

Thermal performance: A catalyst for behavioural change

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When we consider the established negative impacts of extreme temperatures on those in a carceral environment, it follows that climate change poses an escalating risk to controlling and decreasing rates of recidivism in the prison system. Thermal discomfort is a widespread problem in Australian prisons because of the age and construction type of existing facilities, coupled with their extreme local climates. It risks negatively impacting criminality, social stability and state resources. Improving the thermal performance of new and existing prison buildings may provide a resourceful and practical small-scale solution to the negative effects of unrelenting climate change and the subsequent impacts on state and social fabric.

This study uses both secondary and empirical data in exploring solutions to climate change in the context of Australian prison infrastructure. A literature review of relevant published work, journals, conference reports, guides, and organisational and governmental publications will establish the extent of the issue and place it in the Australian context. Empirical analysis of proposed building fabric upgrades to an existing facility in central Australia will set out potential solutions applicable to both new and existing prison buildings.

This study examined the adverse physiological and psychological impacts of extreme temperatures on the human body and established why prisoners are considered an especially at-risk group and more vulnerable to temperature-related conditions than most. The paper explores how aged existing infrastructure provides inadequate protection from the elements and how overcrowding in several facilities compounds the heat and subsequent risk, resulting in climate-related unrest bringing the problem in Australia to the fore.

A final case-study, of empirical data will show how, in comparison to influencing operational models in the prison system, improving the thermal performance of the building fabric offers an immediately applicable solution without the socio-political complexities. A case-study of work on an existing facility will illustrate

how thermal performance and comfort can be vastly improved in cost-effective and efficient ways through a combination of medium and small-scale, microclimate-specific design interventions. It will establish how, with little interruption to daily operations, these mechanisms also stand to improve staff working conditions and mental health as well as ongoing operating costs.

With the threat of escalating extreme temperatures and the impact they have on peoples' physiological and psychological health, especially of those in carceral environments, capital investment in the thermal performance of prison infrastructure offers an effective first response to mitigate risk and provide humane and sustainable custodial care. Providing an architecture that targets superior thermal performance has the potential to substantially impact the effectiveness of the therapeutic model by providing a physical environment conducive to the well-being of both prisoners and staff in carceral environments.

Understanding the issue

Climate change in Australia

Climate change is driving extreme temperature and weather events around the world and creating inhospitable living conditions across Australia. These changes appear to be increasing in intensity and frequency and have an indelible impact on our lives and societies.

Every two years, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Australian Bureau of Meteorology (ABoM) publish a *State of the Climate Report* that captures the major changes in climate trends across Australia and globally. The report published in 2022 reads ominously even after several improvements recorded during and after the Covid-19 global pandemic.¹ The following significant figures provide an overview of the current climate and the urgency of the issue.

Since Australian climate records began in 1910, the sea temperature has risen by 1°C and the air temperature by 1.4°C, with every decade since 1950 being warmer than the preceding one. The frequency

1. Commonwealth Scientific and Industrial Research Organisation & Australian Bureau of Meteorology. (2022). *State of the Climate 2022*. The Bureau of Meteorology, Commonwealth Scientific and Industrial Research Organisation. <http://www.bom.gov.au/state-of-the-climate/2022/>

of very high monthly temperatures has increased 6-fold since 1960 across the country. Warming has increased both day and night average temperatures in all months of the year and the frequency of what's referred to as 'summer very hot days' (where the average national temperature exceeds 39°C) has increased at alarming rates in the past decade. The 2022 report identified 2019 as the hottest year on record with 33 summer very hot days. This figure exceeds the combined very hot days recorded in Australia in the 50 years before, where just 24 days were recorded as reaching a daily national average of 39°C or more.²

Global and local climate changes are trending toward increasing intensity, posing an ongoing and escalating risk to our current lifestyles and how we experience the thermal comfort of our physical surrounds. Once we understand the increasingly negative impact extreme temperatures have on bodies and minds, we may appreciate the need for an alternate approach to an infrastructural design that can control and mitigate poor thermal performance and foster all users' health and well-being.

The impacts of extreme heat

Extreme temperatures can negatively impact our mental and physical health and are exacerbated by the nature, location and micro-climate of the surrounding environment. The effect of extreme heat on the body and mind is well documented.

In Australia, deaths related to heatwaves outnumber all others from extreme weather incidents. Physically, extreme heat can cause dehydration and heat stroke, which can be fatal in nearly 50 per cent of cases.³ Extreme temperatures can compromise all major organ function and can exacerbate pre-existing and medicated conditions like diabetes and high-blood pressure. Psychologically, extreme temperatures may decrease cognitive function, increase aggression and anxiety, and exacerbate the symptoms of neurological diseases.⁴ Extreme heat, and even minor and consistent increases in ambient temperatures, have been seen to

correlate with lower levels of tolerance and increases in violent tendencies.⁵

If we consider then that increases in aggression, anxiety and violent tendencies brought on by extreme temperatures would only add to a tenuously stable environment, it stands that controlling these temperatures in prison buildings has the potential to catalyse the more stable and tolerant behaviour of both staff and prisoners in the carceral community.

Communities most vulnerable to extreme temperatures

Extreme temperatures do not affect all communities in the same way, some people are more at risk of adverse effects than others and require approaches to thermal regulation that are sensitive to their condition.

In extreme heat, some communities in our societies have the mental and physical ability to control their environment and mitigate the effects of extreme heat. They may change their clothing, drink cold water, move to a cooler space, change their behaviour and activity levels or turn on the air-conditioning. Studies show that some communities, due to impaired mental health, physical health, or social conditions, may experience

a more limited, if any, control over their own environment making them more vulnerable to the impacts of extreme temperatures than others.⁶ Studies have established that these groups include older people, young children, and those with mental and chronic physical health conditions for which they are medicated. Medication can interrupt the body's usual thermal responses and prevent it from self-regulating temperature as it normally would.

Each year the Australian Institute of Health and Welfare (AIHW) conducts a survey into the health and wellbeing of prisoners nationally. The 2022 survey established that of the 40,600 people incarcerated in Australia at the time, over half suffered from chronic physical health conditions, with a similar number reporting mental health conditions and over 60 per

Improving the thermal performance of the building fabric offers an immediately applicable solution without the socio-political complexities.

2. See footnote 1: Commonwealth Scientific and Industrial Research Organisation & Australian Bureau of Meteorology. (2022).
3. Hughes, L., Hanna, E., & Fenwick, J. (2016). *The Silent Killer: Climate Change and the Health Impacts of Extreme Heat*. Climate Council of Australia. <https://www.climatecouncil.org.au/resources/silentkillerreport/>
4. See footnote 3: Hughes et al. (2016).
5. Mukherjee, A., & Sanders, N. (2021). *The Causal Effect of Heat on Violence: Social Implications of Unmitigated Heat Among the Incarcerated* (Working Paper 28987). National Bureau of Economic Research. <https://www.nber.org/papers/w28987>
6. See footnote 3: Hughes et al. (2016).

cent reported to be on prescribed or illicit drugs.⁷ When we consider these conditions, the use of medications or illicit drugs and the inherent lack of control over their environment, it follows that prisoners are especially vulnerable to the adverse impacts of extreme temperatures.

The carceral community, with limited autonomy and managing physical and mental health conditions that make them particularly vulnerable to the adverse effects of climate change, need a specific and regulated approach to thermal control for the continued stability of an environment that may effectively minimise violent incidents and reduce recidivism.

The relationship of heat and violence

Numerous studies have established correlations between extreme heat and rates of criminal activity. A study into the specific relationship between violence within the carceral environment and the effects on staff, prisoners and state resources illustrates the urgent need for regulated thermal control in prison infrastructural design.

In their 2021 paper, Mukherjee and Sanders explore the relationship between heat and violence in facilities across Mississippi. It was found that average temperatures between just 27°C and 50°C saw a 20 per cent increase in the severity of violent incidents and an 18 per cent increase in the likelihood of their occurring. Heat was also seen to affect the number of officers on duty at any one time and the way they interacted with inmates. The study established those higher temperatures in carceral facilities often also resulted in a generally more aggressive atmosphere between staff and inmates.⁸

The cost of these increases in severity and the occurrence of violent incidents includes extensions to existing prison sentences, the injury or death of prisoners and staff and damage to existing property.

Reducing the economic cost of longer sentences and the inhumane subjection of prisoners and staff to extreme and dangerous living and working conditions should be considered a priority in the current context of climate change, and in some instances, escalating prisoner numbers.⁷ The thermally efficient design of prison infrastructure to meet the current and changing climate, provides a significant opportunity to achieve these outcomes and create environments that foster rehabilitation, reducing recidivism. This can be achieved through implementing tighter controls on the design of climate-responsive prison architecture that is required to adhere to specific temperature ranges through effective building fabric and mechanical systems design.

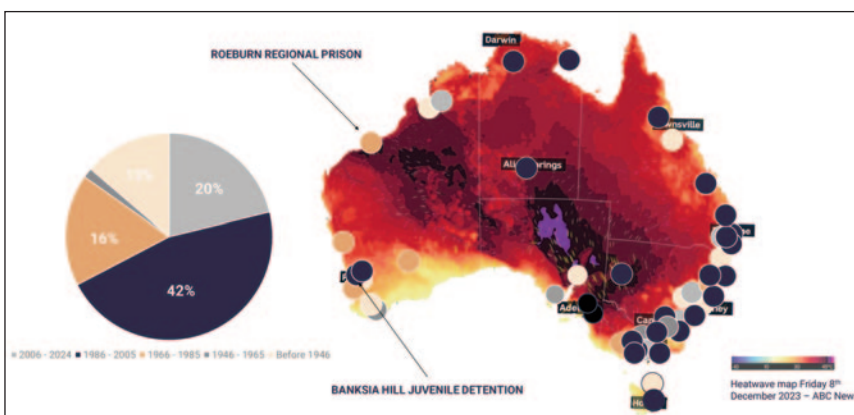
The Australian context

Australian building design regulations

In Australia, building design is controlled through regulations captured in the National Construction Code (NCC) and provide a best practice benchmark to which architects design prison facilities. There are significant gaps in how the NCC applies to custodial infrastructure with most developments sitting outside of the usual planning processes and resulting in few mechanisms for enforcing a minimum temperature range in prison construction.⁹ A critical element of the NCC introduced in 2006 and which represents a turning point in sustainable Australian building design is Section J, which focuses on energy efficiency and the limiting of greenhouse gas emissions in the construction industry. Section J also gives building practitioners and authorities a useful range of sustainable targets to measure designs against.

In evaluating the climate resilience of prison facilities nationally, let's consider the current stock of prisons around Australia as being built either before or after the introduction of this standard in 2006.

Figure 1. Locations of prison facilities across Australia by date of completion



7. Australian Institute of Health and Welfare. (2023, 15 Nov). Adults in Prison. Australian Institute of Health and Welfare. <https://www.aihw.gov.au/reports/australias-welfare/adults-in-prison>

8. See footnote 5: Mukherjee, A. & Sanders, N. (2021).

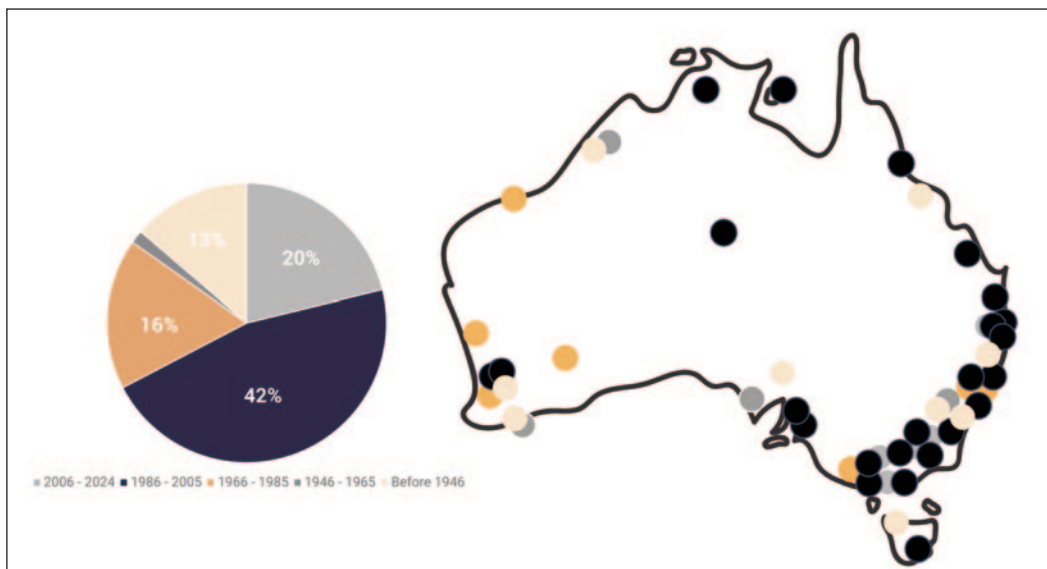
9. Grant, E. (2012). Design issues for prisoner health: Thermal conditions in Australian custodial environments. *World Health Design: Architecture, Culture, Technology*, 5(3), 80–85.

There are over 100 correctional facilities operating in Australia today.¹⁰ As illustrated in Figure 1, they are spread across all states and territories with concentrations in the more populated eastern states of New South Wales and Victoria. Approximately 80 per cent of prisons in Australia were already established by 2006 with close to half of those being built in the last 40 years. Based on the case study and professional experience across most jurisdictions, it can reasonably be inferred that older facilities have not adopted best thermal design practices, established and improved upon since 2006. By extension it may be reasonable to suggest that most prisoners and staff at facilities in their original state may be living and working in conditions that could endanger their mental and physical health, through exposure to extreme temperatures and a built environment not equipped to withstand them.

The climate conditions of prison buildings

Further to this, let's consider the location and age of facilities in relation to their local climate. Figure 2 overlays the temperature data from a heatwave in December 2023 with the current facilities across the country. The result describes the vulnerable position a significant number are in, when considering their age, existing infrastructure and the climates they are exposed to. A few facilities have been covered in the media in relation to extreme temperatures and an infrastructure unfit to accommodate them, including at Alice Springs Correctional Centre,¹¹ and Don Dale Youth Detention Centre.¹² Unrest and reports of torturous thermal conditions at these facilities describes an issue that threatens the effectiveness of the operational model in keeping staff and prisoners safe and reducing rates of recidivism.

Figure 2. Temperature map of December 2023 heatwave with prison locations overlaid by date facility was built



Western Australia study of thermal performance

Following several similar heat-related incidents across Western Australia, in 2015, the Office of the Inspector of Custodial Services (OICS) reviewed the conditions of a number of correctional facilities, including the death of an Aboriginal elder in custody in 2008, and an inspection into conditions at Roeburne Regional Prison in 2013.¹³

The study Thermal Conditions of Prison Cells established that with a core body temperature of around 37°C, temperatures nearing or exceeding that

pose significant risk to our mental health and physical function. The study set up a hierarchy of risk levels based on temperature, ranging from 'Caution'-between 27°C and 32°C where fatigue was likely during physical activity-to 'Extreme Danger', where temperatures exceeded 54°C and heat stroke was highly likely. Consider also that half of the time heat stroke can be fatal. The study found Roeburne Regional Prison on Western Australia's mid-west coast was the country's hottest facility with average maximum temperatures ranging between 43°C and 45°C and up

10. See footnote 7: Australian Institute of Health and Welfare. (2023).
 11. Hayman, R., & Garrick, M. (2018, 31 December). *Call for air-conditioners in 'inhumane' cells after outback heatwave triggers prison riot*. Australian Broadcasting Corporation. <https://www.abc.net.au/news/2018-12-31/union-calls-for-alice-springs-prison-air-conditioning-after-riot/10675502>
 12. Maynard, S. (2019, 13 August). *Weaponised Weathers: Heat, Don Dale, and 'Everything-ist' Prison Abolition*. Right Now & Sydney Environment Institute. <https://rightnow.org.au/opinion/weaponised-weathers-heat-don-dale-everything-ist-prison-abolition/>
 13. Office of the Inspector of Custodial Services (2015). *Thermal Conditions of Prison Cells*. Office of the Inspector of Custodial Services, Government of Western Australia. <https://www.oics.wa.gov.au/wp-content/uploads/2015/11/Thermal-conditions-review-final.pdf>

to and over 50°C in summer. Of course, the finding was that these extreme temperatures posed significant health risks to prisoners and staff in facilities across Western Australia.

Design factors impacting thermal conditions

The OICS report made several recommendations for dealing with the soaring temperatures. These were both operational and design-centred solutions including addressing the widespread issue of overcrowding, installing mechanical cooling systems and improving the thermal performance of the existing building fabric. The recommendations aimed to attend to unrest and provide humane, climate-responsive and resilient facilities that are fit for purpose

Retrofitting the existing building fabric offers a unique opportunity to significantly improve the thermal performance of older infrastructure at a fraction of the cost of most other methods relative to their efficacy. The technical response escapes much of the socio-political nuances of addressing overcrowding and in Australia, providing air-conditioning to prisons where schools in the jurisdictions may not enjoy the same. Depending on the location of facilities, reworking the existing building fabric can normally be done quickly, using widely available materials and simple construction methods. This makes it an effective small and mid-scale technical solution to a prolific issue that has far-reaching negative impacts on the prison and wider local community.

The Current study

The incident

The empirical study is situated in central Australia, in a hot dry climate at a facility built before the introduction of Section J or the threat of escalating extreme temperatures was a reality. The CSIRO and ABoM 2022 State of the Climate Report in Australia established 2019 as the hottest year on record. The December of 2018 saw the extreme heat reaching unprecedented levels at a custodial facility in the Red Centre of the country. An arid desert location, aged and thermally inferior building infrastructure and overcrowded accommodation culminated in prisoners refusing to go back into their rooms to sleep at night

and ultimately to violent clashes with staff. The incident brought the relationship between humane custodial care and climate change to the mainstream media demanding a solution that would be socially and financially acceptable. The author was engaged to investigate an architectural response for controlling the extreme temperatures and providing that humane space.

The central desert location of the facility at once provided a challenging context to remedial building fabric upgrades. The single-skin masonry construction of the existing buildings exacerbated any thermal protection they may have provided, had they been insulated, shaded and ventilated appropriately for the local climate. As is customary in many older, secure environments, high thermal-mass materials like masonry and concrete offer a robust solution that relies heavily on other passive-design tools to function effectively in extreme temperatures. Without looking at the system holistically and singling out just one characteristic of a building material's function, like thermal mass, features that could augment a design can work against it if used in isolation or applied inappropriately for the location.

Thermal mass refers to a material's ability to store and release heat. Very broadly the higher the thermal mass, the slower it heats up and cools down. Concrete and masonry are traditional and widely used materials in prison design and have a high thermal mass, storing heat during the day and radiating it internally when temperatures drop off at night. While this can be a useful tool in the right conditions, it only exacerbated the extreme heat gain inside the already over-crowded cells to over 40°C some nights — putting sleep and rest out of reach for most and fraying an already tense environment.

It was critical the design approach offered a resourceful solution that could easily be fitted with minimal intrusion into secure prisoner-accessible areas and that offered immediate and effective relief from the heat. Staff and prisoner safety were priorities as how best to upgrade the building fabric to be resilient to current and future climate trends was explored. When looking in general at upgrading the existing buildings to meet climate challenges, the principles of efficient passive design, including amongst others thermal mass, sun-shading, insulation, glazing and mechanical systems, were initially considered.¹⁴ The existing

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14. DCCEEW. (2024, April). *Your Home*. Department of Climate Change, Energy, the Environment and Water. <https://www.yourhome.gov.au/>

infrastructure was analysed in person for a firsthand impression of the working and living conditions of staff and prisoners and an understanding of the local climate to best implement thermal upgrades.

Analysis of the existing

The existing infrastructure was largely single-skin, high thermal mass concrete blockwork with no insulation to external walls. Windows were small, offering little cross ventilation and had no sun-shading. Cells were built with concrete lids, no insulation to the ceiling space, limited roof overhangs and there were no cooling systems installed. To compound the poor mechanics of the building fabric, the dorms were over-crowded with both staff and prisoners exhausted from the extreme summer heat.

Low-hanging fruit

In the conversations on how best to tackle thermal comfort in custodial care, architecture offers a relatively straight-forward solution that has no impact on the operational model, nor asks for the social and political buy-in that issues of over-crowding and controlling prisoner numbers often do. In the incidents at this particular facility, retrofitting the existing building skin presented a practical way out of an emotionally charged situation that stood to benefit all users of the facility and build resilience into the fabric that would protect it from ongoing social and climate change. The focus was on three key architectural interventions and one mechanical as a holistic approach to improving thermal performance.

Architectural interventions

Using the thermal performance criteria set out in Section J of the National Construction Code as the benchmark, the impacts on thermal control of insulation, sun-shading and glazing to the building fabric were investigated. The existing wall and roof construction provided just one tenth of the protection from the elements required by the Building Code and by extension provided an inhospitable living and working environment for users, especially those in need of mental and physical health care. It was imperative a resourceful solution that did not require extensive intrusion into secure spaces, risking prisoner and construction staff safety, was provided.

Recladding external walls and roofs with appropriately dense insulation and secure cladding systems provided the most substantial increase in thermal protection that exceeded the required national standards. As a composite cladding system, re-insulating the external skin also offered a relatively safe and accessible construction method and at the lowest cost per square meter of all interventions. A similar approach to improving the performance of existing

Perspex windows included 'insulating' those with a UV resistant film, which stood to improve performance and protect openings from further damage. Finally, the use of sun-shading devices over openings along the facades kept the arid desert sun off the external skin, minimising the workload on the insulation and protecting internal spaces from the harsh sun.

A holistic design approach

Ideally and if budget allows, building fabric upgrades and mechanical cooling systems should be used together in a holistic approach to temperature control. As a complete system, they enhance each other and ensure the longevity of the whole, while reducing overall life-cycle costs in the long term.

In comparison, the wall and roof insulation upgrades offered the greatest improvement to thermal performance in relation to their cost per square meter. Together with a mechanical cooling system, they offered the greatest and most cost-effective upgrade over the life of the facility to improve thermal performance and ensure the healthy living and working conditions of staff and inmates.

Conclusion

The impacts of climate change in Australia and globally are often felt more acutely by those most vulnerable to them and with the least control over their environment. This is true for many groups in our societies and especially for those incarcerated. The increase of extreme temperatures driven by climate change looks to continue and become more dangerous to society's mental and physical health, especially for those living and working in aged and unfit facilities in the prison system. With extreme temperatures negatively impacting the physiological and psychological health of staff and prisoners in this system and the sometimes-irreparable damage this causes to both people and property, it is becoming increasingly important to address the question of thermal performance in the carceral context. The design of prison architecture to meet the rigours of climate resilience offers a solution applicable to the construction of new facilities as well as the revitalisation of existing ones and without the emotional charge of rewiring operational or political models. Thermally high-performing prison infrastructure stands to provide humane environments conducive to rehabilitation and that foster the well-being of all users.

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