

NEW INNOVATIONS FOR CONCRETE AND CLAY TILE ROOF ASSEMBLIES

By Richard K. Olson



Figure 1 – Concrete flat-tile installation.

Traditional concrete and clay roofing tiles have been used for centuries in most parts of the world for steep-slope installations on both residential and commercial buildings. Over the past five years, the advancements and demands for higher overall roof assembly performance have driven new innovation in roof designs. The Tile Roofing Institute (TRI) continues to work with its members to help identify new and innovative roofing options for steep-slope applications of both clay and concrete roofing tiles. The market and design communities are seeking greater long-term performance, durability, and energy-efficient products that enhance a more green and eco-friendly technology. Tile products perform outstandingly well in several key areas to provide better roofing options to consumers. See *Figure 1*.

ENERGY EFFICIENCIES

California has led the charge for greater energy efficiencies that other states are now implementing. With the need to reduce peak energy demand and reduce heat transfer to the occupied living areas, the roofing envelope has been a high priority in the innovating model. The tile industry continues to be at the forefront of the research identifying key areas that improve buildings' overall energy performance and assisting in energy reduction in both hot and cold climates.

Solar Reflectivity

If roof claddings can help redirect the sun's energy back off the roof surface, the initial energy and heat transfer can be significantly reduced. The tile industry has developed tile-coloring applications for both concrete and clay tiles that will far exceed the Title 24 energy code requirements. Innovative energy tile products on

the market provide from 0.15 to 0.70 solar reflective ratings, depending upon the color of the tiles; in most cases, they cost the same as traditional tiles. The lighter the color, the higher the reflective ratings the tile will meet.

In research performed by Dr. William Miller at the U.S. Department of Energy's Oak Ridge National Laboratory (ORNL), up to a 70% reduction in heat transfer through the roofing assembly was obtained compared to an average asphalt shingle roof. In addition, special polymer coatings have been developed that will allow traditional darker-colored tiles to perform similarly to a higher reflective rating, allowing more earth tone colors to be used in high-reflective code areas.

Concrete and clay tiles were offered in a wide array of energy-efficient colors and materials without the need for paint coatings long before energy efficiency was pushed to the forefront of technological development. Beyond tiles' natural ability

to be highly reflective and have high thermal mass, the tile manufacturers have developed improved technologies to provide even greater energy efficiency in colors that customers prefer.

Thermal Mass

As an industry, we have been able to show that the thermal mass of concrete or clay roof tiles helps reduce the heat transfer into the attic or conditioned living areas. Tile roofs are an obvious choice for design professionals looking for energy-efficient designs with attractive aesthetics. The thermal mass shifts the peak energy demands as the tiles absorb more heat than other roofing materials, thereby taking longer to heat and cool.

Above-Sheathing Ventilation

Working in collaboration with ORNL, the industry has been able to quantify the effects of the design air space that is found in a traditional concrete or clay tile application. This natural airspace, combined with the chimney effects of a steep-slope application with air intake at the eave and exhaust at the ridge, generates a thermal barrier from the air movement that will further reduce the heat transfer to the roof sheathing. Other roofing materials for steep slopes are now providing similar benefits to help increase the overall energy performance.

WIND PERFORMANCE

The high-wind regions of the country have been a focus of the tile industry since Hurricane Andrew in 1992. We continue to review and revisit our design applications in areas where the wind speeds exceed the basic code. With the new International Residential Code and International Building Code (IRC/IBC) of 2012 and 2015 in place, the recognition of roof performance to the new ASCE-7-10 standard (*Minimum Design Loads for Buildings and Other Structures*) is required in most jurisdictions.

The TRI worked with its member companies to generate new fastening tables to identify the increased uplift resistance required by the new codes. The design requirements were simplified to make it easier for design professionals and roofing installers, while also providing for greater safety by designing the roof to meet the worst-case perimeter zone requirements. These areas typically include a significant portion of current roof designs, due to multiple roof planes, dormers, hips, and valleys.

The TRI performed extensive wind tunnel testing in the United Kingdom to validate tile performance up to 125 mph in full-scale testing. The new ASCE-7-10 requirements increased the previous values in certain applications and exposures, and the TRI addressed these in its current, updated installation manuals, available at www.tilerroofing.org.

INDUSTRY GUIDES

The TRI worked in collaboration with its member producers to generate industry-based installation guides. The institute recently updated both the *FRSA/TRI Florida High Wind Tile Installation Manual*, Revised 5th Edition, 2014, and its national installation guide to be inclusive of new fastening options.

The 2015 version of the *TRI Concrete and Clay Roof Tile Installation Manual* carries a formal evaluation report issued by the International Association of Plumbing and Mechanical Officials (IAPMO), UES-ER Report #2015, to show it has been reviewed and is in compliance with all of the applicable codes, including all the new 2012 and 2015 IBC/IRC.

FIRE PREVENTION

TRI's concrete and clay tile manufacturers continue to expand research and collaboration with component manufacturers that make products within the roofing assemblies to ensure Class-A fire ratings of tile roof systems. With the Wildfire Urban Interface (WUI) areas expanding in the southwest regions of the country to more urban boundaries (and in some cases, cities), the TRI has worked with the design community to help provide a greater understanding of the challenges that surround roof applications. There are now innovative ventilation products that reduce ember penetration and better flashing and valley treatments that improve the fire protection of concrete and clay tile roof systems. The TRI is working with the underlayment manufacturers to help identify better options for maintaining UL Class-A fire ratings in assemblies for steep-slope applications while maintaining the water resistance of the systems.

The next opportunities will be in the reduction of high-wind ember behavior. The TRI is working with its counterparts in other regions of the world where wildfires are a



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Figure 2 – Traditional high-profile tiles.

significant threat to building performance. Recent work with the Roof Tile Association of Australia has produced some useful data on how to help further improve fire protection.

HAIL RESISTANCE

The Midwest, along tornado alley, where large hailstorms are the norm, continues to provide challenges to the building industry. The TRI continues to work in the development of more realistic hail-testing methods that will mimic more closely the effects of Mother Nature. TRI's original research and testing led to the development of the FM 4473 standard specification, *Test Standard for Impact Resistance Testing of Rigid Roofing Materials by Impacting With Freezer Ice Balls*. Our member producers have worked to reengineer their tile products to increase the overall performance for Class-4-rated tiles that will meet the Class-4 hail impact rating utilizing a 2-in. ice ball at terminal velocity. With the ability to easily replace single tiles, the cost to replace broken tiles is generally minimal, compared to repairs of other roofing systems with similar damage.

SEISMIC RESISTANCE

The West Coast region of the U.S. has experienced increased seismic activity over the last few years. The design community is looking for greater fastening or supporting research to increase the performance of roof and wall assemblies. The TRI completed industry-based seismic performance testing at the University of Southern California to demonstrate the ability of its concrete and clay tiles to outperform code requirements with traditional fastening methods.

SOLAR APPLICATIONS

As part of overall energy performance design, the industry is seeing greater adoption of solar panels in steep-slope roof applications. The solar industry has been working with tile producers to provide several innovative options for solar.

Tile Replacement

Several solar manufacturers now make panels that will interlock to individual tiles. The arrays of these panels are inserted to assume the actual tile locations and interlock at the overlap and course areas of the existing tiles. The wiring is easily installed in the air gap areas under the tiles.

Large Panels

As an industry, we are working with the various solar-mounting companies to learn how to properly install their proprietary systems for tile so that they provide proper flashing and sealing for long-term positive performance. In addition, there is the need for correct fastening of the panels to adequately support the solar systems. The lack of clear guidance via the codes is one area that will need to be addressed moving forward for greater clarity for all roofing materials.

ENVIRONMENTALLY FRIENDLY


Several concrete and clay tile producers have developed added features to their tiles to enhance environmental performance over time. From patented coatings for color, durability, and enhanced reflectivity, to additives that help reduce smog and increase insulation properties, the tile

industry is staying on the leading edge of innovation. Concrete and clay tiles are made from natural materials by Mother Earth and, as such, are environmentally friendly from cradle to grave. With one of the longest lifespans of any roofing material, tile roofs help reduce the need for reroofing and the disposal issues associated with traditional roofing products (Figure 2).

COLD-WEATHER APPLICATIONS

The TRI continues to research the effects of cold-weather applications in areas of high solar incidence (the sun shines with sub-zero temperatures). In these areas, the use of greater ventilation options will increase the overall

long-term performance of the roof assembly and reduce ice damming that can lead to roof damage and leaks. The proper design of snow retention is also a benefit for roofs. In almost all regions outside of the U.S., the retention of snow on the roof provides additional thermal insulation to help reduce heat loss in the roofing assembly. Proper attention to snow retention products has provided significant innovation in installation techniques for long-term performance.

The TRI and its members continue to work with their counterparts in the rest of the world to identify new and innovative practices that will help improve roof performance in all climatic and design conditions. Collaborative work with other organizations and industries has opened the door to even greater knowledge for the next generation of roofing products. 



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Richard K. Olson is president and technical director for the Tile Roofing Institute (TRI). The association represents industry professionals involved in the manufacturing and installation of concrete and clay tile roofs in the U.S.

and Canada, and works with national, state, and local building officials to develop installation techniques, codes, and standards for better roofing systems.