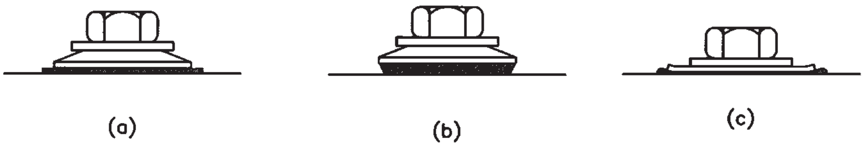

FIGURE 6.9 Proper and improper installation of neoprene washers: (*a*) in a properly installed washer, Neoprene is slightly visible from under the metal washer; (*b*) washer is not compressed enough; (*c*) washer is overtightened. (*After Ref. 15.*)

One popular type of hex-head screw has a cap of stainless steel or zinc-aluminum cast alloy fused on the shank of carbon steel. According to the manufacturer, these capped-head fasteners combine superior corrosion protection of their exposed heads with the hardness of their heat-treated shanks that allow them to be used in self-drilling screws. By contrast, the fasteners made entirely of 18-8 or 300-series stainless steel cannot be heat-treated and thus cannot match the hardness of heat-treated carbon steel. All-stainless fasteners are typically self-tapping screws. The 410 stainless steel can be heat-treated, but can become susceptible to red rust as a result. The zinc-aluminum cast alloy is similar in composition to Galvalume and is chemically compatible with Galvalume-coated panels. The alloy can be color-matched to blend with virtually any metal panel.[16]

Weathertightness of through-fastened roofing can be improved by proper application of tape sealants placed in the panel seams within the side laps and in the overlapping end laps. The sealants should be completely sandwiched within the metal, because they can be damaged by ultraviolet radiation. The sealants recommended by the panel manufacturers are typically made of butyl, aliphatic polyurethane, high-solids acrylic, and silicone with neutral cure.[17]

Many problems associated with exposed fasteners, such as visibility and corrosion, can be solved with concealed-fastener systems. Since these systems are most commonly selected as wall materials, the discussion about them is deferred until the next chapter.

6.4.5 Future

The shortcomings of through-fastened metal roofing are serious but not fatal, as long as the width of the roof is kept modest and the installer's workmanship is good. Even so, standing-seam roof is a much better product, and it has already displaced the screwed-down variety in most large projects. However, one other trend in building design could finally render through-fastened roofing obsolete: the need for better-insulated buildings.

As discussed in Chap. 8, the modern building codes demand a high level of energy efficiency, and the old "hourglass" method of insulating metal buildings may no longer be satisfactory. In that method, fiberglass insulation is simply draped over the purlins, and the roofing is fastened to purlins through it. The insulation is squished at the supports (hence the name "hourglass"), and its overall thermal performance is greatly diminished. The most popular method of improving it is to place the so-called thermal blocks—strips of rigid insulation—between the roofing and the purlins.

In standing-seam roofs, thermal blocks are placed below the roofing, but the supporting concealed clips are fastened directly to steel purlins. In through-fastened roofing, rigid insulation, if used at all, has to extend the full length of the purlins. The metal panels must then be fastened through the rigid insulation. It is axiomatic that the two surfaces connected by screws must be in contact, but in this case it is not possible. As the metal panels expand and contract with changes in temperature, they loosen the screws by rocking them back and forth (Fig. 6.10). Disastrous results are likely to follow in the next strong windstorm.

Presumably, blind rivets or small bolts would perform better, but they are more expensive to install than self-drilling screws, and using them would reduce the main advantage of through-fastened roofing: its low cost. Two other advantages of this roofing system—diaphragm capacity and purlin bracing ability—would also be brought into question. Instead of thermal blocks, a premium under-the-roofing insulation system described in Chap. 8 could presumably be used, but this would similarly undermine the cost advantages of through-fastened roofing.

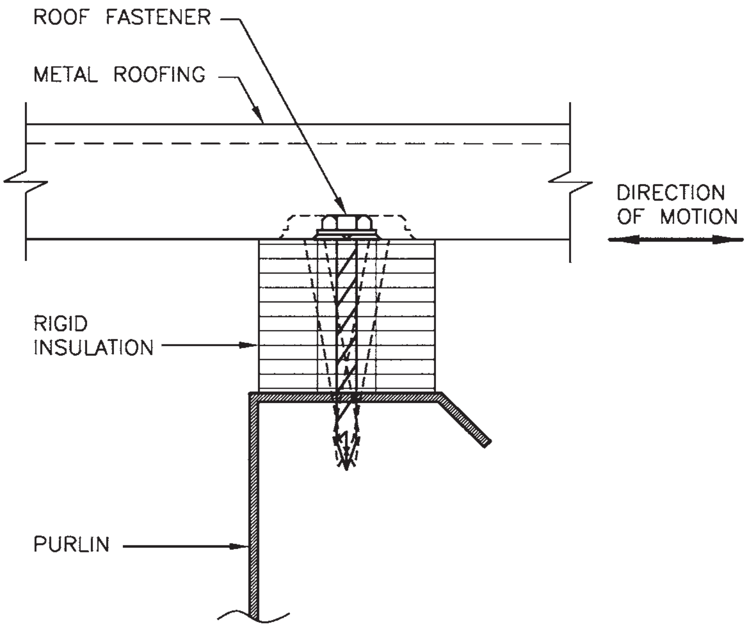

FIGURE 6.10 Rigid insulation placed under through-fastened roofing leads to loosening of screws under continual roofing motion.

6.5 STRUCTURAL STANDING-SEAM ROOF

6.5.1 System Components

Structural standing-seam metal roofing is a major improvement over the through-fastened variety. Instead of being simply lapped together and screwed down, the elevated seams of the adjacent standing-seam panels are formed in the field by a portable seaming machine or, less reliably, by hand tools. A factory-applied sealant is normally placed in the female corrugation of the seam. To accommodate expansion and contraction, the panels are attached to purlins by concealed clips that permit the roofing to move (Fig. 6.11).

Some common clip designs are shown in Fig. 6.12. The clips are typically provided in at least two versions—high and low. High clips are used in combination with thermal blocks placed above the clip base and under the roofing, and the clip height depends on the thickness of the blocks. High clips also allow for air circulation between the purlins and the roofing.

Despite visual differences, all the clips consist of two pieces—the rigid base attached to the purlin and the movable insert rolled into the seam. The clips are usually self-centering, i.e., preset to allow an equal amount of movement up and down the slope. The amount of movement permitted by the clip depends on the length of the slot and the size of the insert within it. One of the best designs is a so-called articulating clip, intended to compensate for misaligned roof purlins.[18] The clip, first introduced by Elco Industries and now offered by MBCI, is shown in Fig. 6.12 (bottom right).

Some other features found in high-end systems include stainless steel, rather than galvanized, clips and movable inserts as well as prepunched holes in both panels and purlins, which reduces panel misalignment. Such prepunching, if available, is a good enough reason to buy a complete metal building system from one manufacturer instead of mixing and matching components from various suppliers.

The most common seam configurations are shown in Fig. 6.13. As it indicates, there are two distinct groups—vertical and trapezoidal. Both types have their adherents among various manufacturers. The trapezoidal seam is more popular, partly because it allows for easy concealment of the clip, and