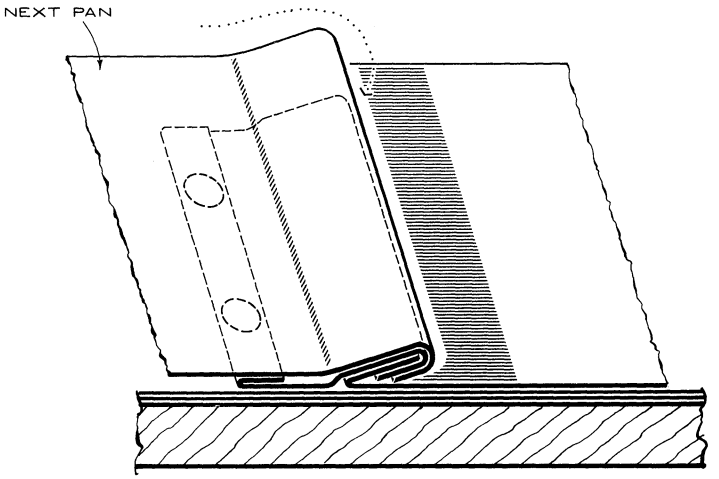
PARTIAL PLAN OF LAYOUT

DIAMOND PATTERN

SHEETS MAY BE NOTCHED AND FOLDED IN SHOP
DIMENSIONS : 15"X 15" OR 18"X 18"



STEP 3

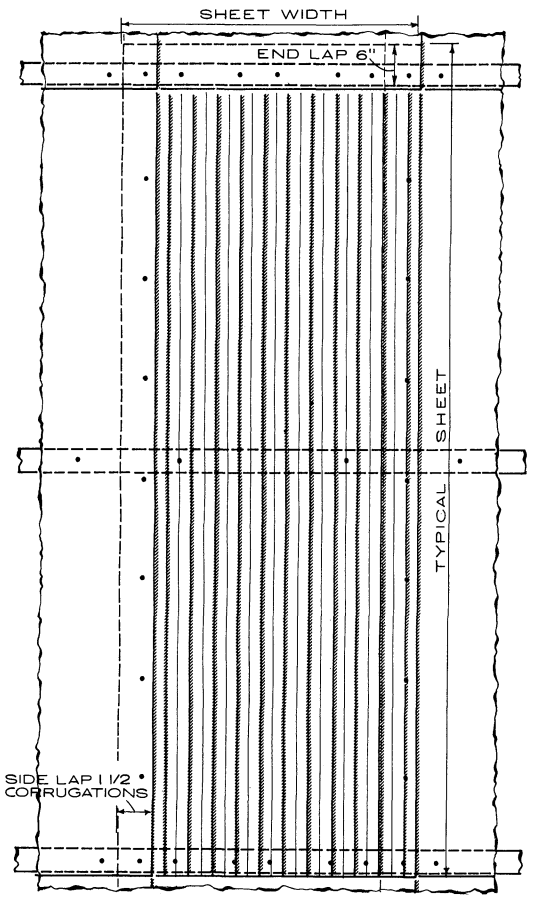


STEP 4

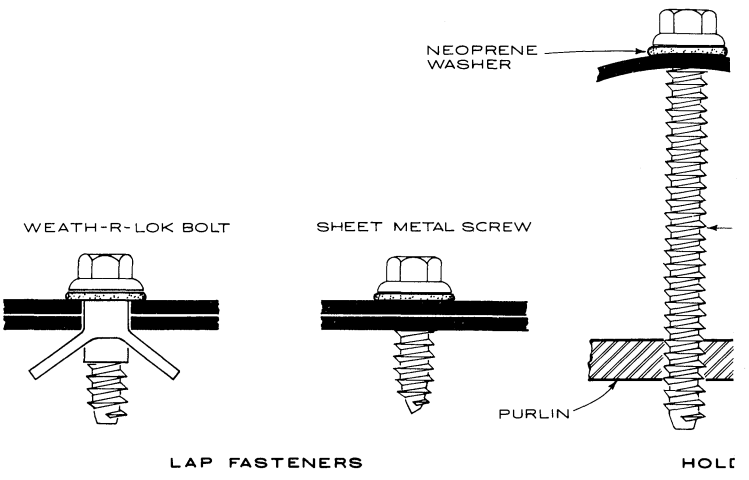
In forming both rectangular and square pans, two adjacent edges of each sheet are folded over the upper surface, and the other two edges are folded under. The pans are then fastened to the deck using 2-inch wide stainless steel cleats and No. 12 by 1 inch flat head annular thread stainless steel nails. Subsequent pans are placed by engaging a folded-under edge with the upturned edge of the preceding pans.

All seams are malleted flat and thoroughly sweated full with solder. On roofs having a pitch of 3 inches per foot or more, seams may be sealed with a suitable compound instead of soldered. On very steep slopes, over 6 inches per foot, neither may be necessary; however, a ¾-inch edge fold would then be preferred. Where seams are to be soldered, pans should be pre-tinned in the shop 1½ inches back from all edges before folding.

INDUSTRIAL ROOFING PANELS ...Typical Designs



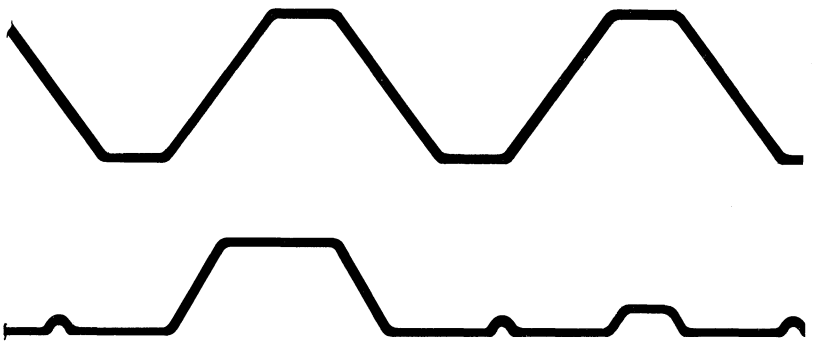
SHEET FASTENING LAYOUT

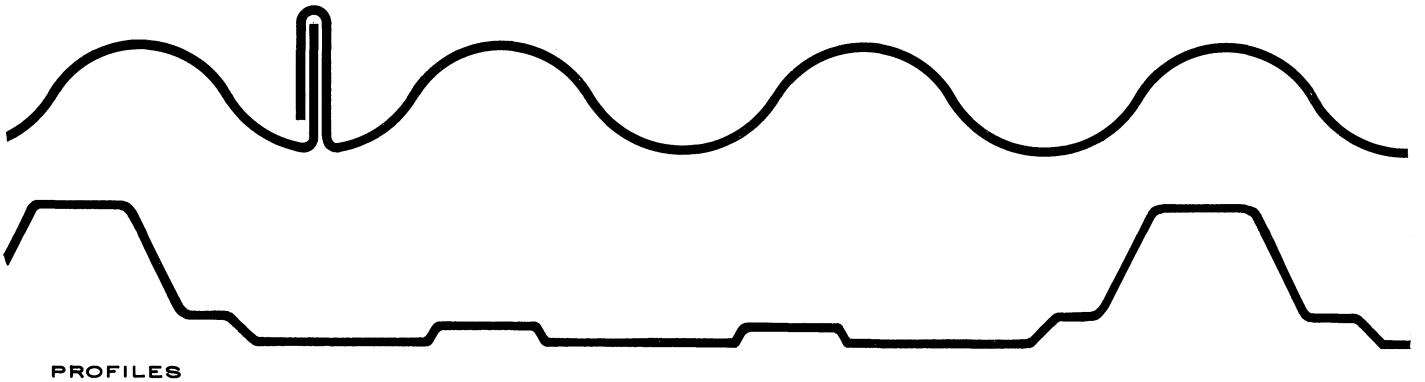


LAP FASTENERS

HOLE

STAINLESS STEEL FASTENERS



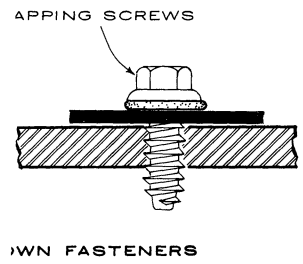


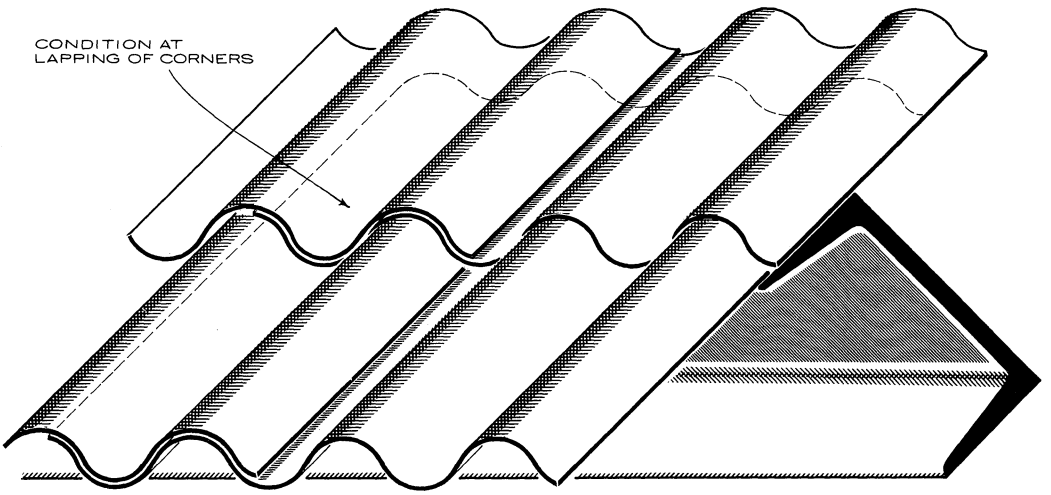
PROFILES

Used as load bearing roofs or siding, industrial panels are usually fabricated from Type 301 or 302/304 stainless steels. For more-severe corrosive atmospheres Type 316 is generally specified.

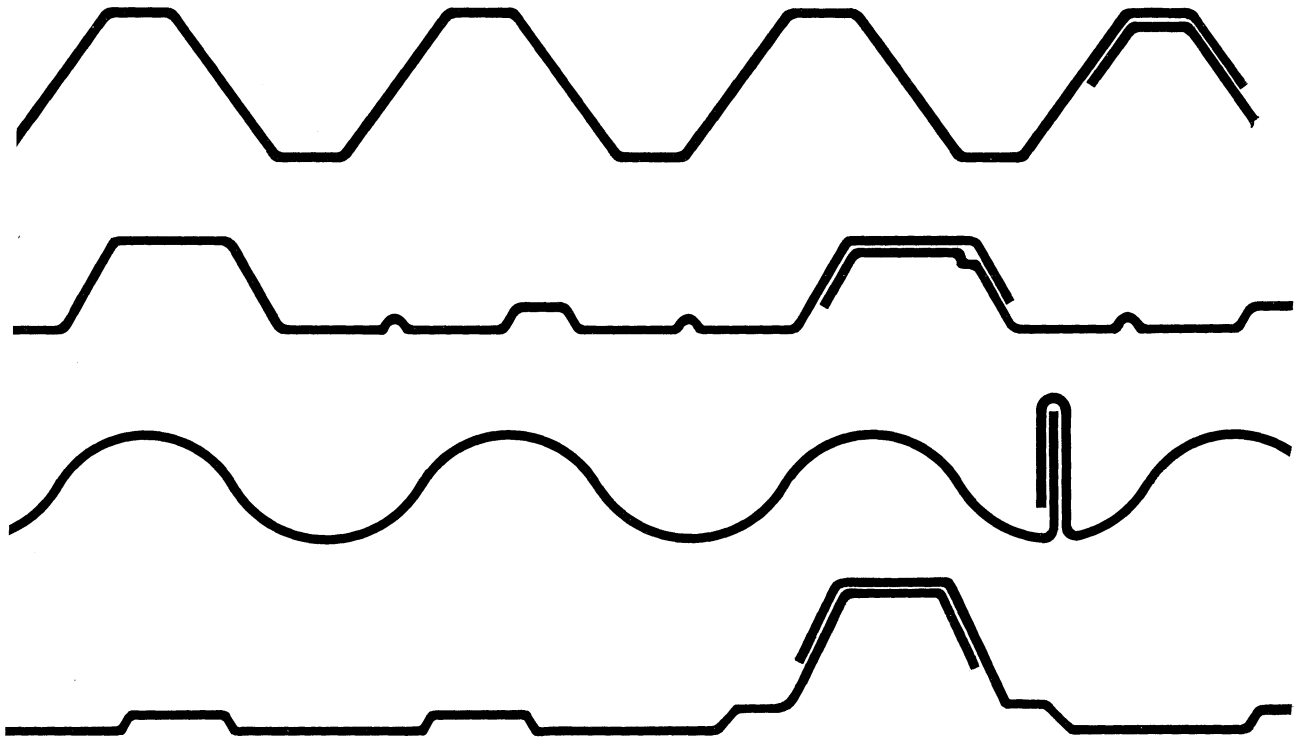
Mechanically joined with stainless steel fasteners, industrial panels can be designed in a number of ribbed or corrugated profiles in widths up to 36 inches and in lengths up to 42 feet.

Because their rigidity and strength is increased by cold working, particularly in Type 301, stainless steel panels can be used on roofs with no underlying deck. A ridge cap of formed stainless steel sheet combines with rubber or vinyl closures to make the roof weathertight. Stainless steel panels backed with insulated sandwich panels also are available and manufacturers of such products should be consulted for design and loading details.

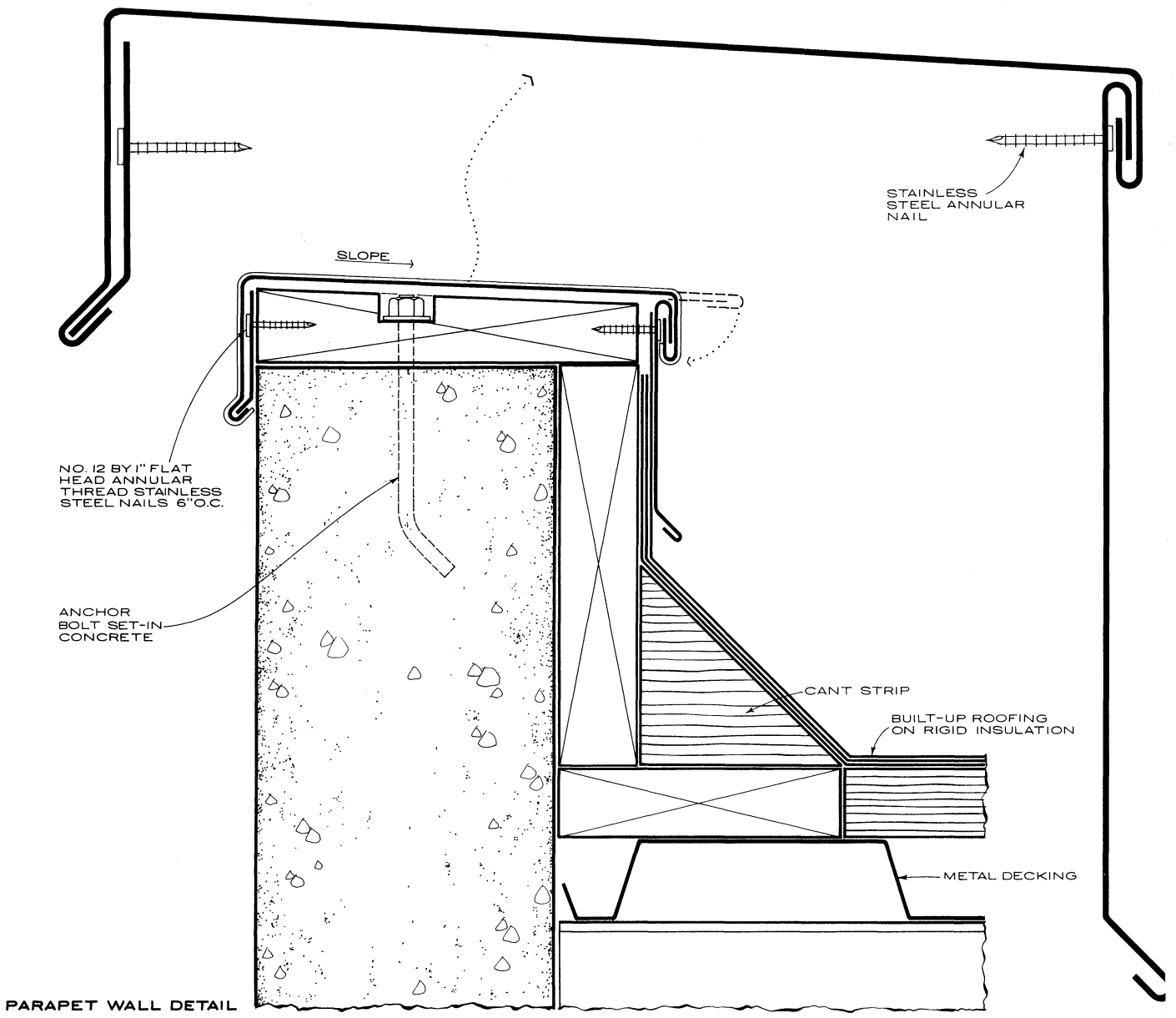




ISOMETRIC DETAIL OF SHEET LAPPING



COPINGS ...Typical Designs

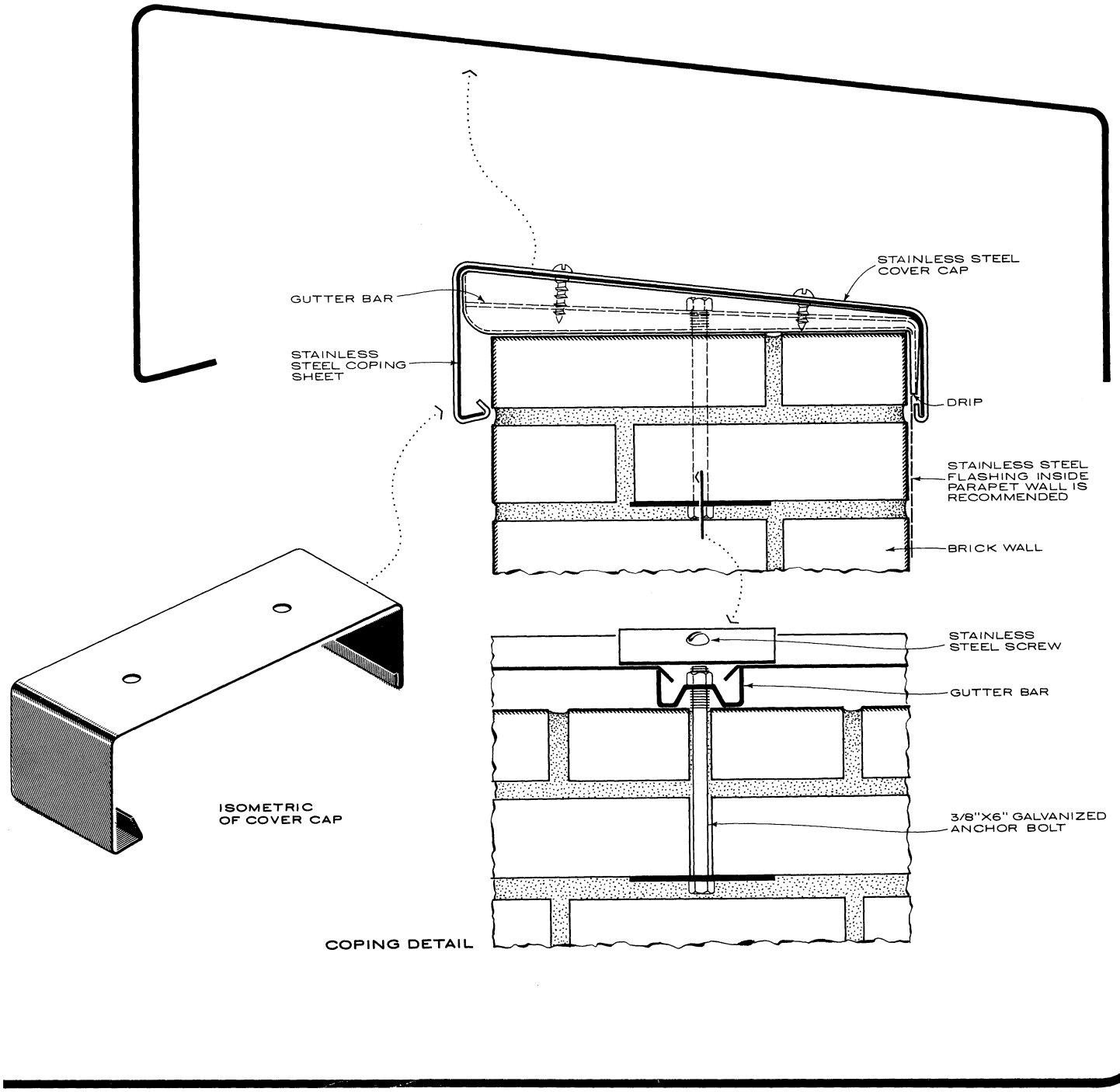


PARAPET WALL DETAIL

A typical coping formed by sheet metal fabricators is detailed above. Some authorities recommend use of building paper or other protection on a wood cap plate. The front edge of the coping is secured to a continuous stainless steel edge strip, minimum thickness .025 inch, or the same gage as the coping bent double. The inner edge of the coping is secured to an edge strip, or to a counter flashing, which may serve as an edge strip, as shown.

Since the coping also acts as the building edge trim, selection of gage and finish is important. (See discussion of flatness).

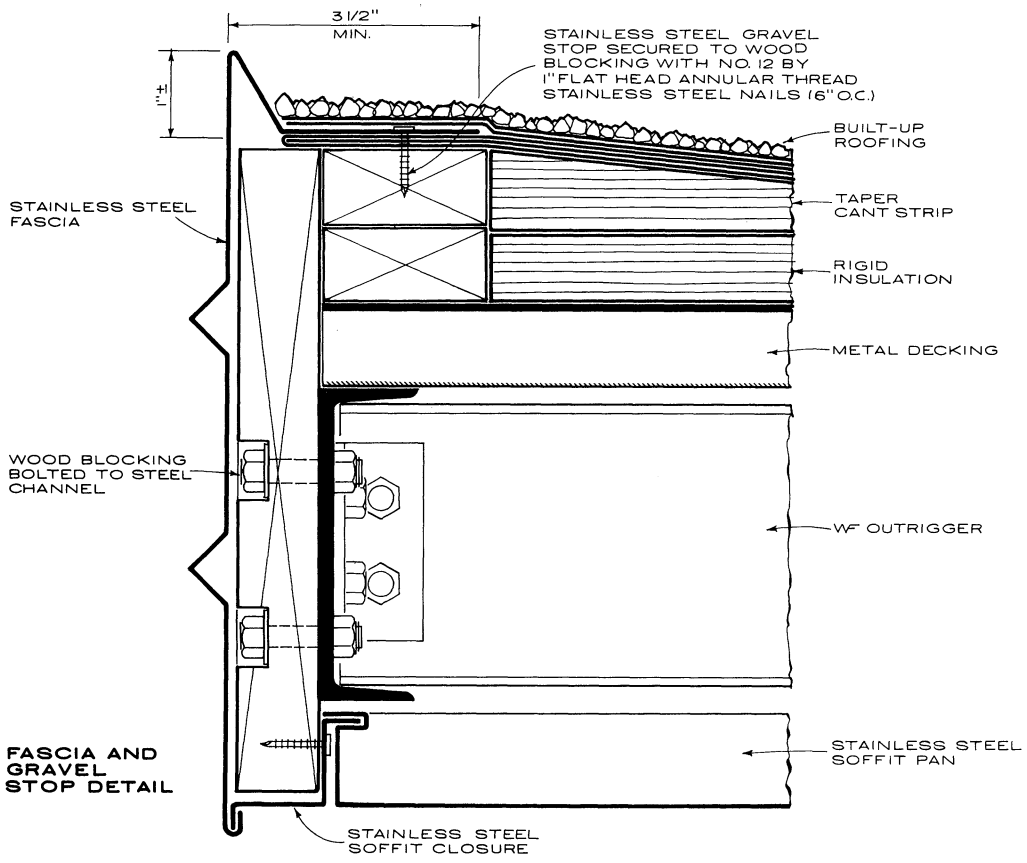
Coping is assembled in 8, 10, or 12-foot lengths with lapped, covered or backed-up joints as illustrated with gravel stops on pages 22 and 23. If a backed-up joint is used, a 12-inch wide back-up plate is recommended and caulking should be used.



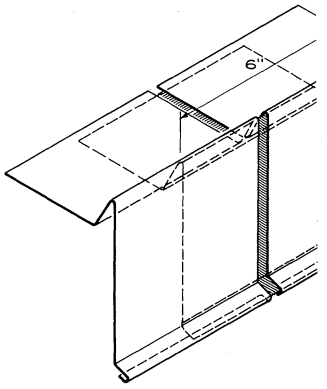
Prefabricated coping products, such as the one shown at right (Overly Manufacturing Company, Patent No. 2544779) are available from Manufacturers.

Type 302/304 stainless steel with a minimum thickness of .018 inch is recommended. Thickness depends on dimensions and the finish selected. Where appearance is important, minimum thickness of .025 inch is recommended.

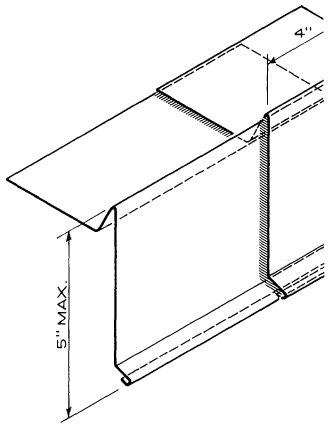
FASCIAS AND GRAVEL STOPS ...Typical Designs

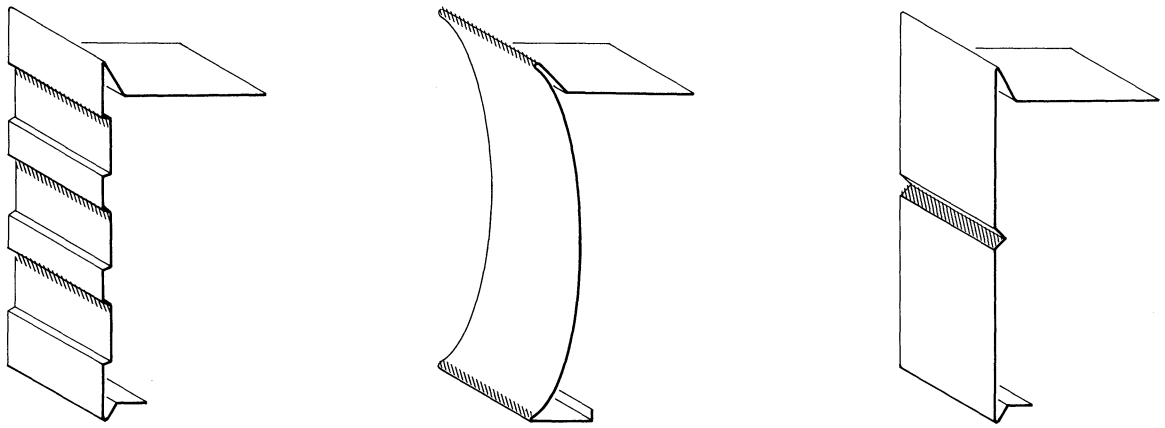


FASCIA AND GRAVEL STOP DETAIL



BACK-UP PLATE





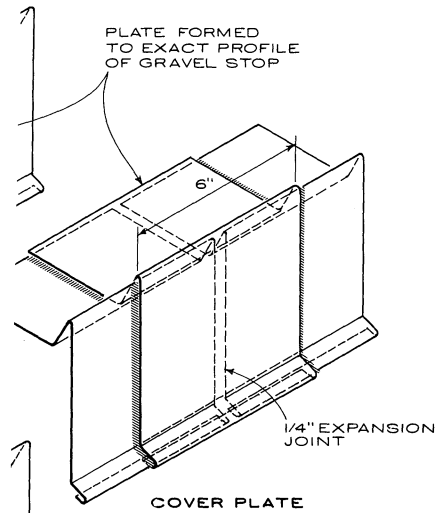
ALTERNATE PROFILES

As an exterior design element on canopies and as building edge trim, gravel stops and fascias can be detailed in a variety of depths, finishes, gages and profiles, depending on the architect's design. When reflective finishes are used on a relatively deep face, care should be taken to control visual waviness. This can be done by increasing the gage, or detailing a ribbed, cross corrugated or curved profile. Matte, textured or patterned finishes may not require such design provisions. (See discussion on flatness).

Fascia is secured by a continuous edge strip or cleats nailed to wood blocking. Inside and outside corners of fascia should be shop formed by mitering and spot welding or riveting and sealing with sealant or solder.

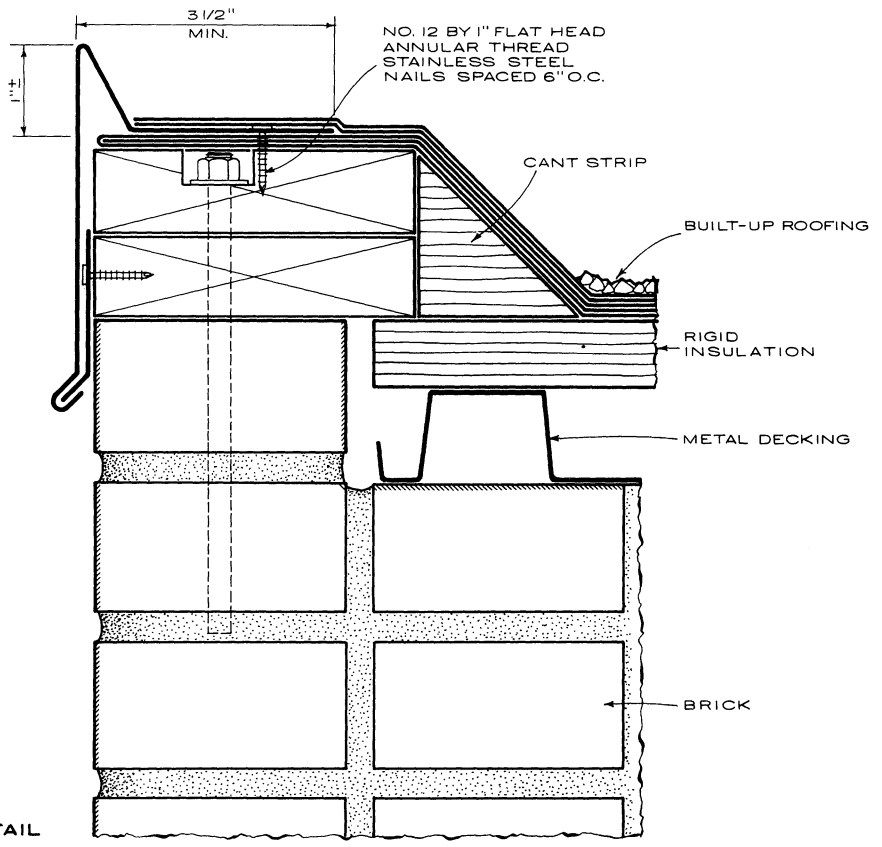
A number of manufactured gravel stops and fascia products are available.

Type 302/304 stainless steel is recommended. Thickness varies with depth of face; for a functional edge strip gravel stop of 3 inches or less, .015 inch minimum is suggested.

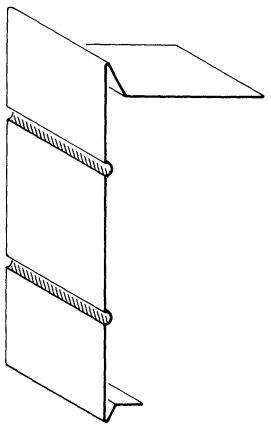


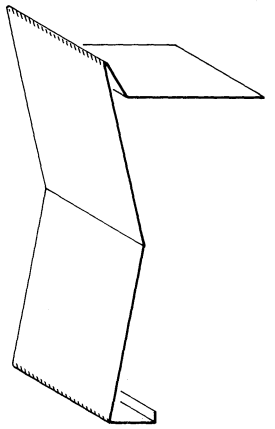
.AP JOINT
FOR FASCIAS
)F 5" OR LESS)

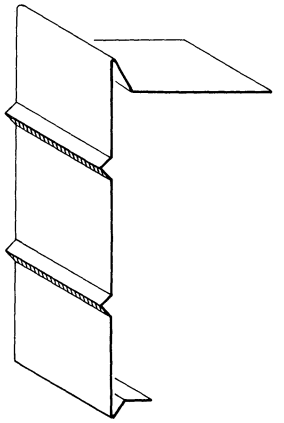
JOINT SYSTEMS



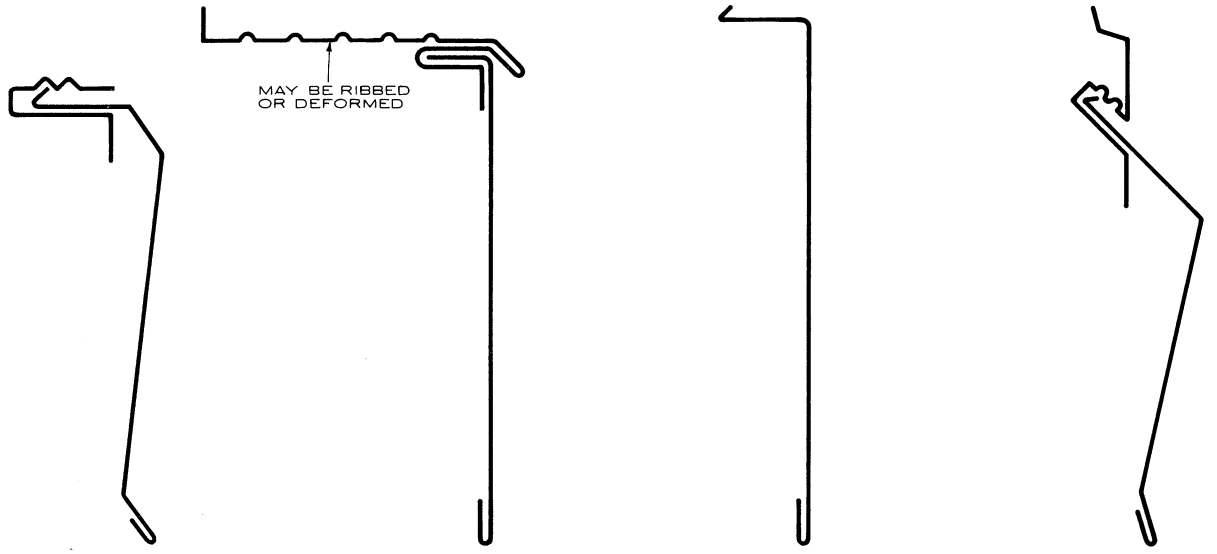
GRAVEL
STOP DETAIL



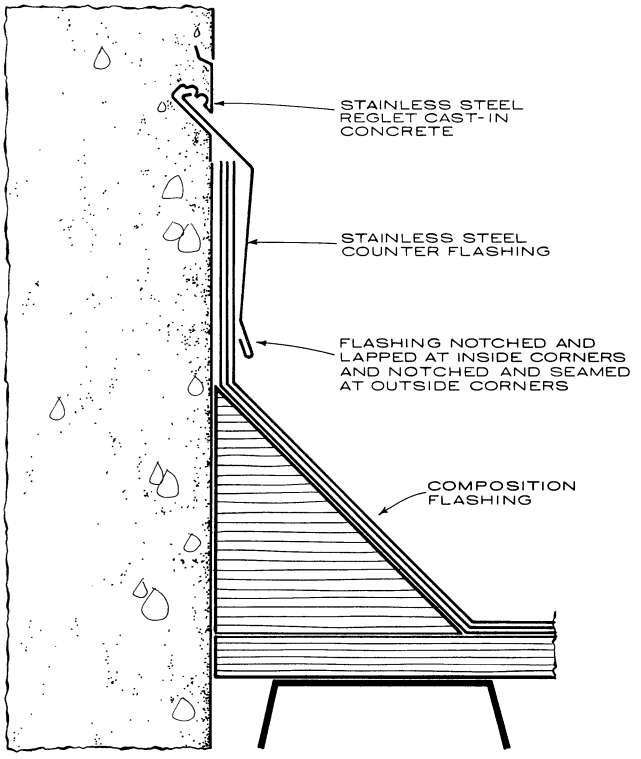




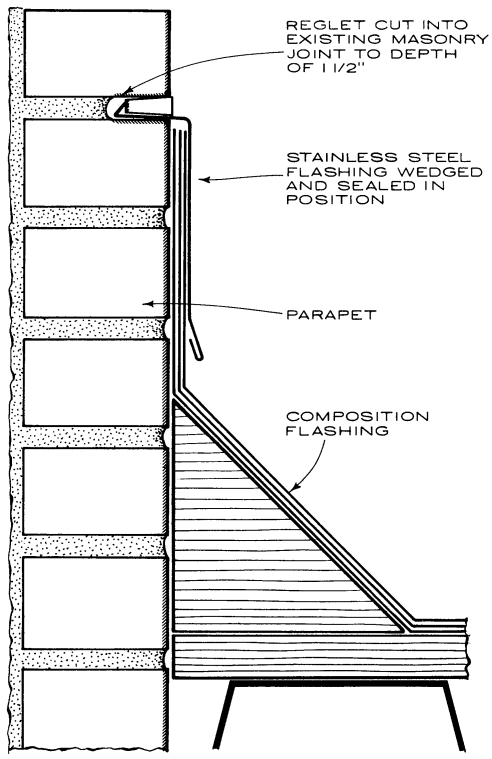
COUNTER OR CAP FLASHING ...Typical Designs



COMMON COUNTER FLASHING PROFILES



NEW CONSTRUCTION



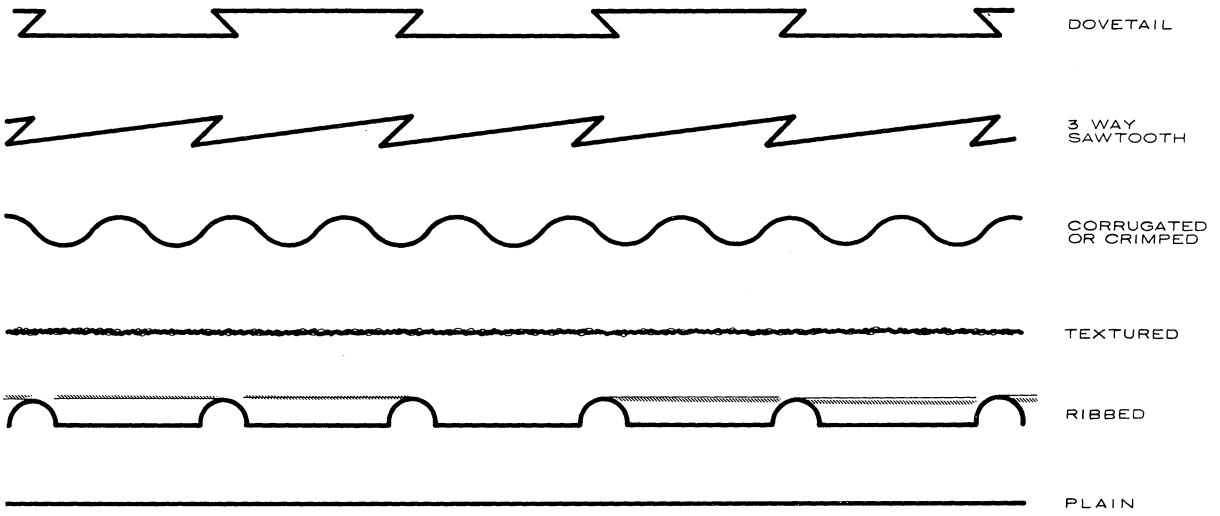
EXISTING CONSTRUCTION

The application is as a cap over other flashing to prevent penetration of water, generally at the junction of a roof membrane and wall. Counter flashing may be combined with thru wall flashing.

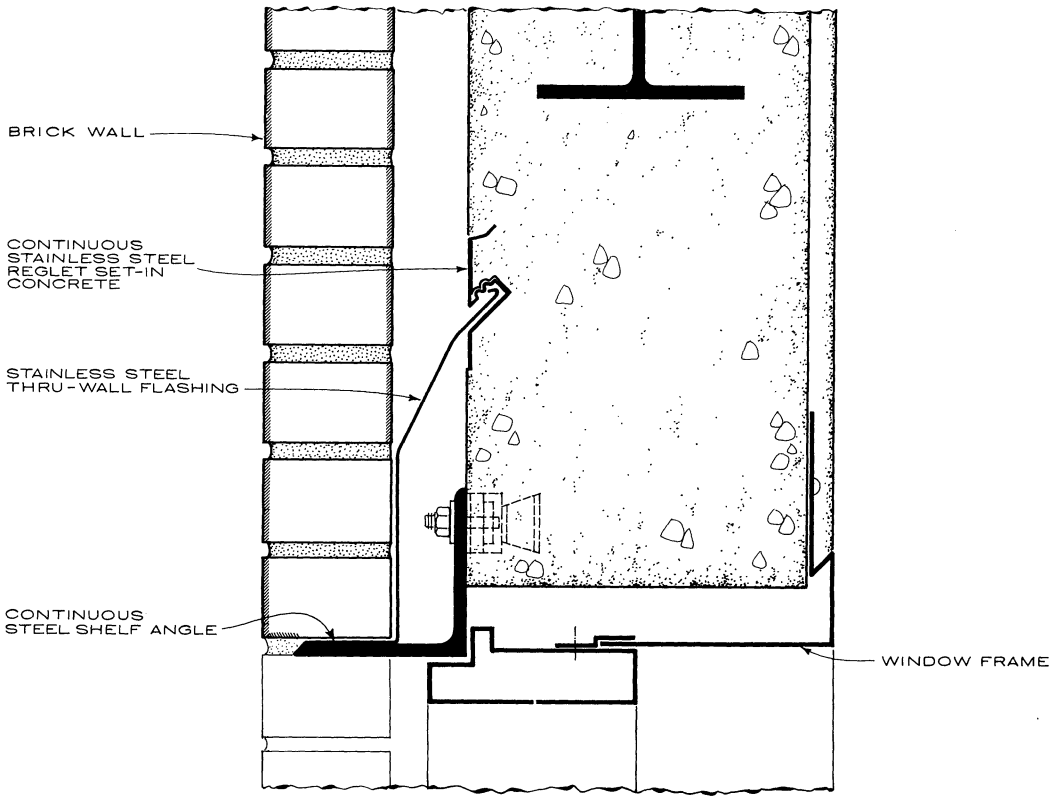
Counter flashing as illustrated at left uses receiver and insert systems recommended for new construction. In an existing masonry wall (at right) a reglet 1½ inches deep may be cut into the masonry joint. The flashing is then inserted and wedged with lead, and the reglet filled with sealant. Ends of sheets are locked or lapped three inches and may be sealed.

Type 302/304, dead-soft fully annealed stainless steel is recommended, with a minimum thickness of .015 inch.

THRU WALL FLASHING ...Typical Designs



TYPICAL PROFILES (PROPORTIONS EXAGGERATED)



DETAIL AT WINDOW HEAD

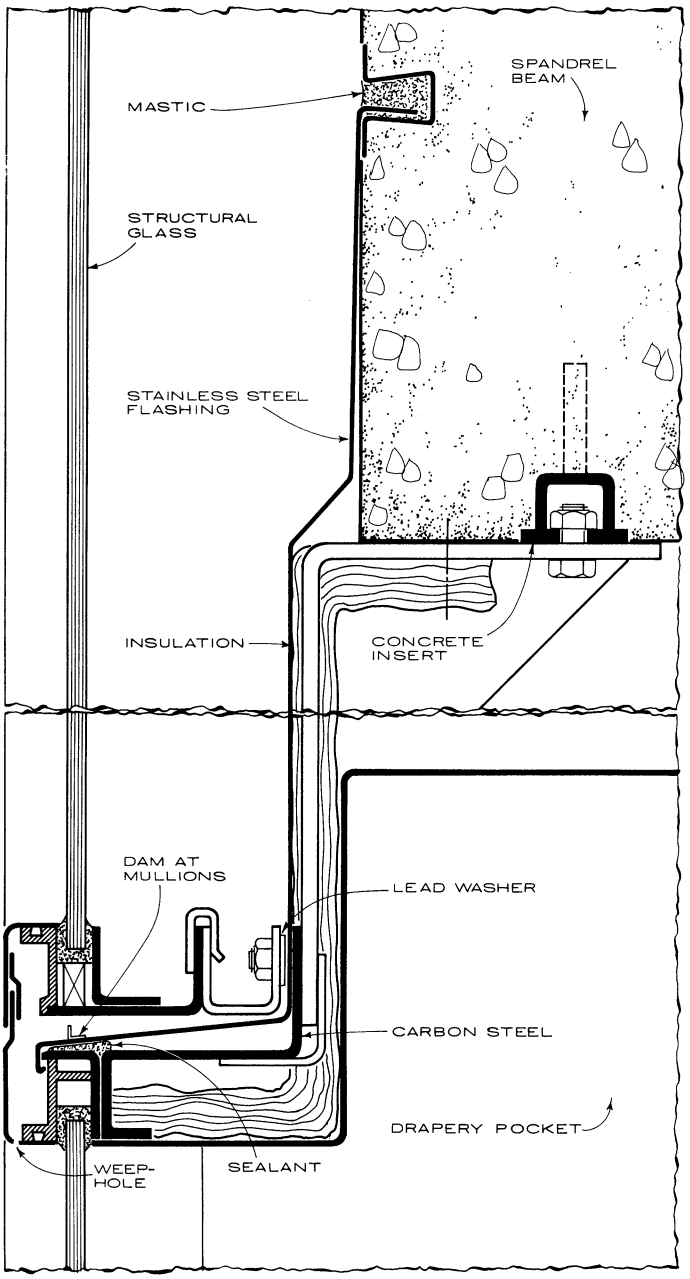
The application is in masonry walls to prevent penetration of moisture.

Several common types of thru wall flashing are available; typical profiles are illustrated above, greatly enlarged.

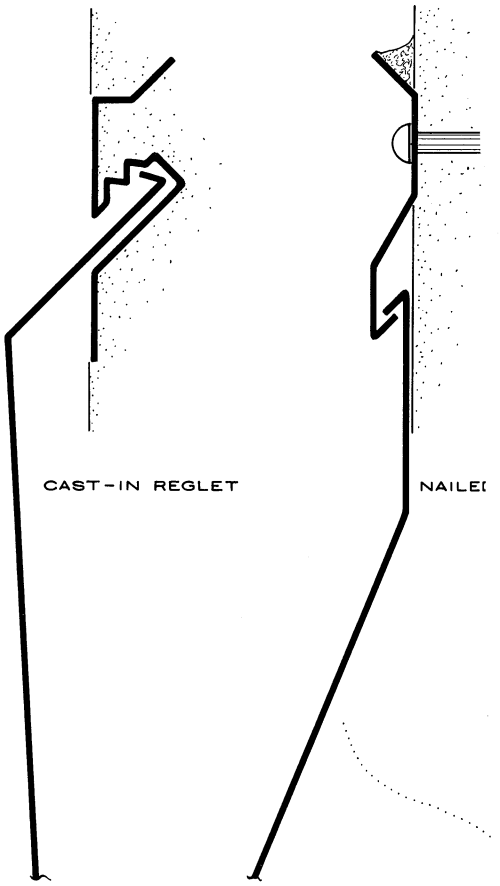
Where sections of flashing are joined, they should be lapped 3 inches.

Type 302/304, dead-soft fully annealed stainless steel is recommended, with a thickness of .010 inch minimum to .015 inch, depending on application.

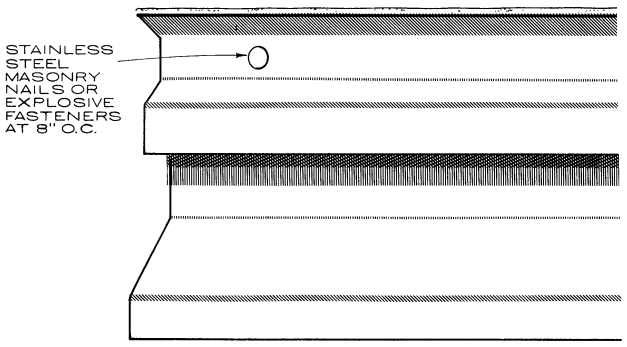
SPANDREL FLASHING ... Typical Designs



DETAIL AT SPANDREL



METHODS OF ATTACHMENT



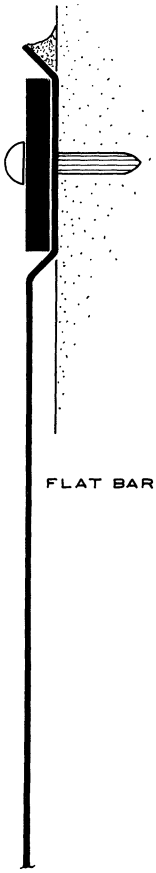
ISOMETRIC

Spandrel flashing is applied behind curtain-wall spandrels, to prevent penetration of trapped moisture or condensate, and to drain it out via weep holes.

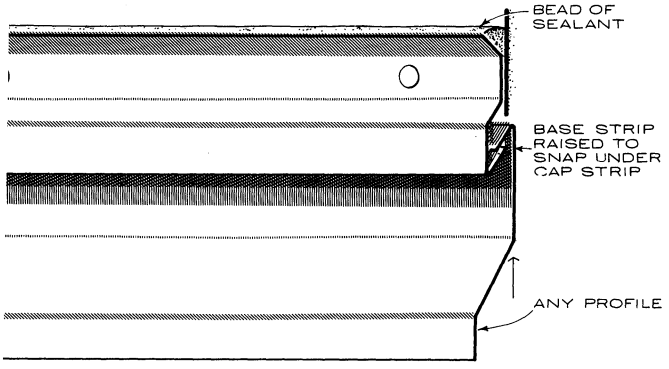
Spandrel flashing may be attached to the spandrel beam by nailing, inserting into a reglet, or locking behind cap flashing, as illustrated above. Details at junction of flashing with mullions and framing members are most important and depend, as does the flashing profile, on the curtain-wall design.

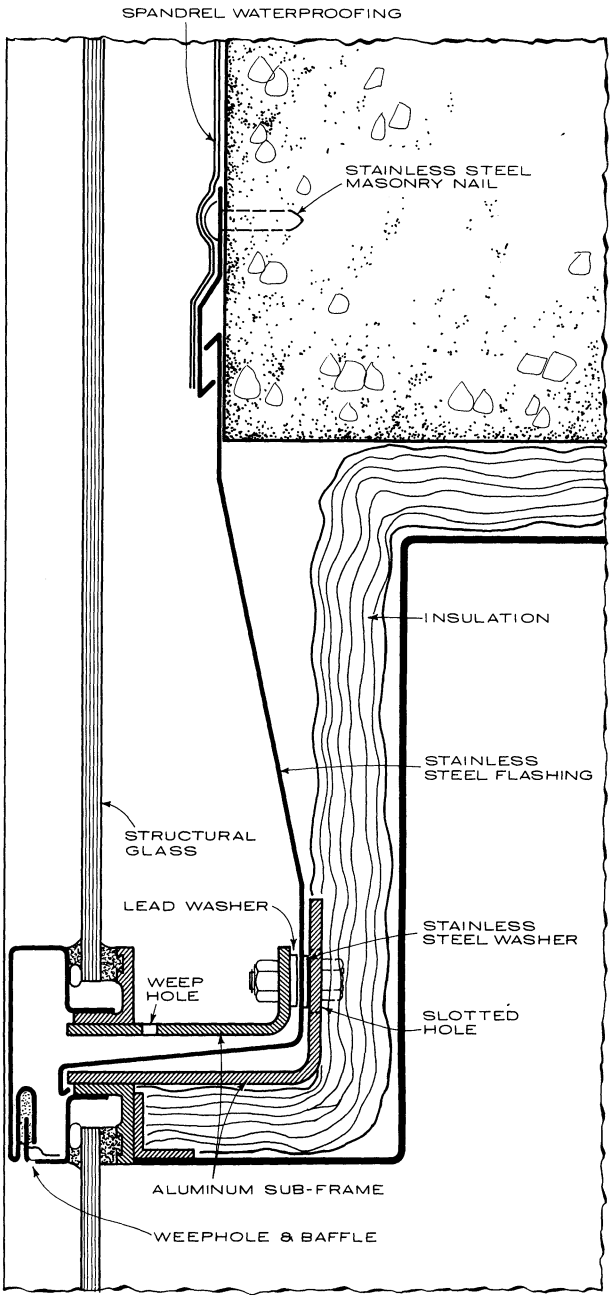
Joints should be lapped at least 2 inches and either continuously soldered or sealed.

Type 302/304, dead-soft fully annealed stainless steel is recommended, at a thickness of .012 inch minimum to .015 inch depending on application.



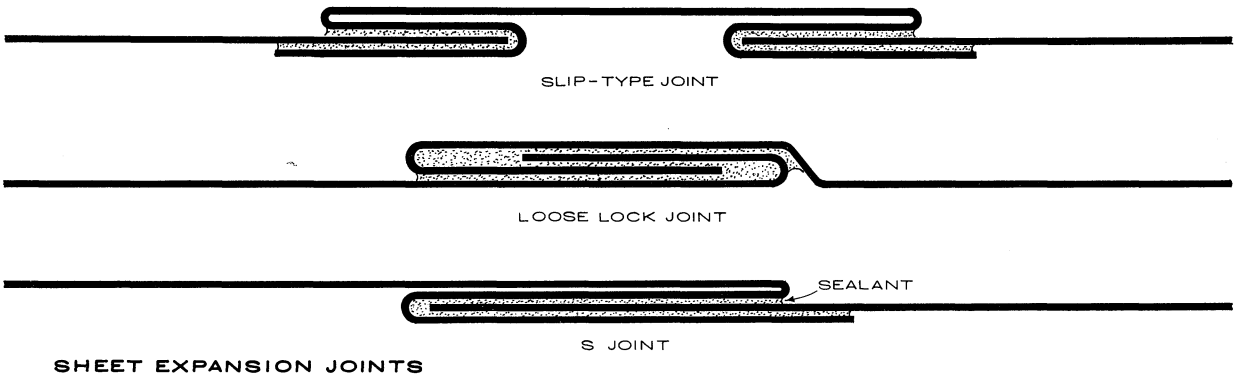
FLAT BAR FASTEN



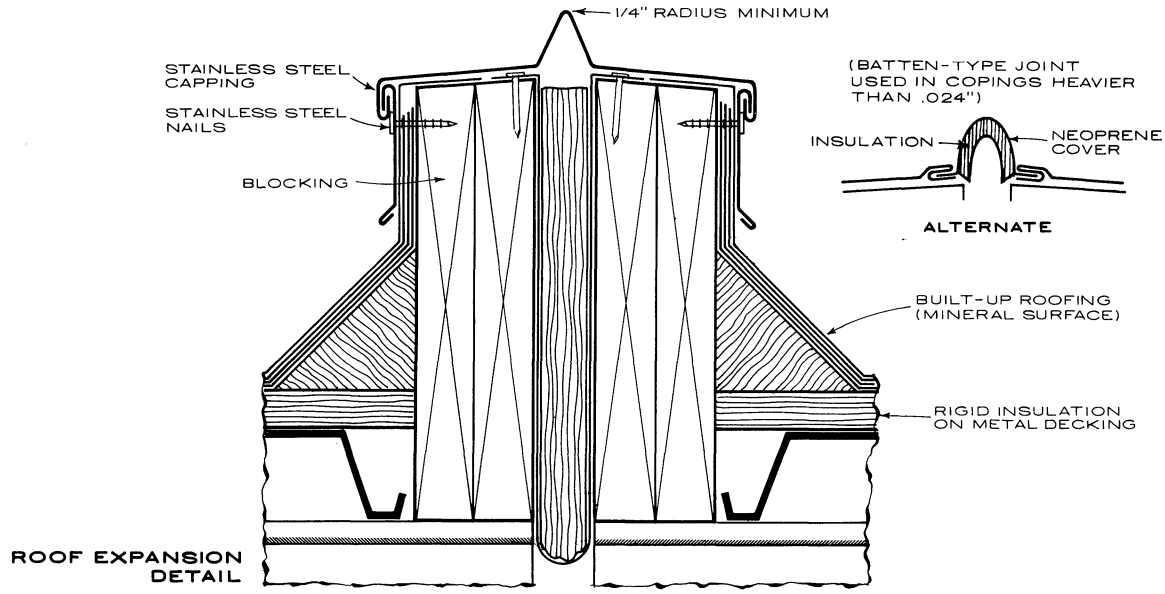


DETAIL AT SPANDREL

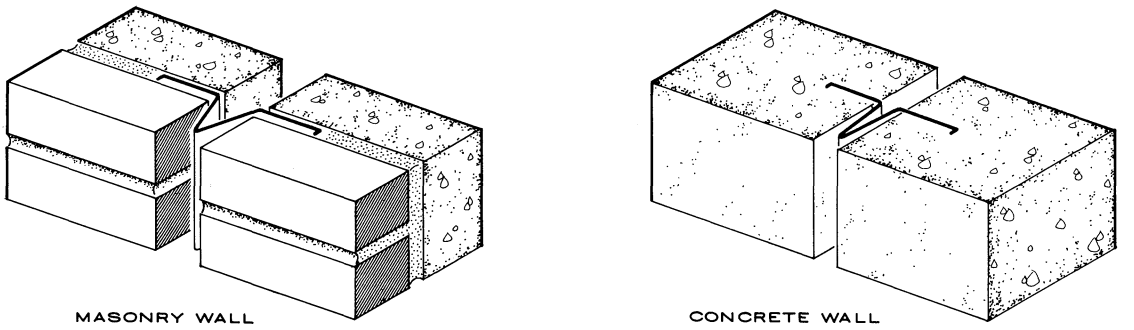
EXPANSION JOINTS ...Typical Designs



SHEET EXPANSION JOINTS



ROOF EXPANSION DETAIL



WALL EXPANSION DETAILS

Expansion joints are used: (1) To accommodate movement in stainless steel sheets; (2) To flash building expansion joints which accommodate thermal movement of building.

(1) Expansion joints of the types shown are set into stainless steel roofing and flashing at intervals from 24 to 40 feet (see application details), unless expansion is otherwise accommodated in seams or by use of crimped or deformed stainless sheet.

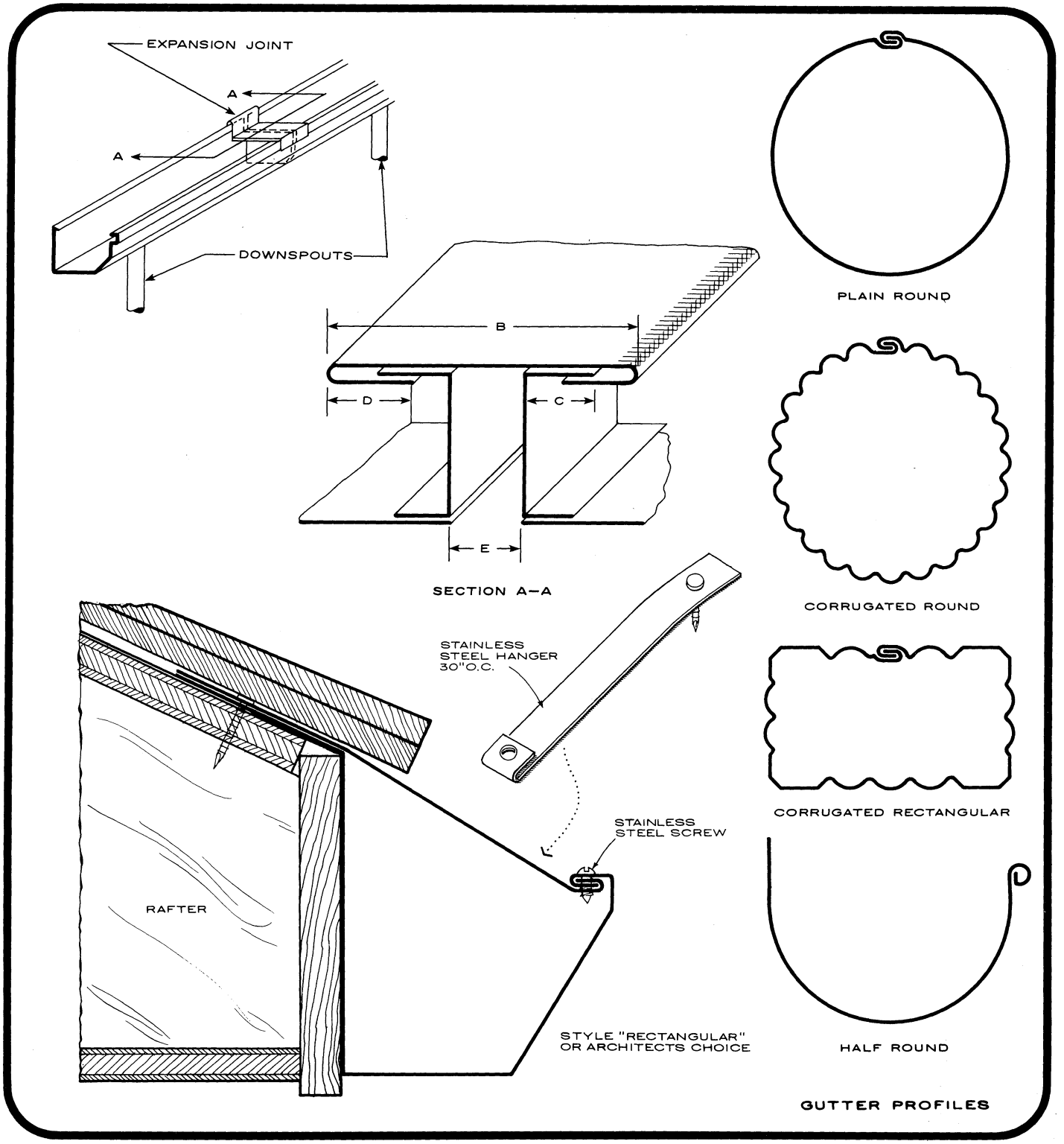
(2) Building expansion joints themselves should be flashed with stainless steel to prevent moisture penetration.

Typical applications in a roof and vertical walls are shown.

Prefabricated expansion joint systems, some featuring neoprene and stainless in combination, are available. Manufacturers' literature should be consulted for details.

Type 302/304, dead-soft fully annealed stainless steel is recommended, with a minimum thickness of .015 inch.

ROOF DRAINAGE ...Typical Designs



Intended to carry water from a roof, standard gutter and downspout shapes above are available, and special shapes can be custom brake formed. Related hardware is also available in stainless steel. Joints in gutter should be lapped one inch minimum, welded or rivited 2 inches on center and soldered. Joint sealants may also be used. Hangers of .037 inch thickness should be spaced 30 inches on center, and expansion joints using stamped prefabricated gutter configurations with stainless steel flanges should be at 30-foot intervals.

The allowance for expansion (E in Section A-A) ranges from $\frac{1}{4}$ to $\frac{13}{16}$ inch for 30-foot lengths of gutter and from $\frac{1}{4}$ to $1\frac{3}{8}$ inches for 60-foot lengths. Width of the cap for the expansion joint (B in section A-A) is 2 inches for 30-foot lengths, and $3\frac{1}{4}$ inches for 60-foot lengths. The flange turned on the upper part of the gutter-end (C) is $\frac{1}{2}$ inch for 30-foot lengths, and $\frac{13}{16}$ inch for 60-foot lengths. Flange turned on the cap (D) is also $\frac{1}{2}$ inch for 30-foot lengths and $\frac{13}{16}$ inch for 60-foot lengths.

Type 301 or 302/304, stainless steel is suitable. Minimum thickness of gutters, leaders, downspouts and elbows is .015 inch.

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7 MOISTURE PROTECTION
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