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Engineering Capstone Projects in Conjunction with Street Coolers:

Ben Macoun

Title: Sustainability in Building: The Urban Heat Island Effect on Pale Pavements

Completed: Spring 2015

Outline of Research:

This Capstone primarily examines the mitigation of the Urban Heat Island through the use of pale pavements being used to reduce the heat absorption in the road surface. This is a long term project that is aimed at finding ways to reduce the heat retention in urbanized areas especially road surfaces which occupy a significant portion of the land surface.

The study involves recording and analysing the heat at specific areas of the road surface and adjacent features such as soil through micro temperature loggers. We have set up 10 loggers in different locations on comparable streets to determine if different factors have a significant effect such as street orientation, the canyoning effect, surface, development density and vegetation cover. Location at Myrtle St, Chippendale.

Melissa Adam

Title: A Study of the Urban Heat Island Effect – Investigating the Effects and Addressing the Idea of a Sustainable City at a Micro-Scale

Completed: Spring 2014

Outline of Research:

This report explores different approaches to mitigating the urban heat effect at a residential block in Newtown (Sydney) with sustainable development as a core principle. Residents and the local government (Marrickville Council) are considered the most important stakeholders for this project: as such, the mitigating strategies have been targeted for them.

A numerical analysis was completed at the Newtown Block using an urban climate model. It was developed as a decision-making tool for local government to maximise the cooling potential of an urban environment. – It was found that at an ambient temperature of 35°C, the ambient temperature could be reduced by approximately 8°C with the introduction of a street kerbside tree planting program.



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Michael Grasso

Title: Large Scale Proposal of Energy Efficient Buildings

Completed: Autumn 2015

Outline of Research:

The urban heat island effect is a problem that has given rise to this project. This increase in temperature causes more energy to be used for cooling and so contributes to climate change. Implementing cool road surfaces is a potential way in which ambient temperatures can be reduced and so this concept is investigated and verified through first-hand investigations of a cool road system built by the Sydney Council in Chippendale. The investigations involved measuring the surface temperature of the cool road and comparing it to the adjacent asphalt road. By doing this, we are able to estimate the savings in energy by implementing the cool road due to the decrease in ambient temperature. We investigate how these requirements are regulated as well as explore sustainability features in residential and commercial buildings which could be more commonplace with improved legislation.

Joseph Caparrotta

Title: An Investigation into Cool Road Pavements to Mitigate the Urban Heat Island Effect

Completed: Spring 2012

Outline of Research:

This report discusses Australia's global position in the carbon pollution economy, the ability to generate clean energy and focuses on how the inner city Sydney suburb of Chippendale can ameliorate the impacts and contribution to the Urban Heat Island Effect. Specific attention is given to light coloured road surfaces. They are identified as the key factor in creating an environmentally and economically sustainable solution.

By increasing the albedo of road surfaces, impending impacts on the environment include: lowering ambient temperatures, reducing or eliminating the Urban Heat Island Effect, lowering the demand on energy and inevitably reducing human induced carbon pollution and global warming.

The solutions presented are analysed to determine their feasibility for employment in terms of financial and environmental cost.



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Matthew Faint

Title: Diagnosis & Determination of a Plan for a Sustainable Chippendale

Completed: Spring 2011

Outline of Research:

This report concentrates on the inner-city Sydney suburb of Chippendale and focuses on the issues of the built environment and how they impact the demand for, and unsustainable use of: energy; food; and water. These are the elements of urban life that contribute most to Chippendale's impact on the natural environment. By diagnosing the problems surrounding these systems we can go some way to determining solutions to make urban living more sustainable.

A plethora of simple, cost-effective solutions were identified as a result of this report. These solutions include: encouraging urban vegetation; growing food on city streets; resurfacing roads with pale pavements; planting roofs or painting roofs white; insulating homes and offices; harvesting stormwater for potable use; updating council legislation to better reflect environmental objectives; and considered planning for food purchases

Santi Botross

Title: Impact of Tree Shading and Pale Road Surfacing on the Building and Energy Usage in Chippendale and Redfern

Completed: Spring 2014

Outline of Research:

This project draws on the climatic similarities between Sacramento and Sydney and applies a cool cities formula to Chippendale and Redfern to evaluate the achievable building energy savings by enhancing urban greening and implementing lighter coloured roads.

The findings from this investigation indicate that a combination of pale roads and greater urban greening produce the most considerable energy and financial savings. Lighter coloured roads with larger tree-shaded areas reduce ambient temperatures within Chippendale and Redfern by 1.0C and 1.4C, respectively.



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Furthermore, this study illustrates that cool roads and urban greening provide numerous indirect social, economic and environmental benefits, some of which include better-quality lifestyles, improved community interactions and civic surveillance, enhanced biodiversity and healthier air quality.

Benjamin Johansson

Title: Sustainable Roads and Their Impact on the Urban Heat Island Effect

Completed: Spring 2014

Outline of Research:

This capstone investigates sustainable alternatives to conventional densely graded black road pavements, inclusive of cool pavements (asphaltic concrete) and the benefits of increased canopy/building cover in relation to cooling road surfaces. Two test sites were established within the precinct of the City of Sydney, where surface temperature measurements were conducted on the existing DGBA road surface and the trial asphaltic road surface. Results were independently mapped out onto a thermal heat map of the site based on each measurement conducted.

The investigation found that DGBA surfaces were significantly hotter than that of the AC road surfaces. Further analysis also concluded that an even greater difference in road surface temperatures was found between shaded and solar exposed areas for both road surface materials measured. Further analysis of the near surface air temperature of both sites found that additional shading and cooler roads reduce the average temperature, effectively mitigating the urban heat island effect within the urban microclimates. A statistical analysis of the data collected showed a strong correlation between the surface temperatures of the roads with regards to the different materials and coverage of the sites.

Peter Hobbs

Title: Microclimates and the Impacts of the Urban Heat Island Effect on Residents

Completed: In Progress

Outline of Research:

This Capstone will examine the microclimate and UHI effects of an inner Sydney suburban block in Newtown. Historical temperature data and site surveying is being used to develop various simulations through computer modelling using the 'ENVI-Met' software package. These results aim to determine



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temperature changes and effects that residents would potentially experience under various mitigation strategies for reducing urban heat.

This Capstone represents a novel approach to the real-world problem of UHI, which is especially important to address in an increasingly warming planet caused by anthropogenic climate change.

Zarah Copeland

Title: Design, Install and Research into Urban Heat Island Mitigation Techniques

Completed: In Progress

Outline of Research:

This Capstone aims to establish engineering solutions that can be used and adapted to mitigate the effects, or preferably, to eliminate the causes of the UHI and determine the effects on humans and local flora and fauna. This will involve on-going data research into the ten-year research project as funded by the NSW Office of Environment and Heritage entitled “Cooling a City Block.” In addition to this, this project will include developing, installing and monitoring UHI Mitigation techniques in Sydney as developed in collaboration with Street Coolers.

Well Yum

Title: An investigation into different types of road surface media in relation to the Urban Heat Island Effect

Completed: In Progress

Outline of Research:

Different paving materials featuring use of lighter surfaces in comparison to black asphaltic roads have been shown to reduce temperatures on roads by reflecting solar radiation back into the atmosphere. However, overtime environmental effects such as dust, dirt and normal wear and tear of a road will deteriorate the ability of a pavement to perform in peak condition. This capstone investigates different types of pavement material and their sustainability within Australia.



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Emma Lawton

Title: Potential Benefits of Using Street Water to Irrigate Street Trees

Completed: In Progress

Outline of Research:

The aim of this project is to analyse the potential benefits that could arise from the use of captured street and stormwater to irrigate street trees, and then compare these to actual results being recorded at newly installed street gardens in Newtown. This analysis will include monitoring the quantity and quality of stormwater used to irrigate the trees, and also the environmental and financial savings that arise from capturing and using this otherwise wasted resource.

The monitoring, assessment and analysis undertaken for this project will help determine the viability of capturing stormwater for use in irrigating street trees, and therefore whether the installation of similar street gardens should be rolled out across a wider area, either by local councils or residents themselves. The results from the project will also help determine whether the street gardens in use are the most effective method to achieve street tree irrigation with stormwater, and if found to be not environmentally or economically viable, other suggestions or recommendations will be made to achieve the desired savings.