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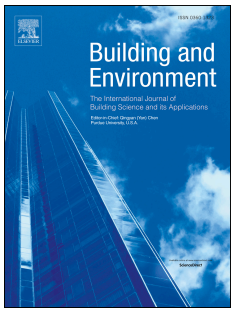


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# Directionally selective shading control in maritime sub-tropical and temperate climates: life cycle energy implications for office buildings

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**Abstract**

Scheduling directionally selective shading devices to increase or decrease their level of occlusion relative to the total incoming solar radiation has the benefit of controlling solar heat gain during a variety of sky conditions and allowing more constant illuminance levels to be achieved within a building. In this study, hourly sky condition and annual solar angles were used to describe the tilt of the slats of an external directionally selective shading control for an external venetian blind on an office building in Melbourne and Brisbane, Australia. The life cycle energy demand associated with this shading control was compared to a static base case with an external overhang and internal venetians. The analysis was extended to the HVAC system which was sized to account for the effect of the shading on solar gain and the artificial lighting requirement. It was found that the embodied energy of the HVAC and shading components accounted for between 21.7% and 25.5% of the total life cycle energy of these systems over 25 years. There was a reduction in embodied and operational energy requirements over a 25 year life cycle for the external venetian blind control of 24.9% for Melbourne and 24.0% for Brisbane relative to the static base case. Based on the simulation results, office buildings with equator facing facades located in similar climates and latitudes may have the potential for equivalent life cycle energy reductions when external directionally selective shading controls are employed to moderate overheating and daylighting.

Keywords: Venetian shading, Embodied energy, Directionally selective shading, Life cycle energy, office buildings

## 1. Introduction

Occupants of office buildings depend on the careful consideration of solar penetration, provision of views to the outside and access to daylight in design of fenestration systems. For several decades the design trend in Europe and America has been towards highly-glazed facades [1]. Equator facing and western facades are particularly vulnerable to overheating causing occupant thermal discomfort as well as non-uniform daylight distribution. A sensible shading strategy can assist in reducing the energy costs associated with solar gains; however, additional shading devices have their own embodied energy demands that contribute to a building's life cycle energy demand. Because shading also has a direct relationship to heating and cooling requirements for a building, if the shading can be controlled in a way that reduces the requirement for heating and cooling, energy reductions can also be translated to other components of the building which are sized to distribute heating and cooling. Examining the interaction between shading and the equipment for heating and cooling an office building can assist in selecting systems which use less energy over the building life cycle.

The aim of this study was to calculate and analyse the life cycle energy demands of an external directionally selective shading control which responds to real-time weather conditions in multiple locations. The contribution that external directionally selective shading control can make to reducing the HVAC systems' sizing and hence embodied energy has also been considered.

## 2. Background

### *2.1. Directionally selective shading of office buildings*

The energy consumed by a newly installed HVAC system differs according to how directionally selective shading is operated and positioned relative to the glazing. Venetian blinds are one type of shading that have the

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