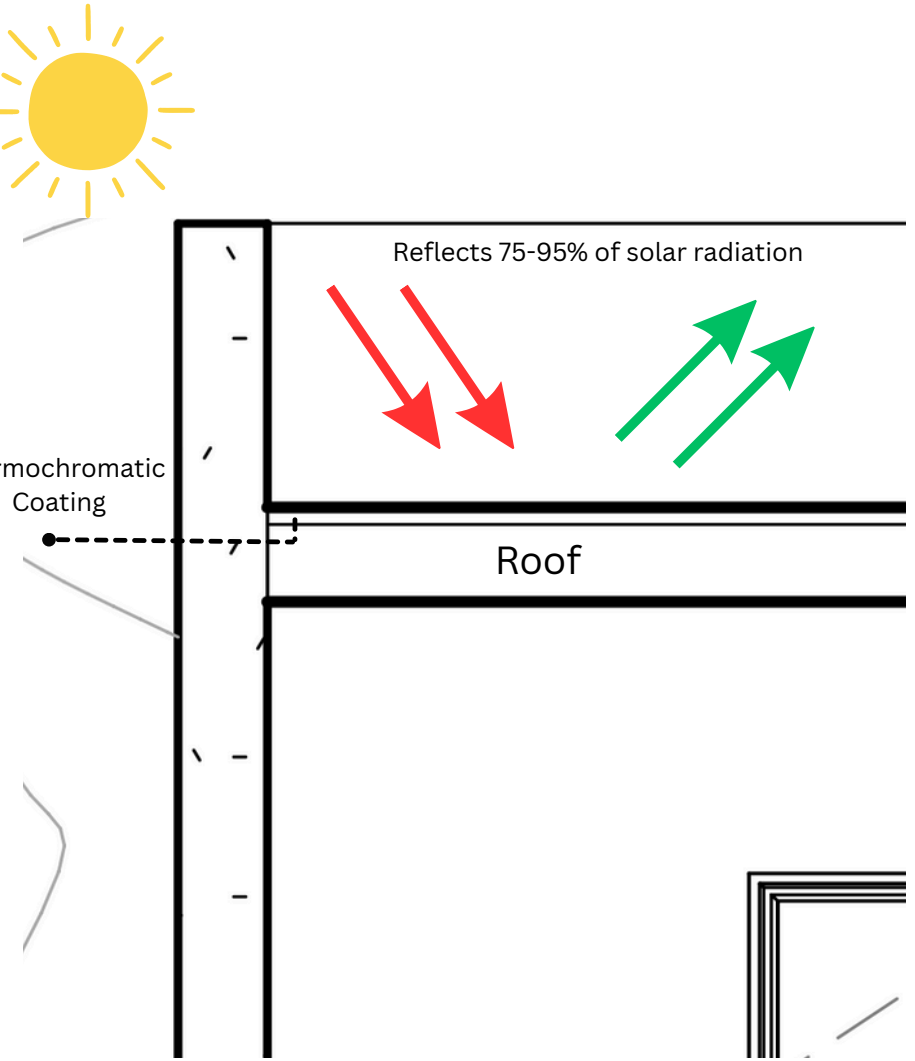
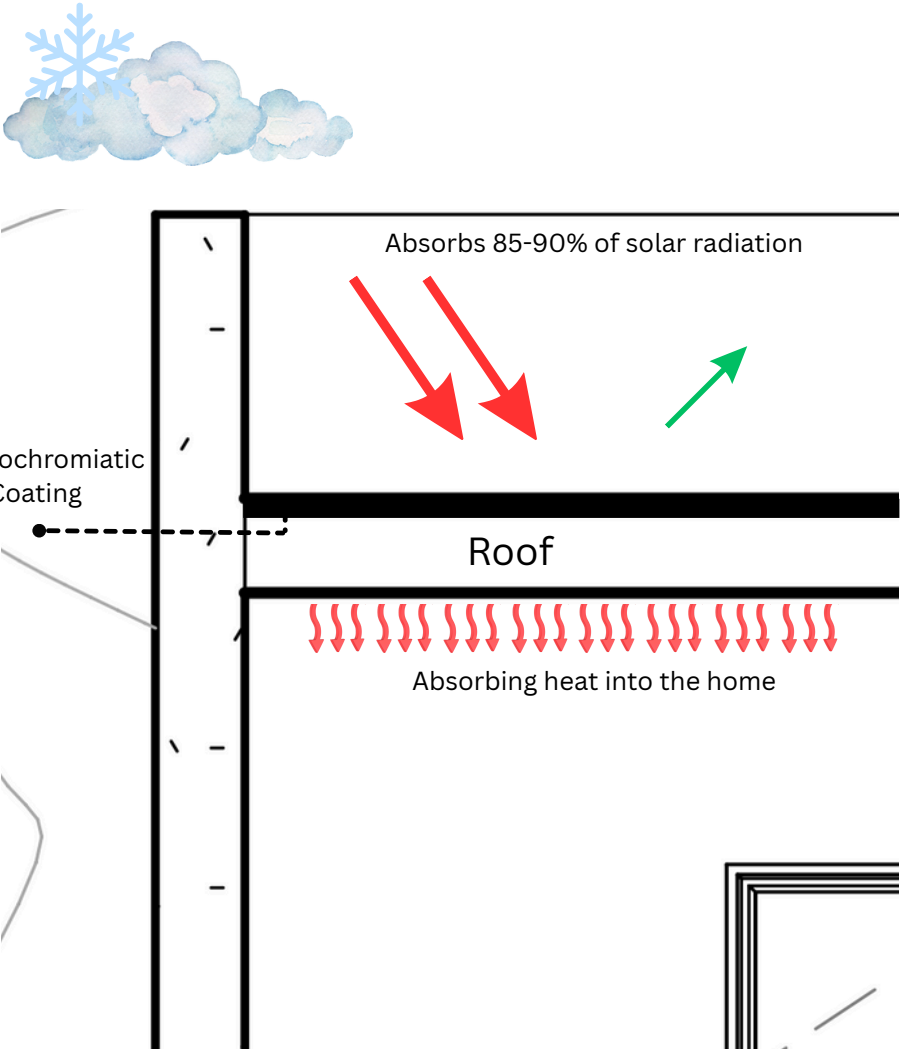


Thermochromic Coating turns white/yellow in hot weather



Thermochromic Coating turns black in cold/chill weather

Calculations

Estimations

1) Roof Size: 100m² roof
2) Peak Sunlight hours per day: 5 hours
3) Solar Absorptance and Reflectance:

- Black Surface: Absorbs 85-90% of solar radiation
- White/Yellow Surface: Reflects 75-95% of solar radiation

4) Dubai's Solar Intensity:

- Peak Solar Radiation: 900-1000 W/m²
- Annual Average Solar Radiation: 2200 kWh/m²/year

Hence,

Total Solar Power:

100m² x 1000 W/m² = 100,000 W or 100kW

Without thermochromic roof (black surface)

85% Absorptance

Heat Absorbed = Total Solar Power x Absorptance

100 kW x 0.85

= 85 kW of heat absorbed per hour at peak

Cooling Load

Total heat gain per day:

85kW x 5 hours/day = 425 kWh/day

Assuming 300 days of sunlight in Dubai:

425kW/day x 300 days = 127,000 kWh/year

Air Conditioning Efficiency

In Dubai, AC units typically have an Energy Efficiency Ratio (EER) of 3 to 4 (every 1 kW of electricity used, the AC removes 3-4kW of heat).

So, to remove 127,500 kWh of heat, the AC would consume:

127,000 / 3.5 = 36,459 kWh / year

Cost Calculation

Dubai's electricity rate: 0.30 to 0.50 AED per kWh (based on DEWA rates).

Estimated annual electricity cost for cooling the black roof's heat gain taking the average of 0.4 AED:

36,459 x 0.4 = **14,583.60 AED per year**

With a thermochromic roof

25% Absorptance

Heat Absorbed = Total Solar Power x Absorptance

100 kW x 0.25

= 25 kW of heat absorbed per hour at peak

Cooling Load

Total heat gain per day:

25kW x 5 hours/day = 125 kWh/day

Assuming 300 days of sunlight in Dubai:

425kW/day x 300 days = 37,500 kWh/year

Air Conditioning Efficiency

In Dubai, AC units typically have an Energy Efficiency Ratio (EER) of 3 to 4 (every 1 kW of electricity used, the AC removes 3-4kW of heat).

So, to remove 37,500 kWh of heat, the AC would consume:

37,500 / 3.5 = 10,714.29 kWh / year

Cost Calculation

Dubai's electricity rate: 0.30 to 0.50 AED per kWh (based on DEWA rates).

Estimated annual electricity cost for cooling the black roof's heat gain taking the average of 0.4 AED:

10,714.29 x 0.4 = **4,285.60 AED per year**

Conclusion:

A thermochromic roof offers a highly effective solution for reducing heat absorption, lowering cooling energy consumption, and significantly cutting electricity costs. With an annual savings of 10,298 AED (70.6% reduction in cooling expenses), this technology proves to be both energy-efficient and cost-effective. Given Dubai's intense heat, integrating thermochromic roofing can enhance sustainability, improve indoor comfort, and contribute to long-term financial savings, making it an ideal choice for modern buildings in hot climates.