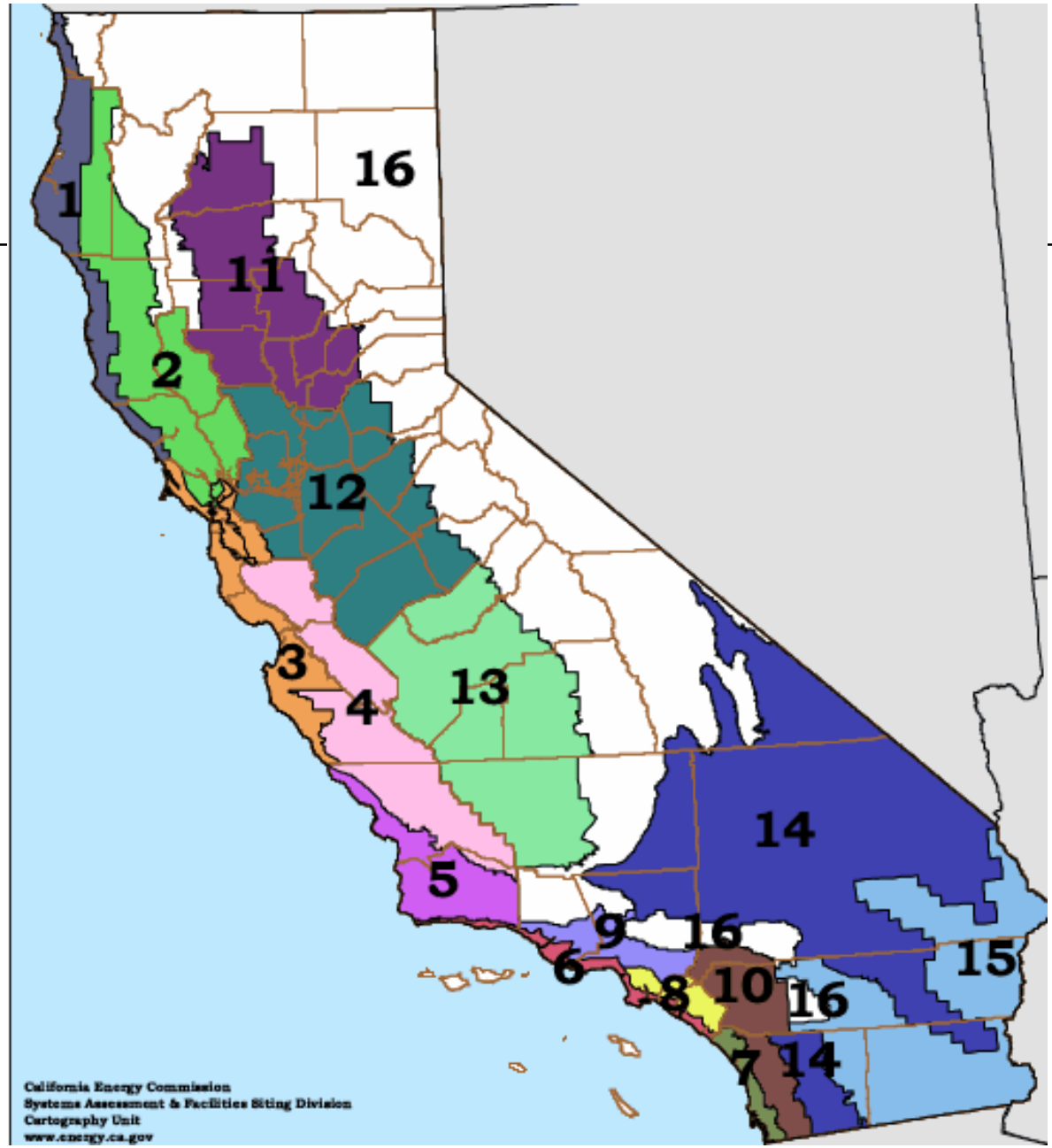
PIER Research for the 2008 Residential Building Standards & 2008 Standards Update

Residential Cool Roof Requirements

June 13, 2007

Bruce Wilcox

Zones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California Energy Commission
Systems Assessment & Facilities Siting Division
Cartography Unit
www.energy.ca.gov

Low Rise Residential Steep Slope New Construction Prescriptive Requirement

Climate Zones	Aged Reflectance/Emittance
11, 13, 15	0.25/0.75

Any roofing material that meets the minimum reflectance and emmittance or has an SRI of 25 meets the prescriptive standard,

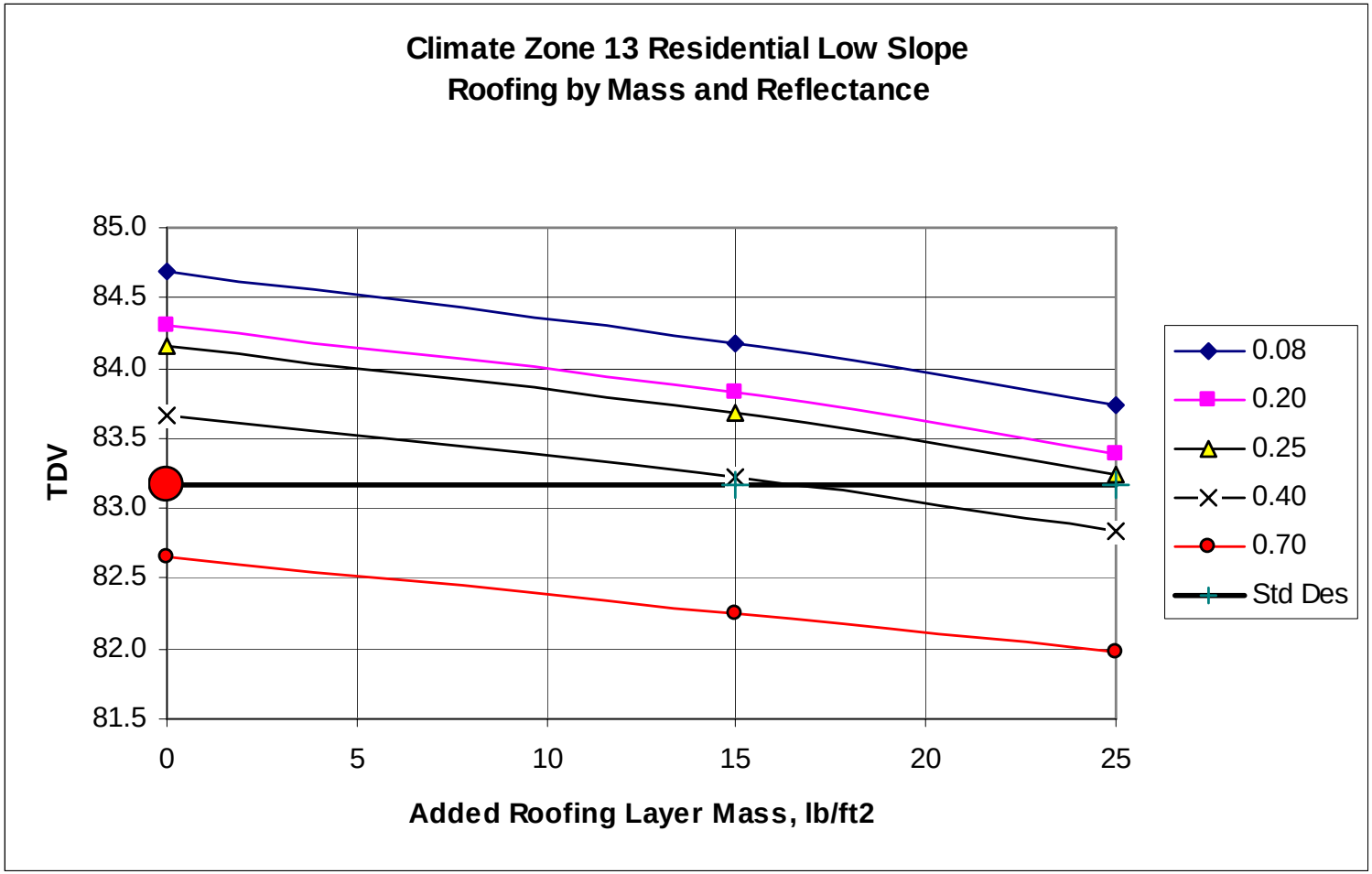
Steep Slope Alterations Prescriptive Requirement

Climate Zones	Aged Reflectance/Emittance	
10, 11, 12, 13, 14, 15	0.20/0.75 or SRI > 19	**Exceptions:** 1. Radiant barrier SRI > 19 2. No Ducts in Attic 3. R-30 Ceiling Insulation **Equivilencies:** 1. R-0.85 or greater above roof deck thermal resistance over a vented attic 2. Ducts sealed and tested to altered existing duct requirement 3. In CTZ 10, 12 and 13, 1/150 Attic ventilation with 30% of vent area high

Low Slope Prescriptive Requirement

	Climate Zones	Aged Reflectance/ Emittance	
New Construction	**13, 15**	**0.55/0.75**	
Alterations	**13, 15**	**0.55/0.75**	**Exceptions:** **1. No Ducts in Attic** **2. In Zone 10, 11, 13 and 14, R-3 or greater roof deck insulation above vented attic**

Low Slope Ballasted Roof



Steep Slope New Construction LCC

First cost premium of 0.25 aged reflectance shingle is $0.35/ft2

CTZ	0.25 Aged Reflectance Shingle Life Cycle Cost Savings, $/ft2 Roof
11	0.35
13	0.40
15	0.57

Based on TDV savings for 0.25 reflectance shingle compared to a 0.08 reflectance shingle in a prescriptive 1761 prototype.

Steep Slope Alterations LCC

First cost premium of 0.20 aged reflectance shingle is $0.31/ft2

CTZ	0.20 Aged Reflectance Life Cycle Cost Savings, $/ft2 Roof
10	1.45
11	1.45
12	1.16
13	1.64
14	1.46
15	2.18

Based on TDV savings for 0.20 reflectance shingle compared to a 0.08 reflectance shingle in a 1761 prototype with 1983 vintage features.

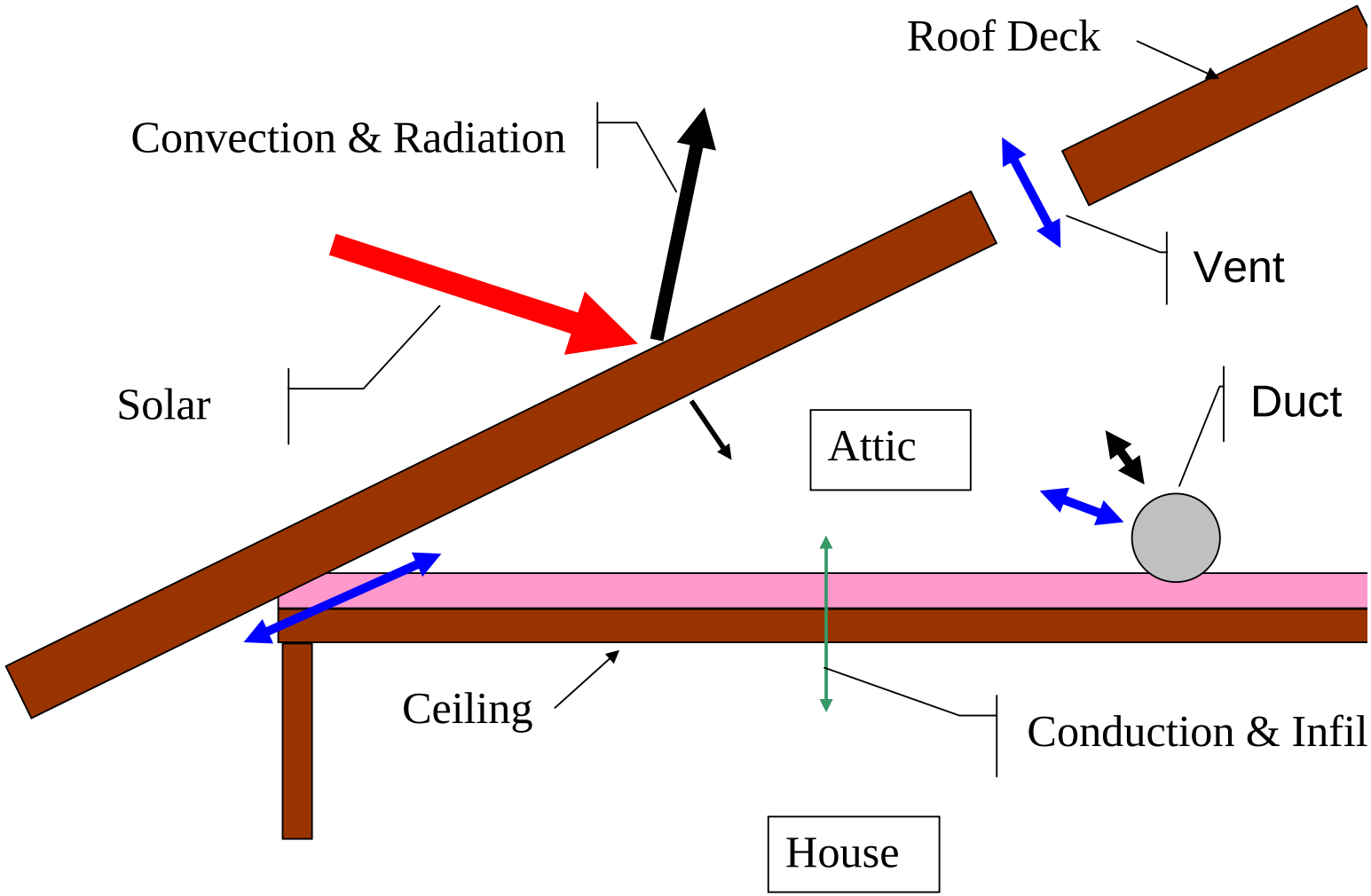
Low Slope New Construction LCC

First cost premium of 0.55 aged reflectance roof is $0.50/ft2

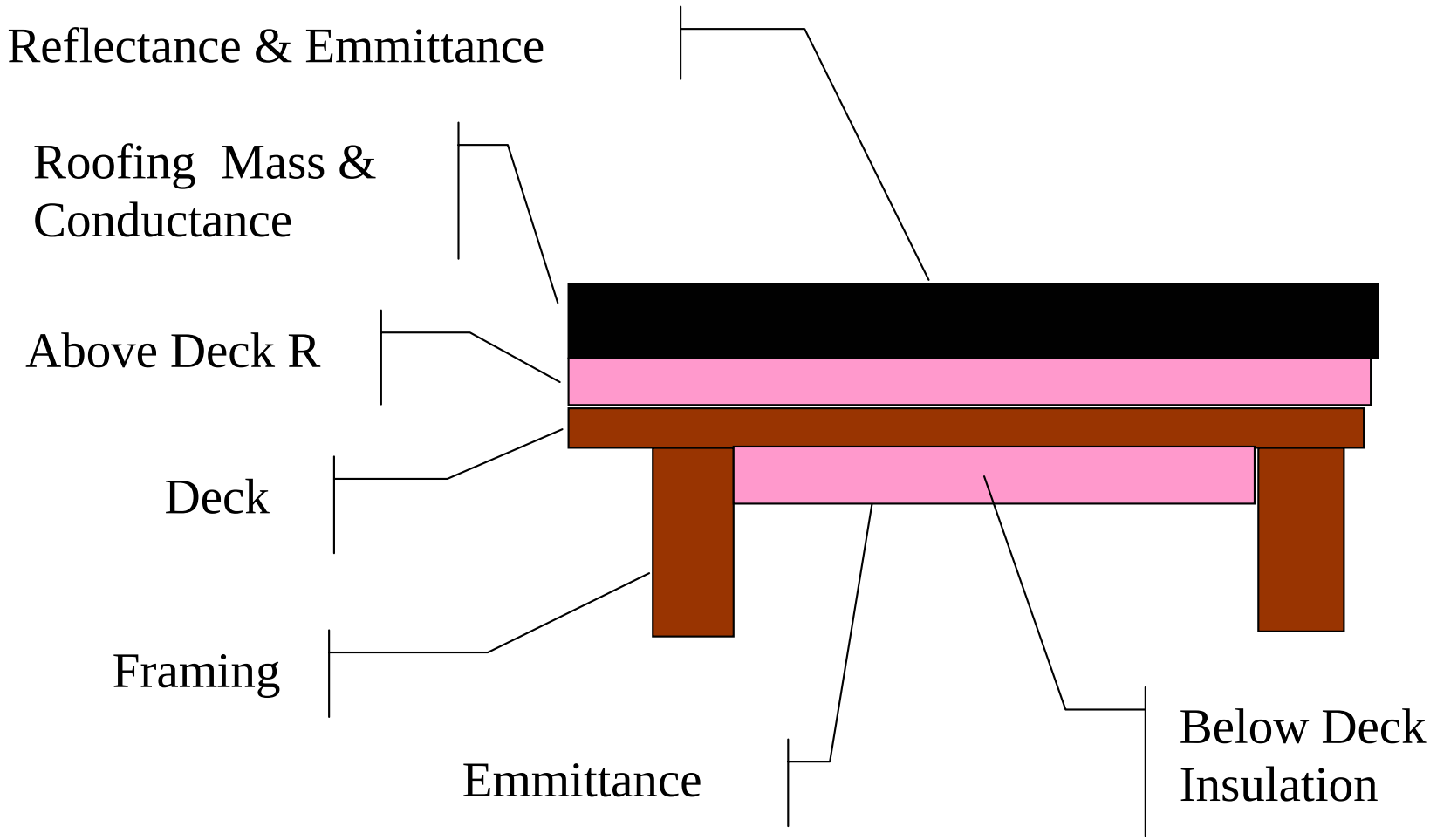
CTZ	0.55 Aged Reflectance Life Cycle Cost Savings, $/ft2 Roof
10	0.36
11	0.39
13	0.50
14	0.34
15	0.68

Based on TDV savings for 0.55 reflectance flat roof compared to a 0.10 reflectance in a prescriptive 1761 prototype.

Performance Path
UZM Attic Simulation Model



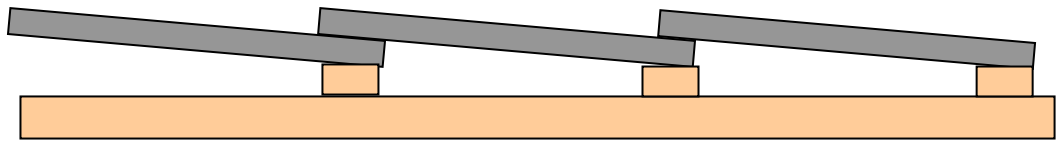
Roof Deck Components and Inputs



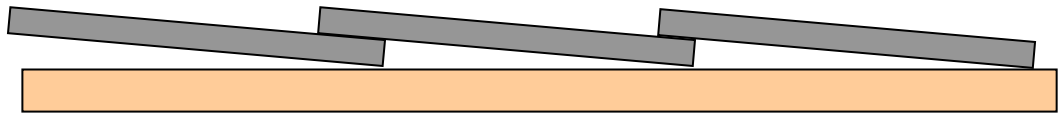
Changes in Tile Treatment

Shingle

Tile on Batten



Direct Nailed Tile



New Construction Steep Slope Performance Path Standard Design

Climate Zones	Roofing Weight	Aged Reflectance/ Emittance
11, 13, 15	Asphalt Shingles	0.25/0.90
All other Zones	If proposed is < 5 lb./ft2, asphalt shingles	0.08/0.90
	If proposed is 5 lb./ft2 or greater, direct nailed concrete tile	0.15/0.90

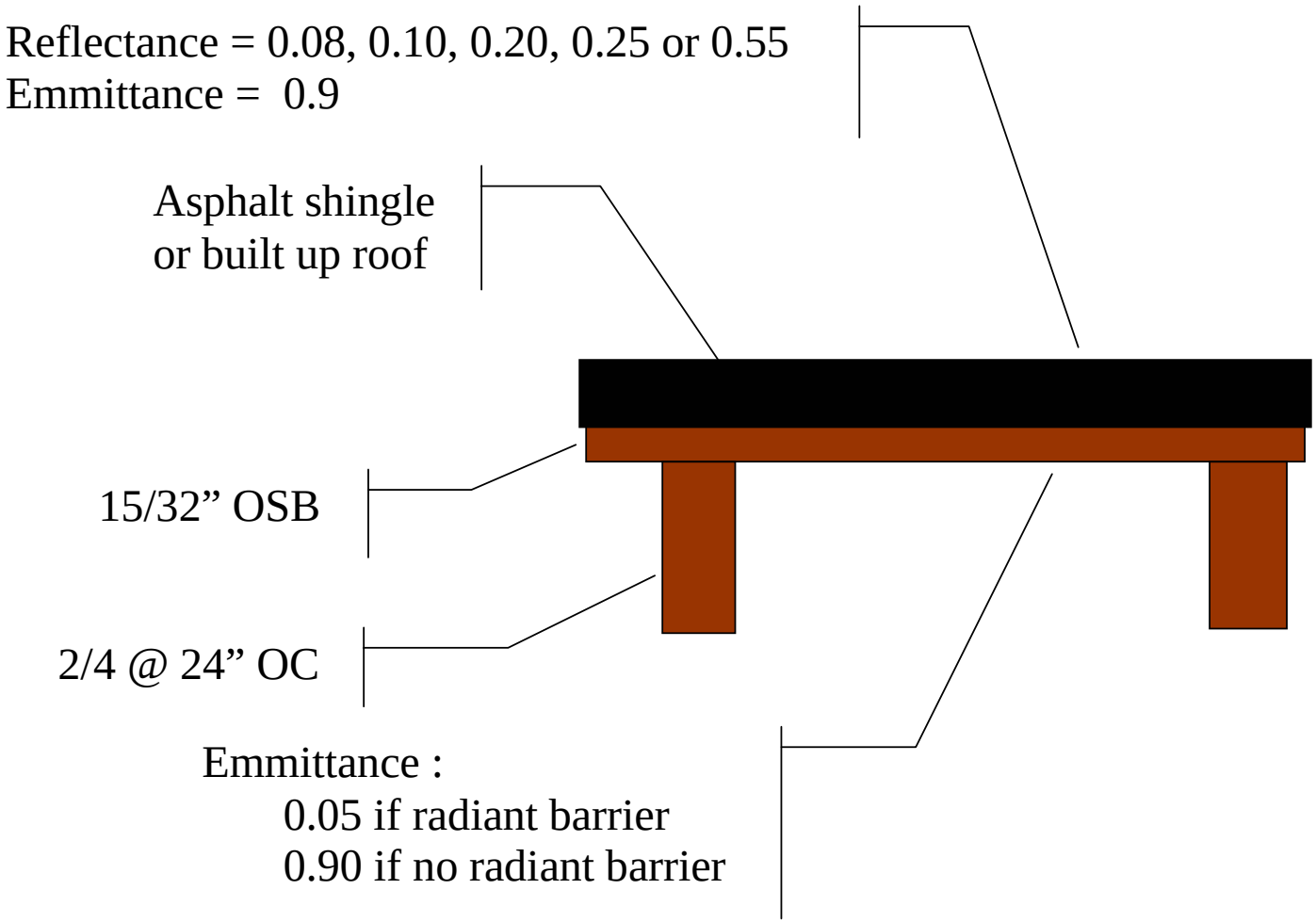
Alterations Steep Slope Performance Path Standard Design

Climate Zones	Roofing Weight	Aged Reflectance/ Emittance
10, 11, 12, 13, 14, 15	Asphalt Shingles	0.20/0.90
All other Zones	If proposed is < 5 lb./ft2, asphalt shingles	0.08/0.90
	If proposed is 5 lb./ft2 or greater, direct nailed concrete tile	0.15/0.90

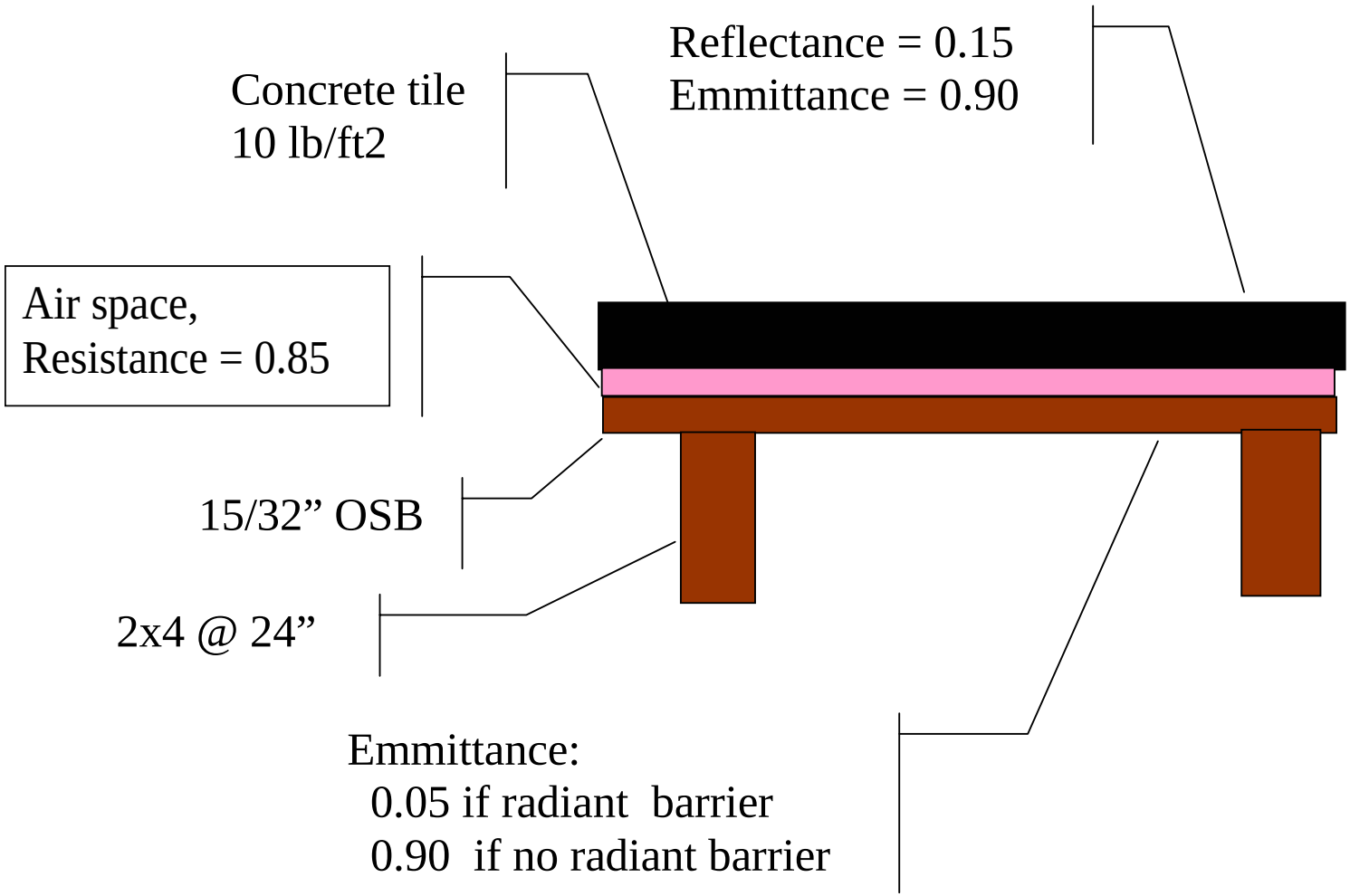
Low Slope
Performance Path Standard Design

Climate Zones	Roofing Weight	Aged Reflectance/ Emittance
13, 15	Built up roof	0.55/0.90
All other Zones	Built up roof	0.10/0.90

Light Weight Standard Design Roof

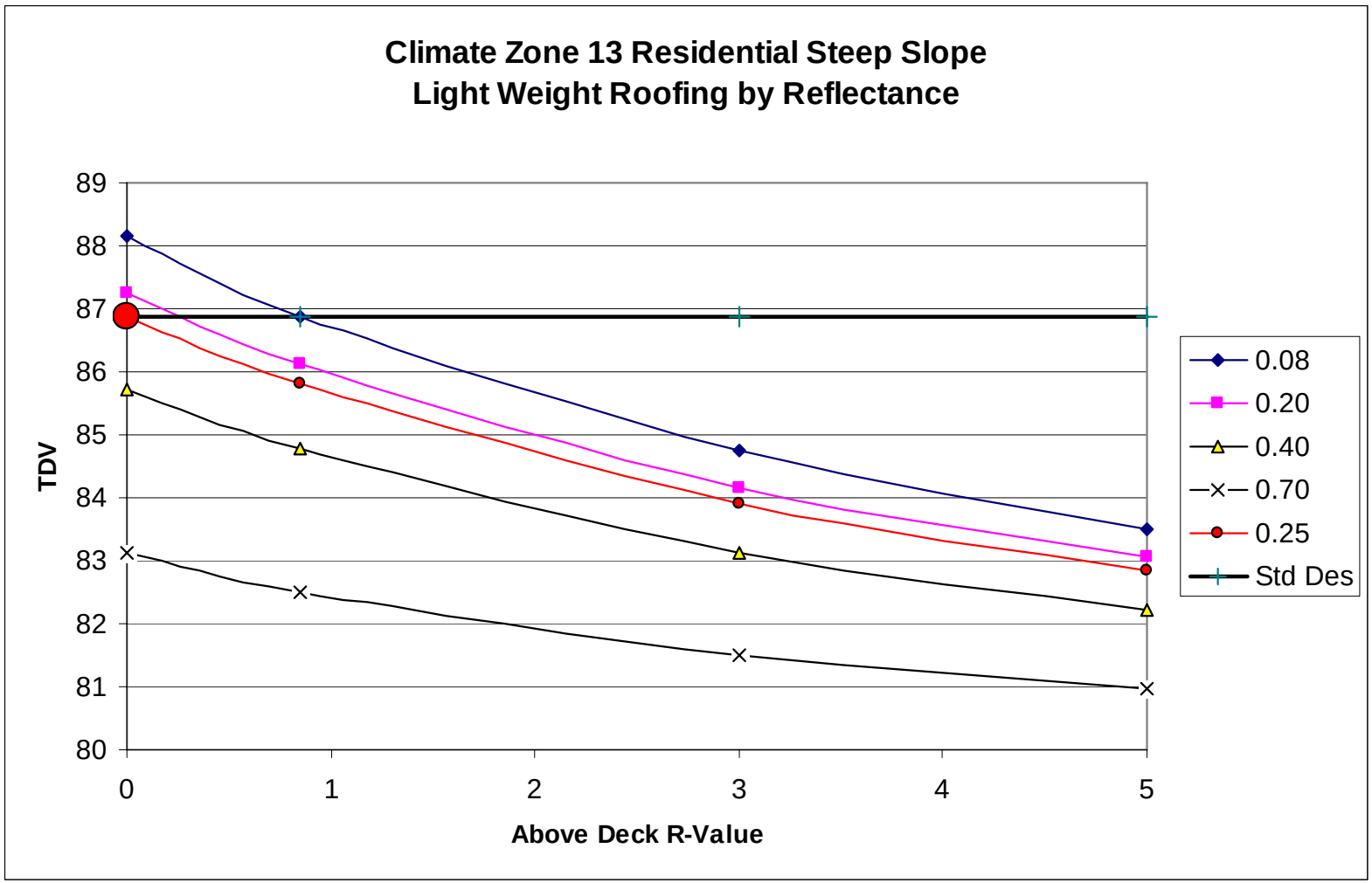


Tile Standard Design Roof

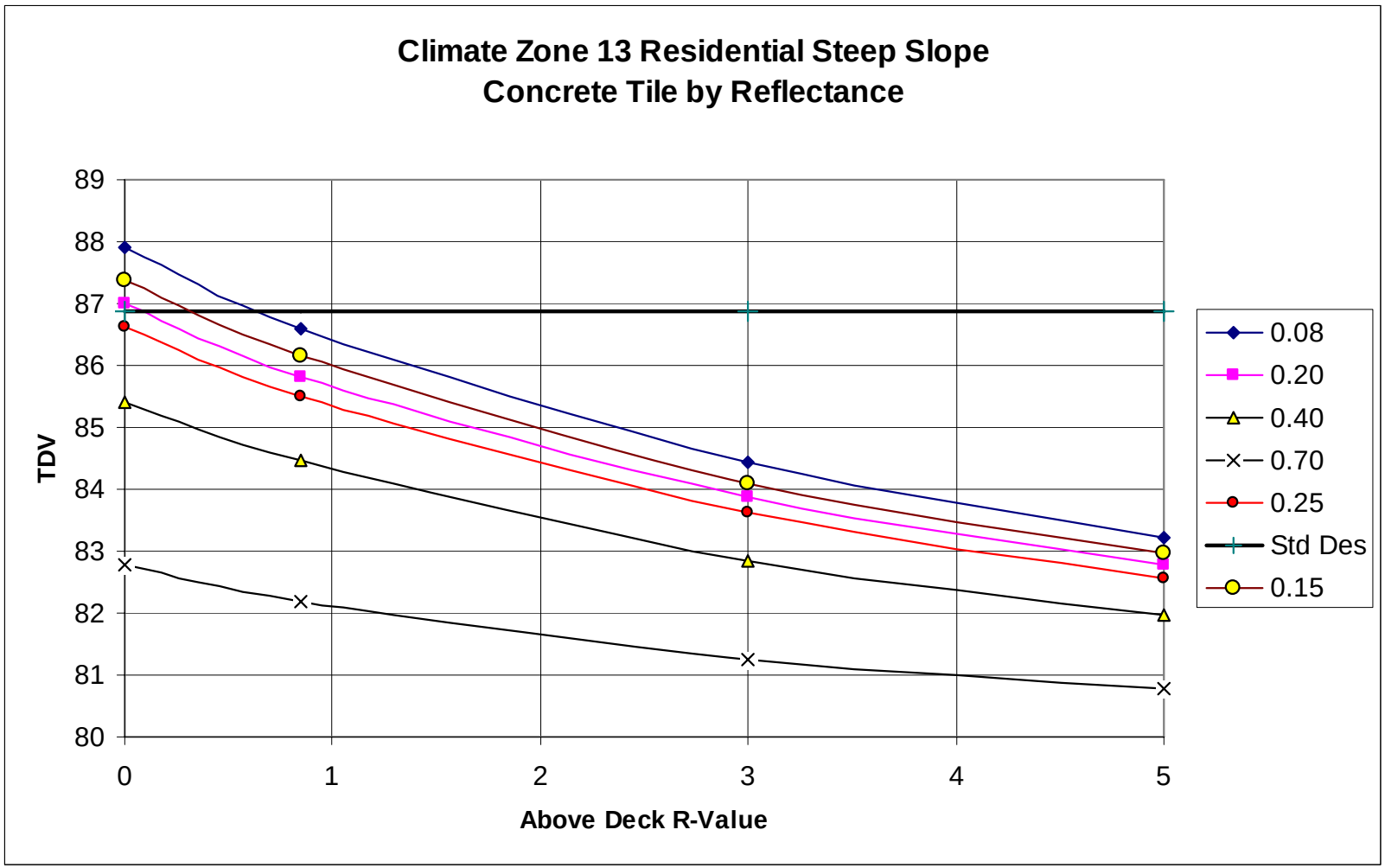


Production Builder House
Tile Roof Reflectance = 0.18

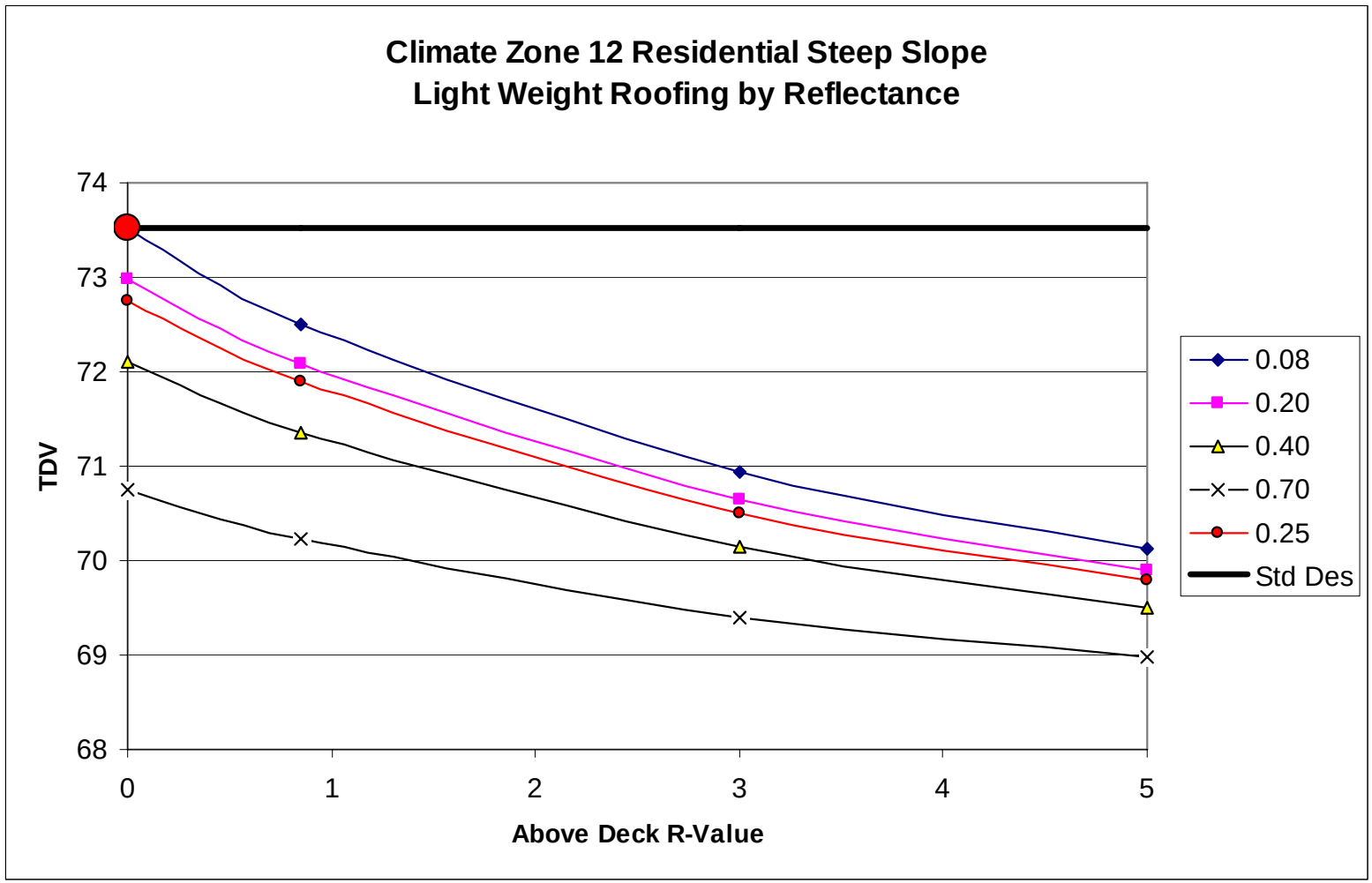
Low Rise Residential Steep Slope New Construction Example Parametric



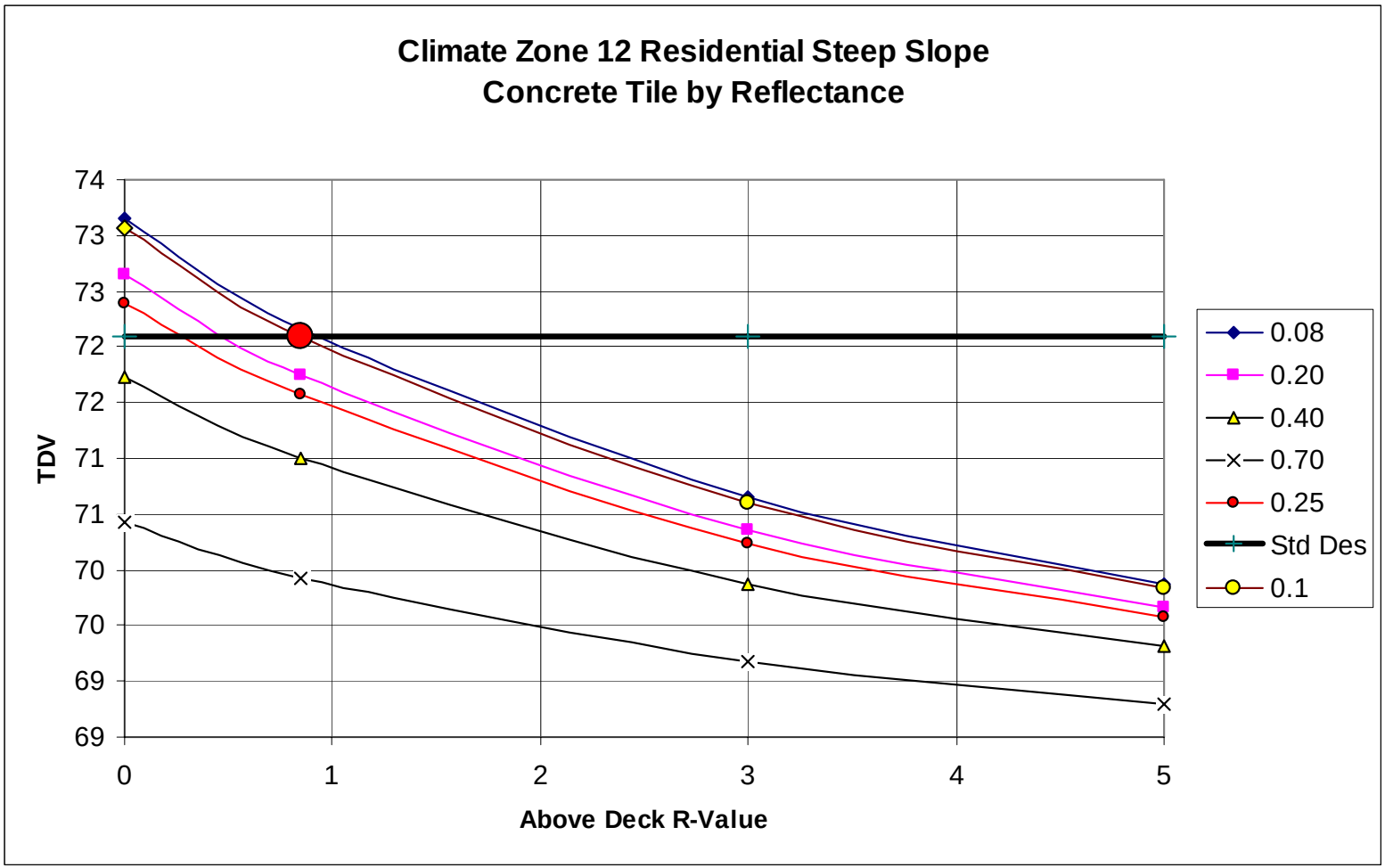
Low Rise Residential Steep Slope New Construction Example Parametric



Low Rise Residential Steep Slope New Construction Example Parametric



Low Rise Residential Steep Slope New Construction Example Parametric



Current Envelope Input Structure for Roofs and Attics

- Just the U-factor
  - U-factors are looked up in Joint Appendix Tables
  - U-factors are for the combined ceiling, attic, and roof
  - Reflectance and Emmittance are not factors
  - Interactive effects are not calculated, particularly for attic ducts

New Envelope Input Structure for Roofs and Attics

- Each surface dynamically modeled
  - Layer by layer thermal properties
  - Roof Deck
  - Ceiling
  - Attic structural mass
- Air flows
  - Between house and attic
  - Attic ventilation

Attic Envelope Input Structure Layer Libraries

Roofing Mass Choices		Library values		
Name	Description	d3	k3	vc3
5 PSF mass	Normal gravel	0.75	1	24
10 PSF mass	Concrete Tile	1	1	24
15 PSF mass	Heavy Ballast or Pavers	tbd	tbd	tbd
25 PSF mass	Very Heavy Ballast or Pavers	tbd	tbd	tbd
Light Roof	All other roofing	0.2	1	24

- User selects layers from the library in the software
- Software assembles the complete model

Attic Envelope Input Structure Layer Libraries

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Light Roof	All other roofing	0.2	1	24

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Duct System Input Structure

- Ducts are simulated as part of the attic energy balance
- Duct system inputs don't change much (more on Friday)