ASCP
AUSTRALIAN SOCIETY FOR CONCRETE PAVEMENTS

PAVEMENT NOTE
NO.002 | JULY 2020

# SUSTAINABLE CONCRETE PAVEMENTS

## REDUCED ENVIRONMENTAL IMPACT OF CONCRETE PAVEMENTS

### CONCRETE PAVEMENTS

- Utilise recycled materials
- Reduced eco footprint
- Low noise
- Save fuel
- Save energy
- Resilient
- Lower heat island
- Absorb carbon
- Fully recyclable

### KEY FINDINGS

- Concrete pavements are 12% and 30% lower in environmental impact at 40 and 70 years
- Concrete pavement rolling resistance reduces fuel consumption by 3% to 17%
- Concrete pavements are 100% recyclable

### KEY OUTCOMES

Concrete pavements typically utilise 20% or more recycled materials, demonstrate lower environmental impact, exhibit low noise, reduce fuel use (and $CO_2$), reduce lighting costs, reduce heat islands, absorb half of the $CO_2$ generated in cement production, and increase corridor resilience.

### CONCRETE PAVEMENT AND ITS REDUCED ENVIRONMENTAL IMPACT

Concrete road pavements reduce environmental impact when compared with asphalt pavements. This Pavement Note summarises the latest findings which compare sustainability aspects of key heavy-duty pavement options. It provides agencies and decision makers with information to assist in meeting sustainability targets.

### USE OF RECYCLED MATERIALS

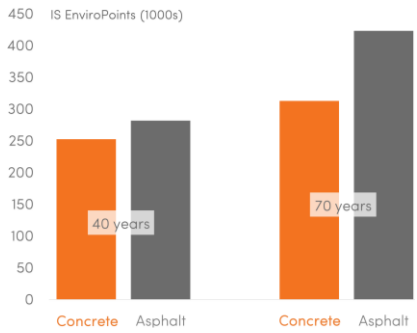
Aside from cement, concrete pavements typically comprise 20% [8 10] or more recycled content, frequently replacing manufactured or virgin materials [14 16 17 18] with:

- Recycled concrete aggregate
- Steel/iron slag aggregates
- Coal combustion products (ash)
- Amorphous silica
- Slag (GGBFS)
- Glass (crushed and ground)
- Recycled water
- Lignin by-products

### LOWER ENVIRONMENTAL FOOTPRINT

Whilst it is true that $CO_2$ emissions from cement production are higher than other binders used in construction materials, a more objective assessment of environmental impact considers the broader environmental implications of energy use (eg, global warming, photochemical smog, acidification, eutrophication and resource depletion).

A comparison of concrete and asphalt pavements at design and extended periods of service showed that concrete pavements are 12% and 30% lower impact at 40 years and 70 years respectively [3].




ENVIRONMENTAL IMPACT 40 AND 70 YEARS

### LOWER HEAT ISLAND

Albedo is the measure of solar energy reflected by a surface [21]. The lighter colour of concrete pavements (compared with asphalt) absorbs less heat energy, lowering the 'heat island' impact in urban areas [9 13 21 24]. This reduced Albedo Effect minimises summer afternoon temperatures in some cities by an average of 2.8 °C [11 27].

### $CO_2$ ABSORPTION

Approximately 43% of the $CO_2$ released in the manufacture of cement since 1930 has subsequently been absorbed by the concrete it produced [15] in that period.

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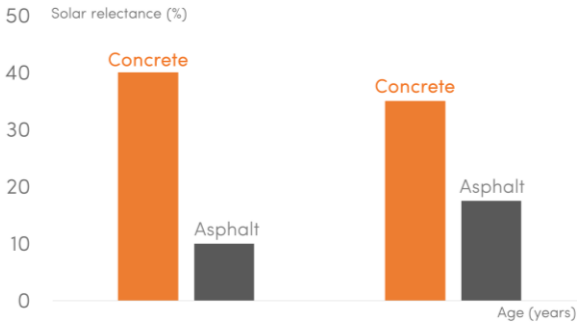
## THE REDUCED ENVIRONMENTAL IMPACT OF CONCRETE PAVEMENTS

### ENERGY SAVING

The light colour of concrete pavement surfaces better reflects lighting which improves visibility for road users [24]. A concrete surface is 1.8 times more luminous than an asphalt surface and with a more uniform distribution [9 19]. Improved light reflectance of a concrete pavement in tunnels typically reduces lighting energy demands by 30% [5 20].




SOLAR REFLECTANCE COMPARED (0 & 5 YEARS)

### RESILIENCE

If subject to extreme climatic events , concrete roads are much less susceptible to breakdown arising from internal pore-pressures (during flooding) and deformation (during extreme heat) due to their superior strength and durability. Improved resilience leads to improved availability during extreme weather events [4 24].

### FUEL SAVINGS

Increased rigidity decreases rolling resistance and reduces fuel consumption by 3% to 17%. In the USA for example, potential annual fuel savings could be 670 million litres, leading to an annual $CO_2$ reduction of 620 000 tonnes [1 2 24 27].

### LOW NOISE

Concrete roads can be textured to meet stringent noise requirements using treatments such as longitudinal tining, exposed aggregate, diamond grinding and grooving [7 9] which reduce the acoustic impact on community and fauna. Concrete pavements can match asphalt surfacing noise performance at low and high speed [25]. Refer also to ASCP Pavement Note 003.


NOISE PERFORMANCE COMPARED (RELATIVE dBA)

### 100% RECYCLING

Whilst concrete pavements can frequently be reused as the foundation for future pavements, in situations in which they are demolished they can be fully and beneficially repurposed in several ways [4 6 26] such as recycled concrete aggregate, granular subbase in flexible pavements, rubblised to form bases, manufactured sand and selected (or verge) material blends. Concrete recycling contributes to a circular economy by the reduction of natural aggregate usage and haulage, the elimination of excavation, landfill reduction and conservation of land [12].

## CONCLUSIONS

Concrete pavements typically comprise 20% or more recycled materials, demonstrate a lower environmental impact over long lives, exhibit low noise, reduce fuel consumption (and $CO_2$), reduce lighting costs, reduce heat island impacts, absorb half of the $CO_2$ generated in cement production, and increase corridor resilience during extreme weather events.

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+ Complete list of references

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