

California Energy Commission Public Comment Submission

Docket No 07-BSTD-1

The Additional Energy Saving Benefits of Tile Roofing with Raised Battens and Open Ventilation

45-Day Revision to Building Efficiency Standards December 17, 2007

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Proposed Revision

The 45 Day Language has recognized the energy saving insulation benefit of the air space between the roof surface and the deck for concrete or clay tile roofs. This has been referenced in the 45 Day language with the prescriptive requirement of 0.15 aged reflectance for all climatic zones compared to 0.20 for other materials. Reports by Miller, et al support this reduced requirement for reflectance (see "Additional references" below).

*Current 45 Day Language: Residential Alternative Calculation Method (ACM) Approval Method
Reference Express terms Section 3.4.4 Roof Deck*

Standard Design

The following characteristics shall be used to model the roof deck of the standard design.

Solar reflectance and emittance of the roof surface (unitless). The standard design for steep slope roofs with a weight of 5 pounds or more per square foot (typically concrete or clay tile roofs), shall have an aged reflectance of 0.15 for all climate zones. For all other steep slope roofs (including asphalt and metal shingles and wood shakes) the aged solar reflectance for the standard design shall be 0.20 in climate zones 10 through 15 and 0.08 in other climate zones.

Recent work by G. deWith and N. Cherry (Abstracted in the Reference below) demonstrates the additional energy saving benefit of increasing the dimension of the air space between the roof covering and the deck. Table 9 from the abstract shows that tile, with its associated air space, provides a reflectance benefit of between 0.05 for the worst case of flat tile fixed directly to the deck, to greater than 0.49 reflectance for profiled tile with raised batten and ventilation (in Climate zone 11, no amount of increase in reflectance of the reference roof construction will match the performance of any tiled roof with 0.10 solar reflectance).

It is proposed that an addition be made to the 45 Day language to take advantage of the energy saving of the raised batten air space by reducing the reflectance requirement to 0.10 for steep slope roofs with a weight of 5 pounds or more per square foot. This will allow greater consumer choice, maintain the requirements of the code and derive energy savings that benefit this State and consumers of tile products with inexpensive and environmentally friendly raised batten systems.

Reference

de With, G; Cherry, N. 2007. The heat benefits of a concrete or clay tile roof with Above Sheathing Ventilation (ASV). England, Oct 2007

ABSTRACT

The purpose of this study is to quantify the heat benefits of a concrete or clay tile roof (hereafter called "tiled roof") by comparing this roof with a reference roof construction as defined in the Californian Energy Efficiency Standard "Title 24".

The product features that provide the basis for the heat benefits of a tiled roof over a traditional roof covering are as follows.

The thermal mass of the tiles provides a heat sink that buffers the solar energy, resulting in a lower energy consumption of the roof structure.

The ventilation under the roof tiles, commonly referred to as "Above Sheathing Ventilation" (ASV), removes heat from under the roof tiles resulting in a lower energy consumption of the roof structure.

The energy performance of a tiled roof and a traditional roof has been simulated in Californian climate zones 10 to 15. The computer algorithms and model setup are in compliance with the modeling requirements defined in "Title 24", and the results from the simulations are as follows:

The ventilation and thermal mass of a high profiled tile with counter-batten system provides an equivalent performance of at least 15% solar reflectance in all zones.

In most zones the equivalent solar reflectance from ventilation and thermal mass is considerably in excess of 15% with a maximum value of 49%.

In climate zone 11, which has relatively high wind and temperature range, no amount of increase in reflectance of the reference roof construction will match the performance of any tiled roof with 10% solar reflectance.

		The performance benefits of ASV and thermal mass in terms of equivalent solar reflectance		
Test no.	Climate zone	(a) Flat tile laid direct-on-deck	(b) Profiled tile with counter batten	(b) - (a) Improved ventilation
1	10	39%	49%	10%
2	11	> 100%	> 100%	> 100%
3	12	12%	32%	20%
4	13	21%	27%	6%
5	14	18%	28%	10%
6	15	5%	15%	10%

Table 9 The benefits of ASV and thermal mass in terms of equivalent solar reflectance compared to the reference construction defined in "Title 24".



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Additional references:

Miller, W.A., MacDonald, W.M., Desjarlais, A.O., Atchley, J.A., Keyhani, M., Olson, R., Vandewater, J. 2005. Experimental analysis of the natural convection effects observed within the closed cavity of tile roofs. RCI Foundation conference, "Cool Roofs: Cutting through the glare." Atlanta GA. May 12-13.

Miller, W. 2006. The impact of above-sheathing ventilation on the thermal and moisture performance of steep-slope residential roofs and attics. Proceedings of the 15th Symposium on Improving Building Systems in Hot and Humid Climates. July 24-26, 2006.

Miller, W.A. 2006. The Effects of Infrared-Blocking Pigments and Deck Venting on Stone-Coated Metal Residential Roofs. ORNL/TM-2006/9. Oak Ridge, Tenn.: Oak Ridge National Laboratory.