LOW-SLOPE METAL ROOFING: the Other Option

BY STEPHEN TEAL

Photo 1 – Ultra low-slope aluminum standing-seam roof, education center, England.

While previous issues of *Interface* have dealt very effectively with various aspects of metal roofing, there has been little mention of "bulb seam" metal roofing.

These systems have been used in Europe for over 40 years (*Photo 1*) and are starting to gain ground in Canada and somewhat in the U.S. While they may be new to most readers, the primary manufacturer of this type of system has over 1 billion sq. ft. installed throughout the world.

Bulb seam systems are like most products in that success is dependent upon detailing and workmanship, and inasmuch as the roof should be installed by factory-trained and certified technicians. The systems are seeing great success with numerous high-profile projects around the world, including Heathrow Airport, Dubai Airport, the Dubai Mall, and at the 2012 London Olympics, to name a few. When installed by a certified installer according to the manufacturer's details, a system warranty of up to 40 years is available. Some of these systems have undergone extensive testing, including ASTM, FM Global, hail testing, acoustic performance, and low U-value assembly testing.

When polyamide halter clips are used, additional benefits are realized (*Photo 2*). There is virtually zero thermal bridging, increased ability to accommodate thermal movement, a lower coefficient of friction, and improved acoustic performance of the roof. Halter clips are available in various heights in increments of 0.2 in. (5 mm) to a maximum of 9 5/8 in. (246 mm) overall height. The polyamide clips will greatly assist with the trend towards increased R-values in the newer building codes.

Pans are available in various widths, from 12 to 20 in. (300 to 500 mm) and usually two seam heights—2 and 2.5 in. (50 mm and 65 mm), allowing for up to 8 in. (200 mm) of mineral fiber insulation

Photo 2 – Typical polyamide clip (halter) detail.

Photo 3 – Low-slope standing-seam aluminum roofing with green roof sections.

Photo 4 – Arsenal showing vegetated roofing over low-slope standing seam and curved system.

without the use of any Z bars. Thicker insulation can be used by installing a hat section under the clips or a layer of high-density isocyanurate as a base layer. U-values as low as 0.9 W/m/K can be achieved with this insulation combination.

Most manufacturers of this type of system provide copper, aluminum, zinc, and stainless steel sheet material. Galvanized steel is generally not used due to potential corrosion issues. Approximately 95% of the roofs installed are in aluminum, usually mill-finish, embossed material. While prepainted aluminum is readily available and commonly used, in a low-slope environment, the prepainted finish will not usually last the 40-plus-year life expectancy of the roof. Hence, there is a trend in the industry towards anodized finishes.

Aluminum, like copper and zinc, has a long history of durability; aluminum sheet was used to cover the roof on the San Gioacchino Church in Rome in 1887 and is still in excellent condition. Aluminum is also very environmentally friendly, being the most abundant metallic element in the earth's crust and easily recycled with no loss in physical properties. At least one system can be unzipped and the roof panels reinstalled on another project, should the need arise.

The preference is to site-roll these sheets, allowing for virtually unlimited sheet length. Roof sheets up to approximately 650 ft. (200 m) long have being successfully installed. The elimination of end laps by using continuous sheets avoids the cause of many leaks on low-slope metal roofs. Where end laps are unavoidable, such as when transitioning from curved sheets to straight sheets, the lap should be full-welded, creating a monolithic sheet. Details such as miters should be fully welded, and roof curbs should also be welded into the roof sheets. When roof curbs are installed, if they are not located at or near the fixed point, a double curb is commonly used. The inner curb supports the unit, the outer curb flashing waterproofs and moves with the roof panels, and low-density insulation is placed in the cavity between the curbs.

A correctly installed roof of this type should have zero fasteners through the pan and no caulking required at any location, including in the seams. If this approach goes against the normal thought process, one manufacturer even has vegetated roof assemblies that can be installed directly over the metal roof (*Photos 3* and *4*). It is doubtful that many manufacturers or contractors would be comfortable installing growing medium and plants on traditional low-slope metal roofs.

These roof systems can also accom-

Photo 5 – Low-slope aluminum standing seam with integrated solar panels and skylights.

Photo 6 – Small skylight showing welded detailing.

Photo 7 – Low-slope aluminum roofing with integrated skylights and fall arrest.

modate many types of PV panels (*Photo 5*), walkways, snow guards, etc. without penetrating the roof sheets. Some manufacturers also provide integrated skylight systems (*Photos 6* and *7*). Metal liner panels and decks can be provided with the liner profile matching the clip spacing of the roof panel, thus saving on installation time. See *Photos 8* and *9*.

While the initial cost of this type of roof assembly may be slightly higher than some other options, including membranes, these systems can be considerably less expensive when life cycle cost is considered.

The majority of the installations of these products are low-slope—as low as 2%. Several major chains in the U.K. specify

Photo 8 – Tapered aluminum standing seam with welded curb details.

Photo 9 – Low-slope roofing transitioning into wall showing welded detail at transition.

Photo 10 – Typical low-slope aluminum standing seam with curved roof/wall application.

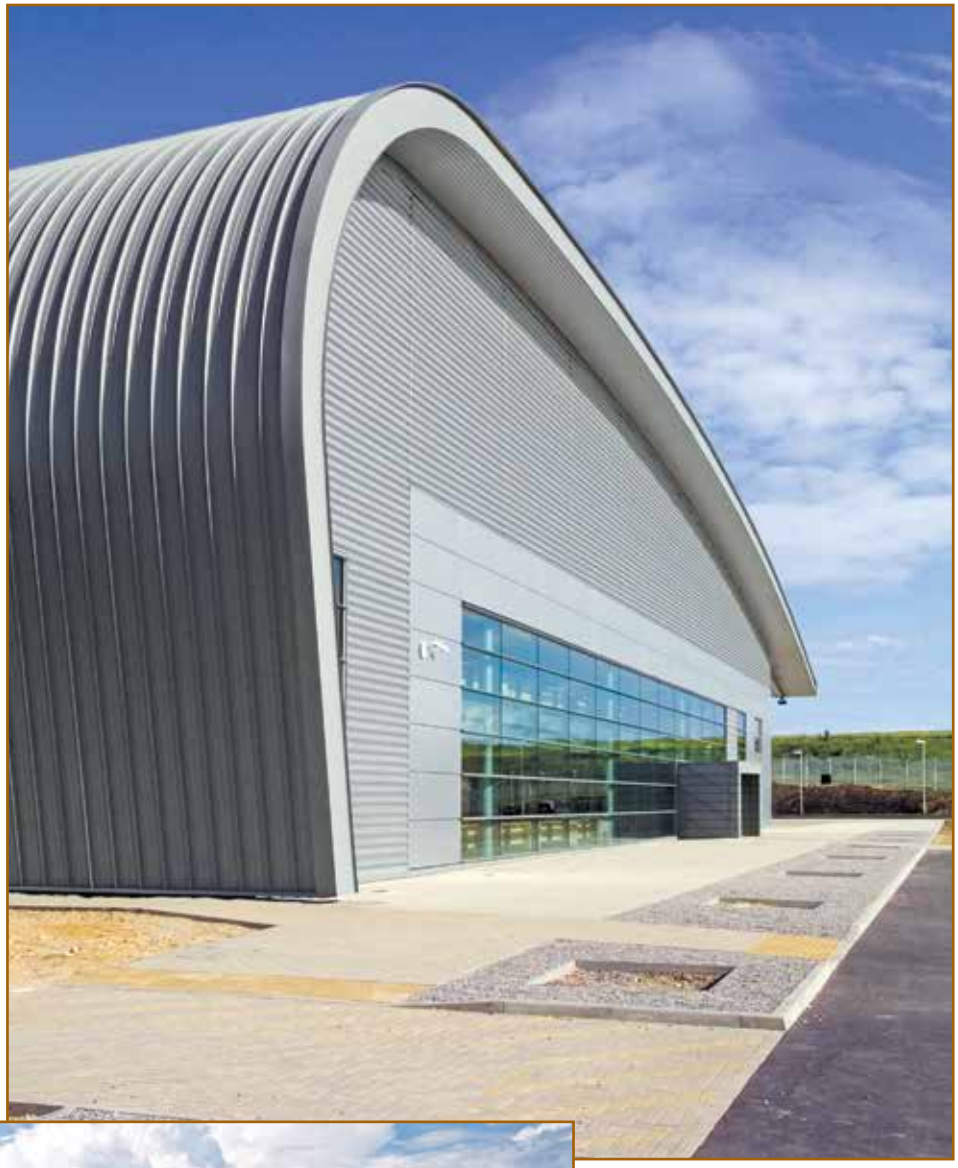

Photo 11 – Low-slope aluminum standing-seam "discus."

these systems for their big-box, low-slope roofs, including Asda, the British arm of Wal-Mart. Bulb seam panels are not limited to low-slope roof applications. Numerous jobs have incorporated the roof sheets transitioning into the wall or curved down to grade. We have seen several applications where these products have been used as both horizontal and vertical wall systems. See *Photo 10*.

Curved roof profiles can be achieved by machine curving or letting the aluminum sheets follow a curve naturally. The radius that can naturally bend depends upon the profile, the gauge of the aluminum, and whether it is concave or convex, but is typically in the vicinity of 150 ft. See *Photo 11*.

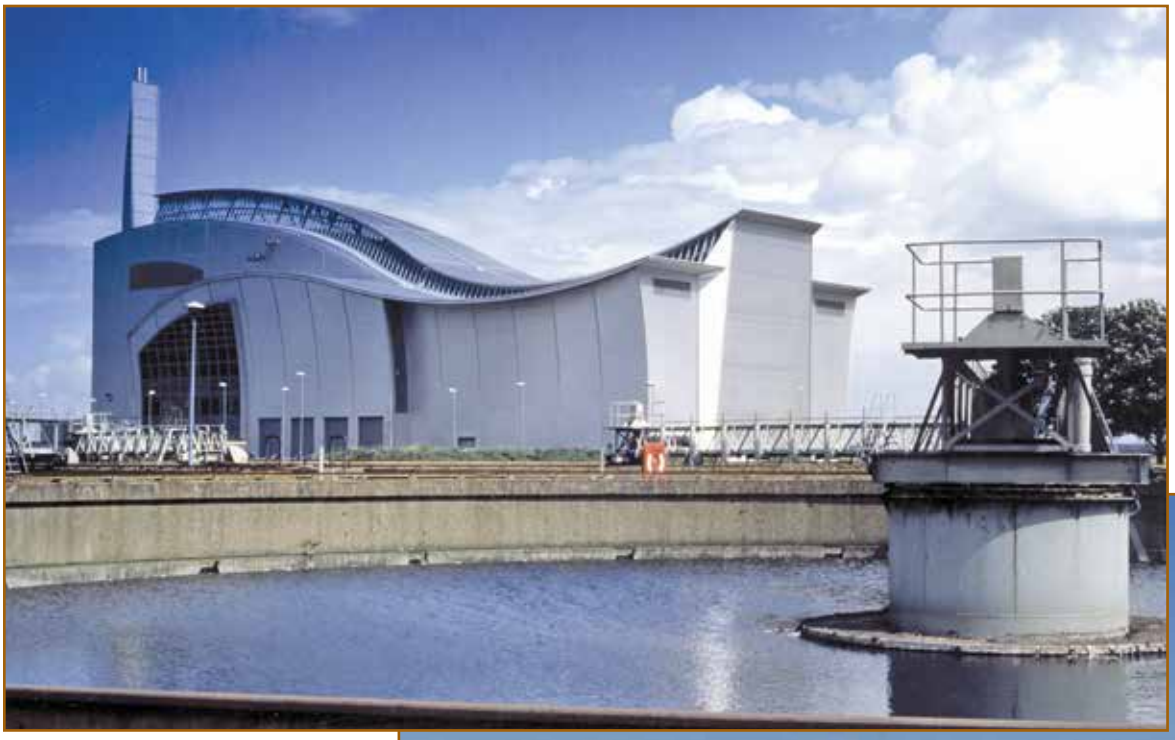

Photo 12 – Complex convex/concave curved aluminum standing-seam roof.

The roof sheets can be site-curved to facilitate both convex and concave roof profiles, down to a radius of 5 ft., or convex-curved by crimping to a minimum radius of 2 ft. Panels can be roll-form tapered, elliptical, wave-formed, or "S"-curved; even tapered curved sheets are common. See *Photos 12* and *13*.

This type of roof sheet can also act as a waterproof substrate to facilitate the installation of exotic materials, such as a rainscreen over the roof panels, without any penetration of the roofing assembly. The rainscreen materials may be almost any type of panel, including solar panels, stone slabs, or composite aluminum panels as shown in *Figure 14*.

QA/QC CONCERNS

The vast majority of these roof types are manufactured from aluminum. One of the primary design concerns is making adequate allowance for thermal movement—typically around 1% or double that of a steel sheet. The location of the fixed point and the respective

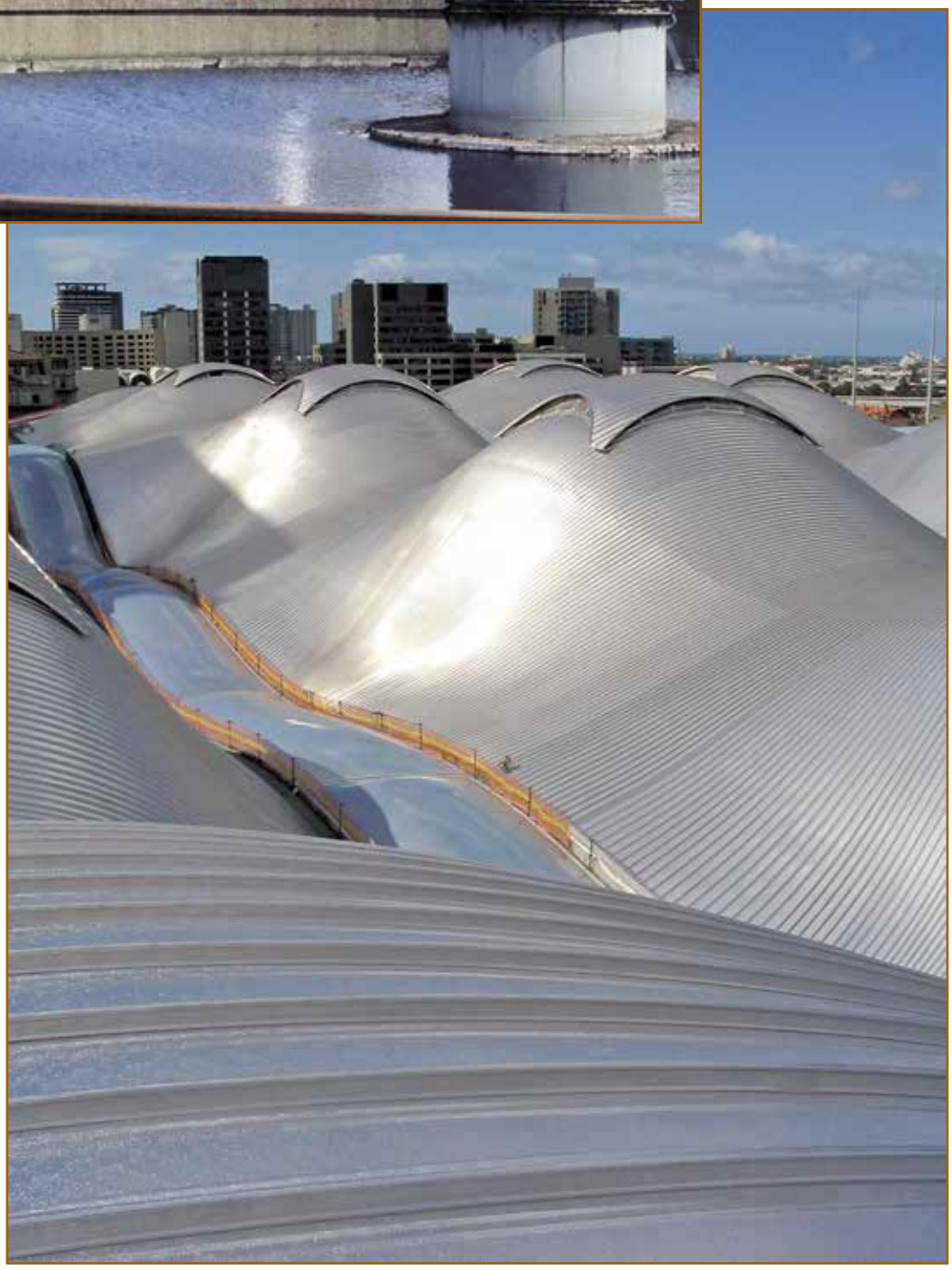

Photo 13 – Curved and tapered complex standing-seam project in Melbourne, Australia.

Figure 14 – Composite aluminum panels over curved and low-slope, standing-seam aluminum roof. No penetration of the roof sheet.

stresses on the fixed-point fasteners should be given careful consideration. The positioning of the fixed point will determine the location and the amount of movement to be taken up in the eave and ridge details. Some attachment clips have limited travel allowance, and care should be taken to ensure that the amount of movement does not exceed the clip design when this type of clip is used. Two-piece clips should also be installed with the sliding portion in the correct position, depending upon installation ambient temperature.

Clip alignment is also critical, as clips that are out of design tolerance can create unintended fixed points. One of the major factors in clip alignment issues is the structure being out of specification, creating humps and valleys in the roof. A less common but significant concern is when auxiliary items such as PV panels or snow stops are mounted to the roof using seam clamps. It is imperative that seam clamps not be located near clip locations when one-piece clips are used so that the panels' thermal

movement is not inhibited.

Flashing detailing must be reviewed to ensure the flashings are not fixed to the roof sheets except at fixed-point locations.

Foot traffic in the pans during construction should be avoided; installers should walk on the ribs. In areas of high traffic, a permanent or temporary grip-strut type walkway might be beneficial. These aforementioned items and conditions must be assessed by a competent consultant early in the design process and should be reviewed by the system manufacturer.

CONCLUSION

These systems have a long track record of successful installations, some of which are very complex in design, while others are just basic boxes, and some have vegetated cover. The roof profile and building shape are limited only by the imagination of the designer. Solar, vegetated, low-slope or steep-slope—the choice is yours. By utilizing aluminum as the standard material, the life expectancy of the roof is greatly enhanced, resulting in a low life-cycle cost. See *Photo 15.*

Figure 15 – Low-slope prefinished standing-seam painted and cranked sheets transitioning to wall, plus curved upper roof.

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SALARIES INCREASING FOR FIRE PROTECTION ENGINEERS

According to a recent survey conducted by the Bethesda, MD-based Society of Fire Protection Engineers (SFPE), the median U.S. total compensation for fire protection engineers is $113,748. This is a 2.9% increase since the previous survey, conducted in 2010.

The 2012 SFPE survey found the median income for an entry-level fire protection engineer with a bachelor's degree and six years or fewer of experience is $70,000 per year. For a mid-level fire protection engineer, the median income increases to $96,200, and as a senior-level fire protection engineer, salary rises to more than $128,000.

Fire protection engineers are among the highest-paid engineers in the nation, leading to a competitive salary in fields such as consulting, insurance, government, and fire service. Earning a professional engineer (PE) license also has salary benefits, as PEs earn 21% more annually than nonPEs.

The survey polled 745 professionals practicing in the profession of fire protection engineering worldwide. Income data is based on earnings (salary plus bonuses) in 2011.