

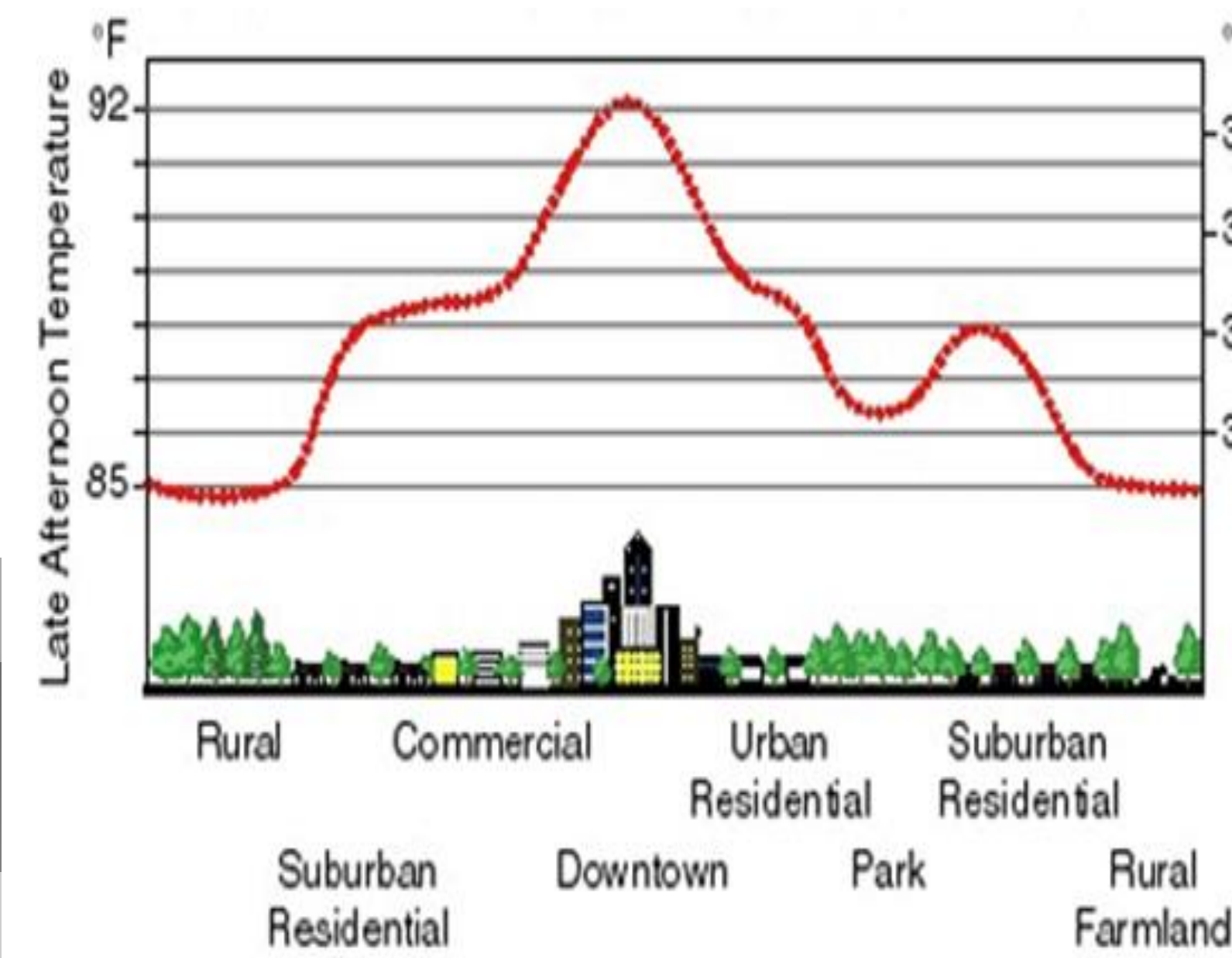
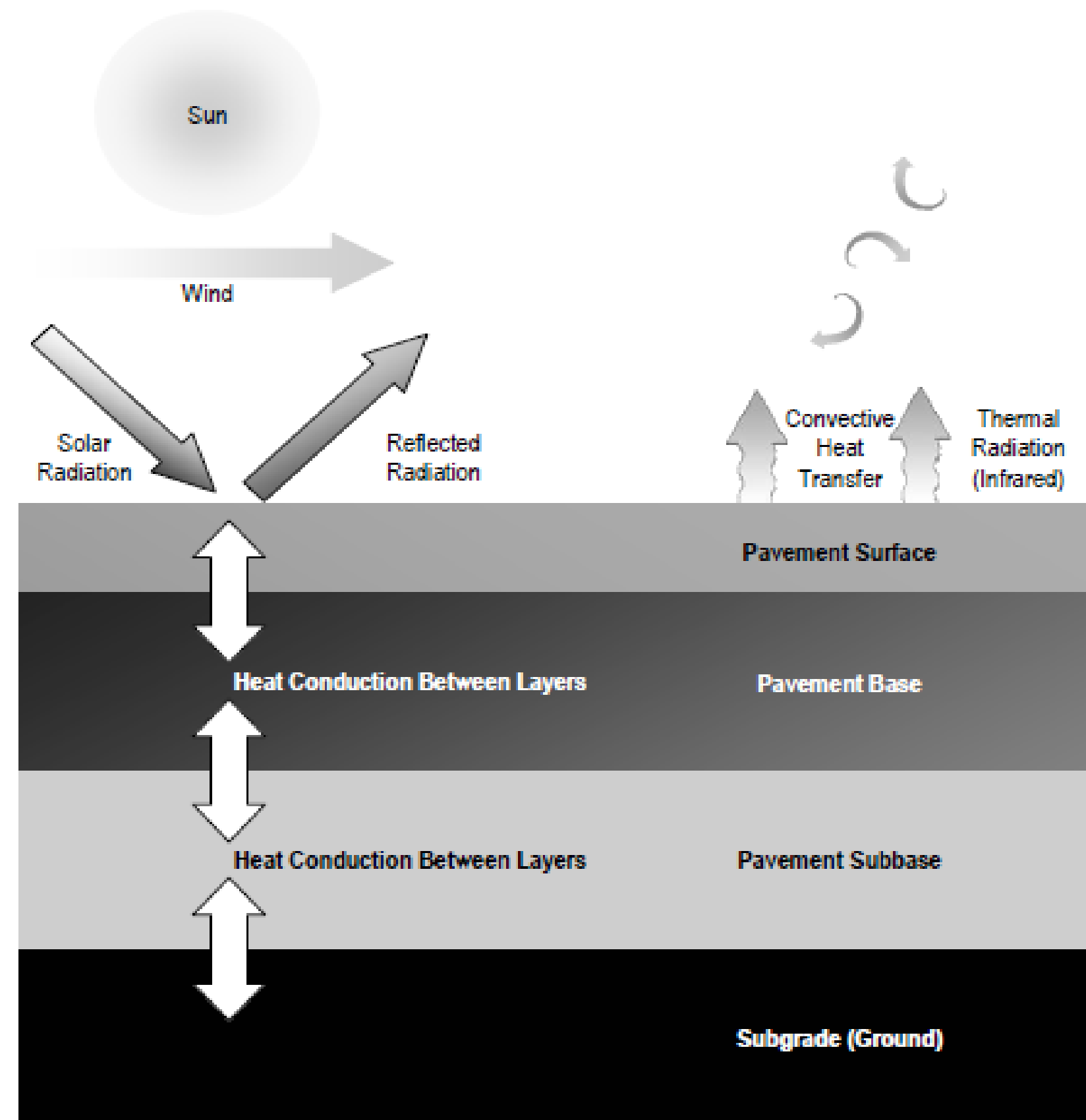
Reducing Urban Heat Island Effect by Using Light Colour Asphalt Pavement

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Urban Heat Island Effect

Specific causes for heightened temperatures and increased smog and pollution in urban areas include:

- Urban building materials absorb (as oppose to reflect) greater proportions of solar radiation
- Impermeability of urban features limit the cooling effects of circulating water
- Convective heat transfer is reduced in urban areas due to large density of buildings
- Anthropogenic heat (i.e., heat produced by humans) is greater in urban areas with increased population density



Phenomenon of increased air and surface temperature in urban areas

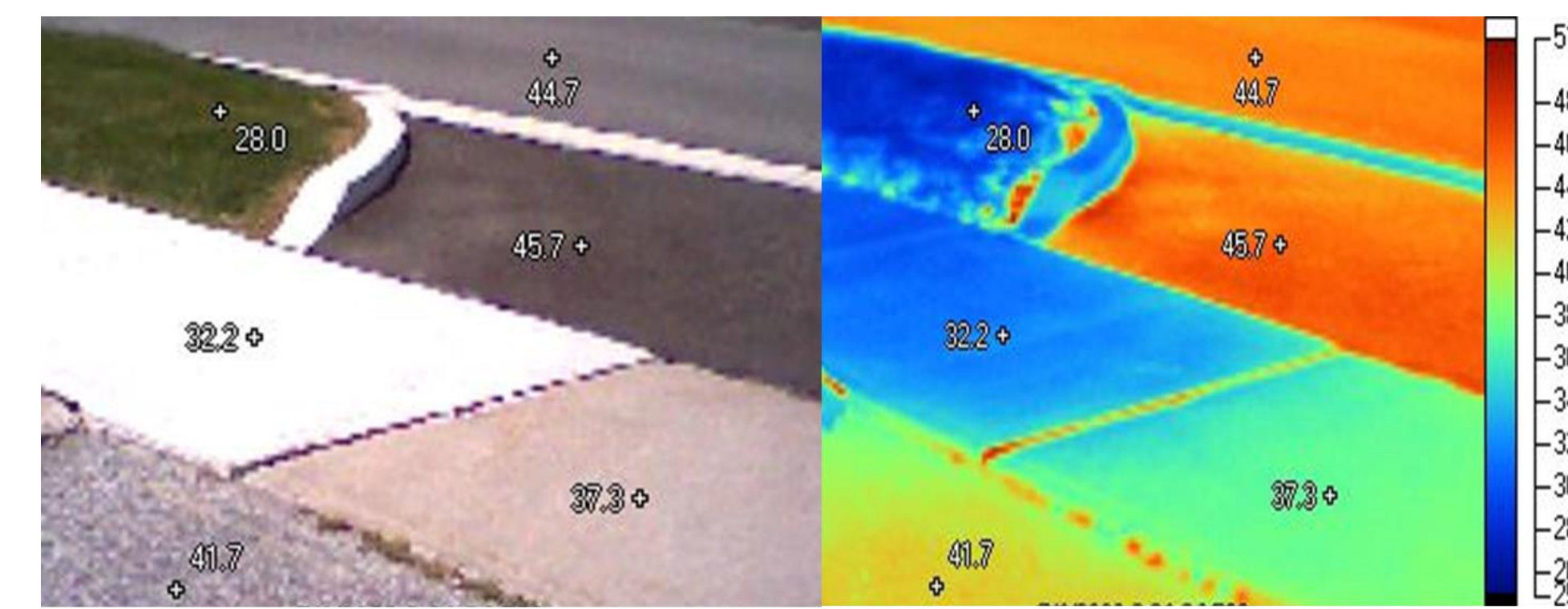
Cool Pavements

The amazing facts about Shibuya Crossing, Tokyo

- Busiest Pedestrian Crossing in the World
- Up to 3,000 people use the crossing per green cycle
- 5 jumbo screens can be seen from the crossing
- The busiest Starbucks in Japan is next to the crossing
- Hachiko Statue (Japan's most famous dog) is next to the crossing
- **Cool asphalt pavement!**



Thermal image of five adjacent surfaces at Golder's office



Light Colour Asphalt Pavement

Light Colour Asphalt Pavement (LCAP) is a process of designing and constructing asphalt pavements that meet the Leadership in Energy and Environmental Design (LEED) Solar Reflective Index (SRI) requirement that at a minimum 50% of the hardscape be constructed using materials having an SRI value of 29 or higher.

- LEED Credit 7.1 entitled "Heat Island Effect: Non Roof".
- The purpose of the development of LCAP is to provide developers looking to achieve LEED certification with a paving alternative that provides performance that is equivalent to conventional asphalt pavement, but that will also meet the requirement of LEED Credit 7.1.
- LCAP process includes aggregate selection, asphalt mix modification, placement of asphalt mix, stripping of surface asphalt film from new pavement, and evaluation of reflectivity of aggregates, mixes, and in-place pavements.

Three LCAP requirements:

- LCAP should meet the LEED requirement of SRI to be at least 29 at an additional cost of the surface asphalt lift that is acceptable to the user
- Meet conventional asphalt mix acceptance criteria for either Marshall or Superpave mixes
- There shall be no adverse impact on pavement performance

The primary advantages of LCAP technology:

- Decreased heat high island effect in urban areas
- Meeting the green standards being implemented by some cities, with a product that is cost comparable to the conventional product, and which provides equivalent performance
- Improved long term durability and resistance to cracking due to decreased rate of oxidation
- Energy savings due to decreased requirements for lighting (streets, parking lots, tunnels) and building cooling
- Enhanced frictional characteristics and microtexture
- Protection of the permafrost in the northern climates

Initial Investigation

- Aggregate and mix SRI analysis – ASTM C1549-09 and E1980-01 – reflectance and emissivity
- Very light colour aggregate from Coco's Badgley Island Quarry identified as suitable for LCAP
- Mix design analysis
- Selecting the optimum mix
- Preparation of Test Slabs 1 and 2
- Reflectance field measurement – ASTM E1918-06
- SRI Calculation – ASTM E1980-01



Test Slab 2 – SRI 30

Summary

- Urban heat island effect is observed in numerous cities
- Dark coloured pavements cause temperature increase
- Light colour asphalt pavement technology developed, SRI > 29
- Practical implementation using Coco's Badgley Island Quarry aggregates
- Benefits include reduced temperature, improved durability and energy saving for lighting and building cooling

Literature Review

Lisa Gartland "Heat Islands – Understanding and Mitigating Heat in Urban Areas"

Tran N, NCAT "Strategies for Design and Construction of High-Reflectance Asphalt Pavement" – coatings, painting, gritting, blasting

City of Toronto "Toronto Green Standard" – incentives, 20% refund of development charge if min 75% of high albedo pavement

MTO GreenPave rating system – 2 points for cool pavement