

Urban Albedo: Digital tools for urban
resilience and growth



Environmental and resilience benefits of high Albedo Concrete

Guy Thompson

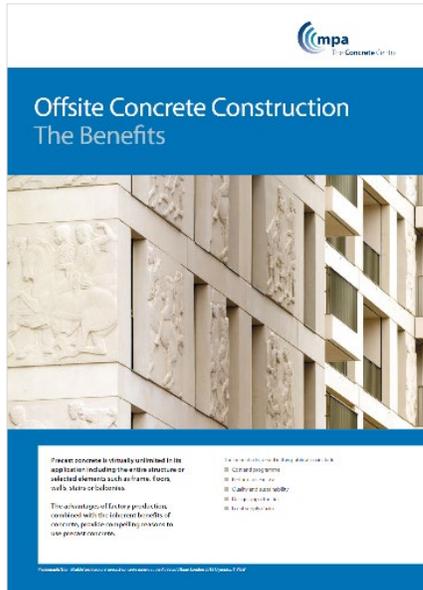
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The Concrete Centre

Who are we?



The Concrete Centre:



- Free resource for specifiers
- Concrete Quarterly
- Publications: general and technical
- Practice workshops
- Seminars and conferences
- Training courses
- Webinars
- Concrete Elegance Lectures

www.concretecentre.com
www.sustainableconcrete.org.uk

Varied resilience guidance literature

Thermal Performance: Part L1A 2013

EXTRACT FROM: RESILIENT HOUSING

Overheating

Overheating is a relatively new issue for UK housing, but is already thought to affect up to 20% of the housing stock in England, and is expected to increase in the future.

Recent years have seen an increase in the number of overheating incidents in new homes, which has led to a number of deaths and hospital admissions. The issue has also been highlighted in the media, with the BBC's 'Newsnight' programme in 2014 asking 'Are we building homes that are too hot to live in?' and the BBC's 'Newsnight' programme in 2015 asking 'Are we building homes that are too hot to live in?'.

Overheating is a significant issue for new housing, as it can lead to increased energy costs, reduced comfort, and health problems. It is also a significant issue for existing housing, as it can lead to increased energy costs, reduced comfort, and health problems.

Overheating is caused by a number of factors, including poor insulation, high levels of solar radiation, and high levels of internal heat gain. It is a complex issue that requires a multi-faceted approach to address.

Summary of design strategies

- **Passive** - As far as possible, step back from entering through external shading, heavily glazed windows, thermal gains from appliances and services should also be minimised where possible.
- **Reduce** - Get heat out of a building using ventilation which has a high capacity to absorb heat. High level ventilation is possible by efficient and design systems should be specified to ensure this can be achieved in a cost-effective manner.
- **Mass** - Use the thermal mass provided in concrete and masonry buildings to absorb heat during the day and then release it at night using night time ventilation. Designing can help this to be achieved by using a range of strategies.
- **Design** - Take advantage of the opportunity to reduce internal heat gain by using a range of strategies.
- **External** - Ensure the occupants understand the best design and use of the building to reduce overheating. This includes the use of shading devices and how to ventilate the building.

ADULTS, CARLTON COLLEGE, CAMBRIDGE

Adults is a new residential wing for students at Carlton College, Cambridge. The design team was challenged to create a building that was energy efficient, sustainable and provided a high quality of life for its residents. The building was designed to be a model of sustainable design, with a focus on passive design and energy efficiency.

The building features a range of passive design strategies, including high levels of insulation, high levels of solar radiation, and high levels of internal heat gain. It also features a range of active design strategies, including solar panels, wind turbines, and rainwater harvesting.

The building is a model of sustainable design, with a focus on passive design and energy efficiency. It is a testament to the power of concrete and masonry in creating resilient buildings.

Architect: Alan and Alan
Structural Engineer: Alan and Alan
Construction Manager: Alan and Alan

Thermal Mass Explained

Concrete floor solutions for passive and active cooling



Design options for low energy buildings

Specifying Sustainable Concrete

Whole-Life Carbon and Buildings



Concrete solutions for reducing embodied and operational CO₂

Zero Carbon Performance - Cost-Effective Concrete and Masonry Homes

This document outlines the results of a collaborative design initiative tasked with producing a practical, cost-effective specification for maximum zero carbon homes.

Introduction

The UK's zero carbon homes are the first generation of homes to be built to the zero carbon standard. They are a significant milestone in the UK's journey towards net zero carbon emissions by 2050. The challenge is to produce a practical, cost-effective specification for maximum zero carbon homes.

The document outlines the results of a collaborative design initiative tasked with producing a practical, cost-effective specification for maximum zero carbon homes.

The A2/2020/2020 Review

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How to achieve good levels of airtightness in masonry homes

Dr David Johnston & Dominic Miles-Shenton

Introduction

In the UK, as in most industrialised countries, the domestic sector contributes substantially to national energy use and CO₂ emissions. Currently, there are over 21 million dwellings in the UK, accounting for just under 50% of the UK's total CO₂ emissions. This is a substantial figure given that the UK housing stock is composed of long physical lifetimes and low stock turnover. Therefore, if we are to mitigate climate change and achieve the Government's target of an 80% reduction in national CO₂ emissions by 2050 (based on 1990 levels), then significant reductions in the carbon emissions from dwellings both new and existing will be required.

Airtightness and air leakage

Air leakage

Air leakage is the uncontrolled exchange of air both into (infiltration) and out of (exfiltration) a building through cracks, gaps and other unintentional openings in the building envelope. The rate of air leakage depends upon the air permeability of the construction, the wind speed and direction, and the temperature difference between the inside and outside of the building, as well as across the building.

Airtightness

Airtightness is the measurement criteria used to evaluate the air leakage of a building. It determines the uncontrolled background ventilation or leakage rate of a building's envelope, together with purpose-provided ventilation, relative to the total ventilation rate for the building. Traditionally, air leakage was expressed in air change per hour (ach) or l/s/m², however currently air permeability is used (l/m²/h) as it takes into consideration the effects of shape and size. The more airtight a building, the lower the air permeability.

One factor that can have significant impact on the energy use and CO₂ emissions attributable to dwellings is airtightness. The current regulatory

In the UK, airtightness is measured at an artificially induced pressure of 10Pa.

Concrete and BREEAM



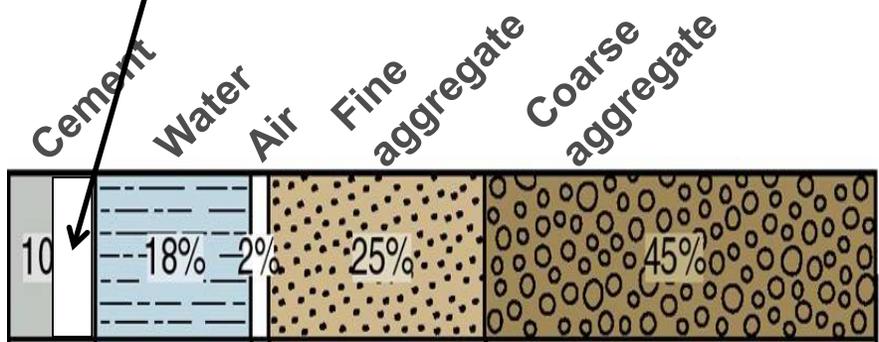
Practical guidance on using concrete and concrete masonry to achieve high ratings in BREEAM UK New Construction 2014 (5/2016 - Issue 3.0)

Some typical values; the albedo (ratio of reflected to incoming shortwave radiation) the darker the greater the increase and rate of thermal absorption and expansion.

| Material surface | Solar Reflectance |
|---|-------------------|
| Black acrylic paint | 0.05 |
| New asphalt | 0.05 |
| Aged asphalt | 0.1 |
| “White” asphalt shingle | 0.2 |
| Aged concrete | 0.2 to 0.3 |
| New concrete (traditional) | 0.4 to 0.5 |
| New concrete with white portland cement | 0.7 to 0.8 |
| White acrylic paint | 0.8 |

- Source: Construction Technology Laboratories (www.CTLgroup.com)

Use of low carbon cements



Approx gen mix by volume

- Use of cementitious replacements through specification can reduce ECO_2
 - Ground granulated blast furnace slag (GGBS)
 - Fly ash (FA)
 - Limestone
- High Albedo
- White cement
 - GGBS

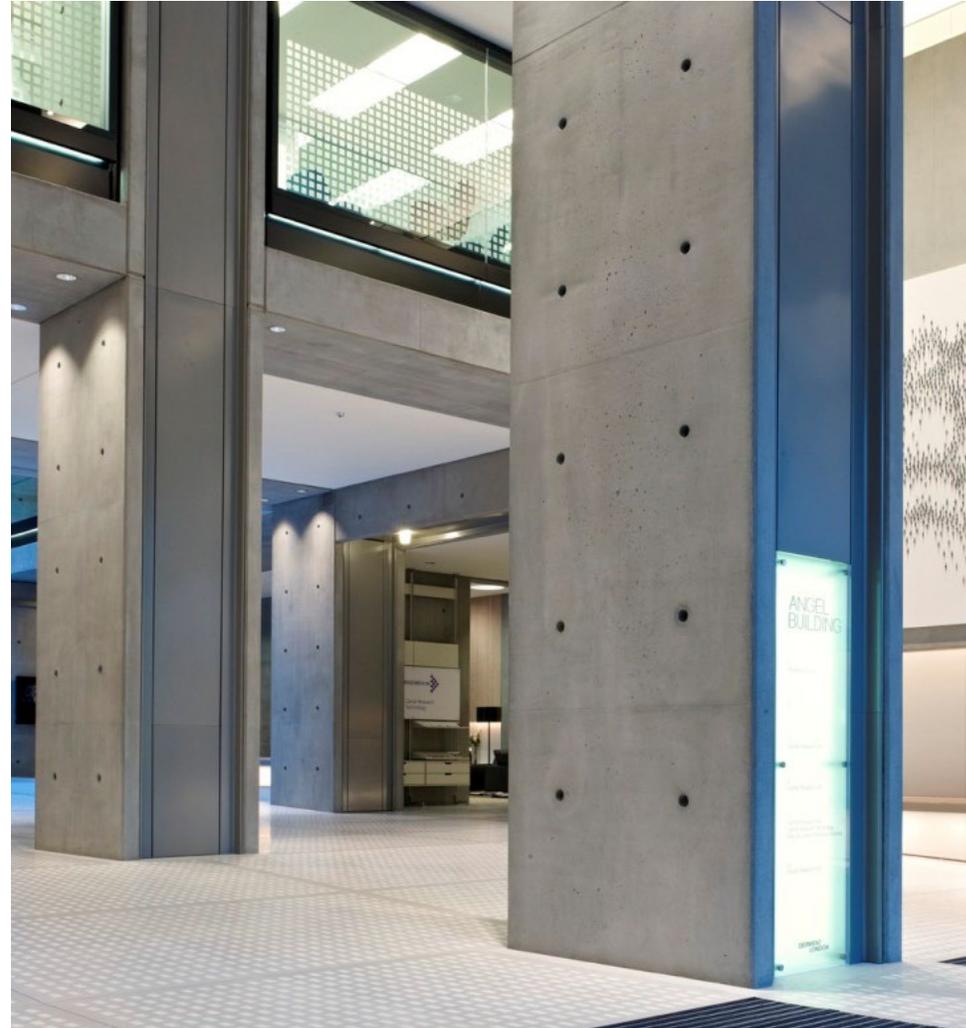
High albedo, blue or green roofs and walls ?



Use of low carbon cements

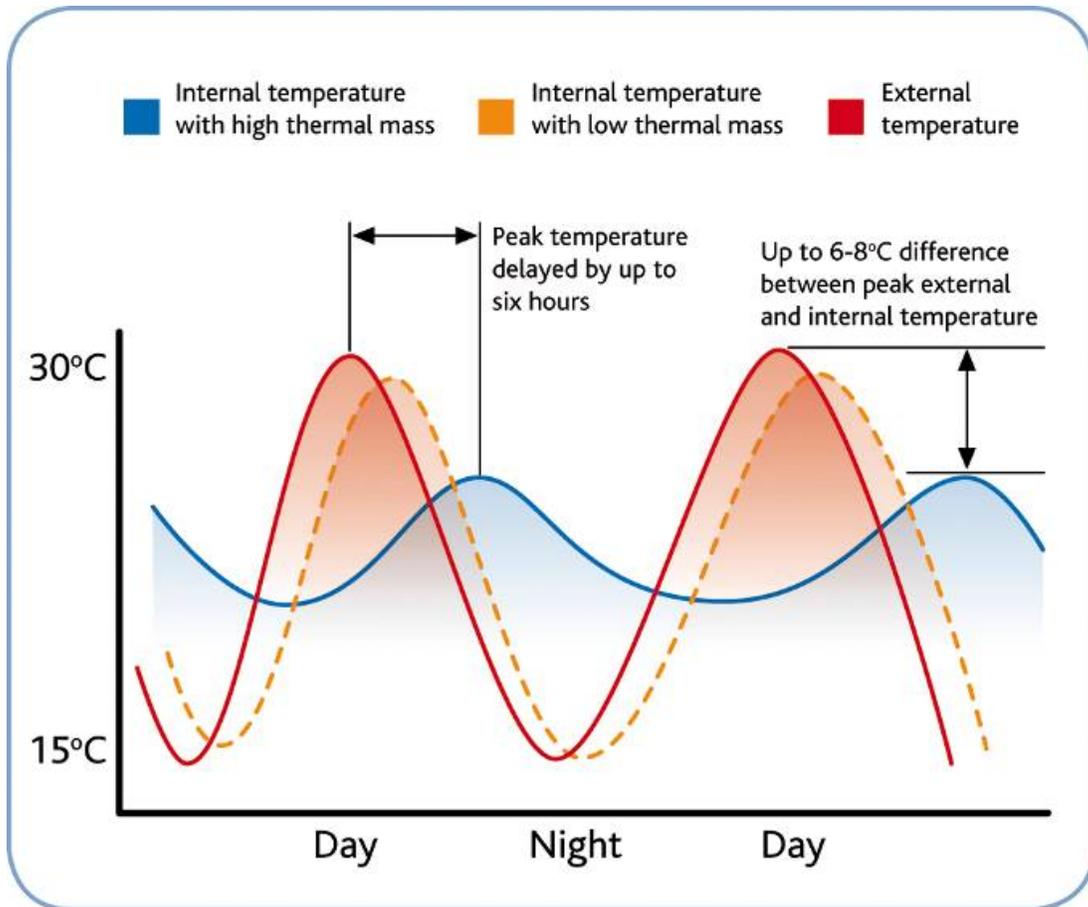


Aquatics Centre, Diving boards
Zaha Hadid Architects
30% GGBS



Angel Building, London AHMM/AKT
34% fly ash

Thermal mass ;night cooling



Innovative recipes and ingredients



Carbon capture aggregate

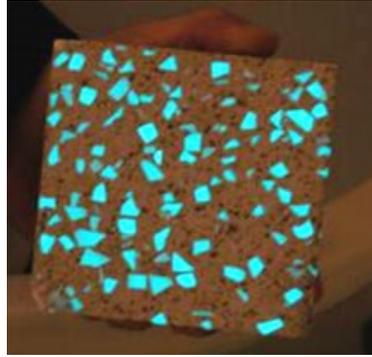


Photo-luminescent aggregate



Self-compacting concrete



Load-bearing light transmitting concrete
LitraCon®



Insulating aggregate



Water permeable concrete



Ultra high performance concrete



Bio-receptive concrete



Lightweight ready mixed & precast structural concrete

Photocatalytic concrete

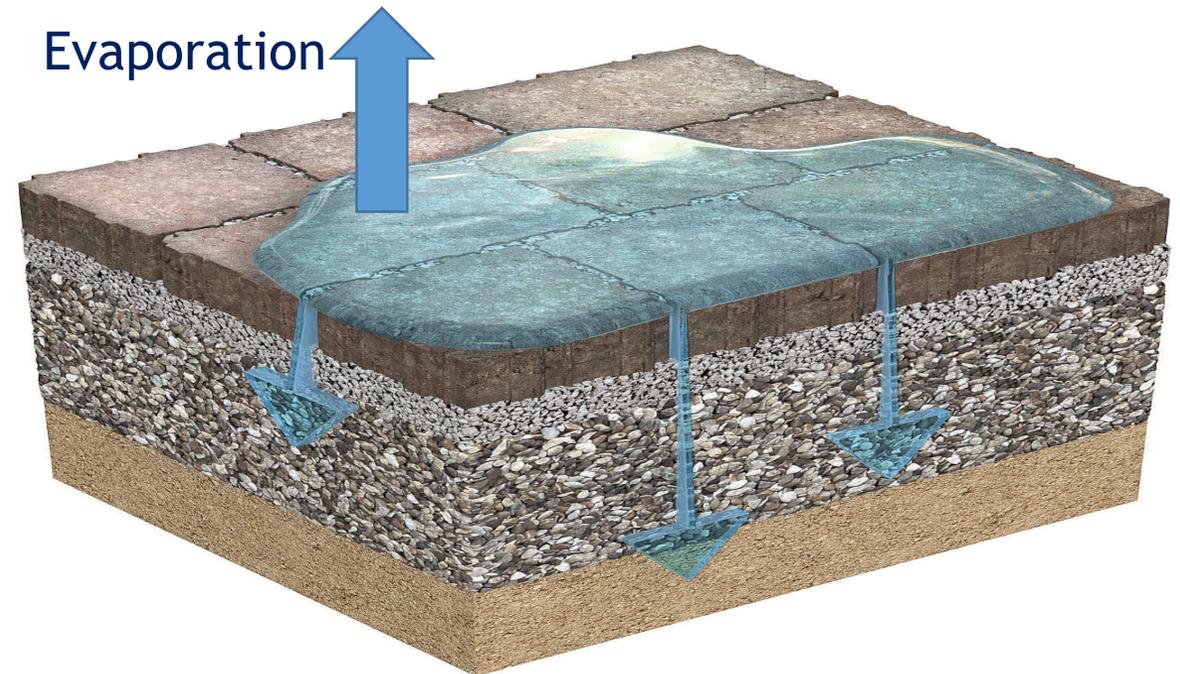


- Smog-eating concrete; NO_x
- Photocatalytic concrete uses titanium dioxide (TiO₂) which, when exposed to natural sunlight, triggers a chemical reaction. This chemical reaction **catalyses*** the decomposition of dirt on the concrete's surface; which makes it self-cleaning.

Cool Pavements: In cities constructed in the United States, pavements and roads comprise about 1/3 of urban surfaces, thus absorbing up to 80-95% of solar radiation and in turn warming surface, air and stormwater temperatures. The implementation of 'cool paving' assists in reflecting solar energy, enhancing water evaporation and maintaining cooler surfaces as compared to conventional pavements.



10% decrease in reflectance = -4 degC



Thermal stabilization method for pavements built on thaw sensitive permafrost based on the use of high albedo surfacing materials.



- Thank you

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