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Creating sustainable cities one building at a time: Towards an integrated urban design framework

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ABSTRACT

One of the tenets of urban sustainability is that more compact urban forms that are more densely occupied are more efficient in their overall use of space and of energy. In many designs this has been translates into high-rise buildings with a focus on energy management at their outer envelopes. However, pursuing this building focused approach alone means that buildings are treated as stand-alone entities with minimal consideration to their impact on the surrounding urban landscape and vice versa. Where urban density is high, individual buildings interact with each other, reducing access to sunshine and daylight, obstructing airflow and raising outdoor air temperature. If/when each building pursues its own sustainability agenda without regard to its urban context, the result will diminish the natural energy resources available to nearby buildings and worsen the outdoor environment generally. This paper examines some of these urban impacts using examples from the City of London where rapid transformation is taking place as very tall buildings with exceptional energy credentials are being inserted into a low-rise city without a plan for the overall impact of urban form. The focus of the paper is on access to sunshine and wind and the wider implications of sustainable strategies that that focuses on individual buildings to the exclusion of the surrounding urban landscape. The work highlights the need for a framework that accounts for the synergistic outcomes that result from the mutual interactions of buildings in urban spaces.

1. Introduction

Greenhouse Gas (GHG) emissions from energy use are typically dominated by three sectors: buildings, transport and industry. One of the ubiquitous urban policies for building energy demand reduction is compact cities with increased building densities (Breheny, 1992; Jabareen, 2006) and at the same time: making individual buildings more efficient in their energy use while creating pleasant and accessible outdoor spaces. Building energy management is central to the discussion on sustainable cities. In 2010, buildings accounted for 32% of total global final energy use and 19% of energy-related GHG emissions. For economies included in the Major Economies Forum (including the EU, US and other OECD countries) where per capita energy use is already high, the contribution of buildings is about 40% of total demand (IEA, 2014; Porse, Derenski, Gustafson, Elizabeth, & Pincetl, 2016). At a city scale in these economies, buildings and transport are typically responsible for up to 80% of energy use and a similar proportion of GHG emissions (IEA, 2010). Given the increased demand for floor area fuelled by global urban population growth, building related energy demand is likely to increase further everywhere.

Current building energy management (BEM) strategies treat each building as independent or stand-alone entity in which emphasis is placed on the material fabric of the building and the efficiency of internal systems. This approach has been termed 'generic', as it is not specific to the geographical, climatic or site conditions where a building is located (Blakely, 2007; Mourshed, 2016). In urban settings, this means that interdependent and dynamic energy relationships (that includes shading and sheltering) that occur between buildings are not considered and the combined impact of building groups on the adjacent outdoor space and its use are not considered adequately (Fig. 1). The emphasis on a generic approach to BEM has been justified on the basis that the thermal elements are inherently efficient before considering the impact of other technologies, including renewables. However, despite buildings being designed as if independent stand-alone entities will perform differently in a changing urban setting; moreover, they will interact with other buildings and the outdoors to modify their microclimatic environment, often for the worse. These effects can be accentuated when buildings with a radically different built form are inserted into an existing urban landscape causing a redistribution of natural resources. Unfortunately, the effect of building form

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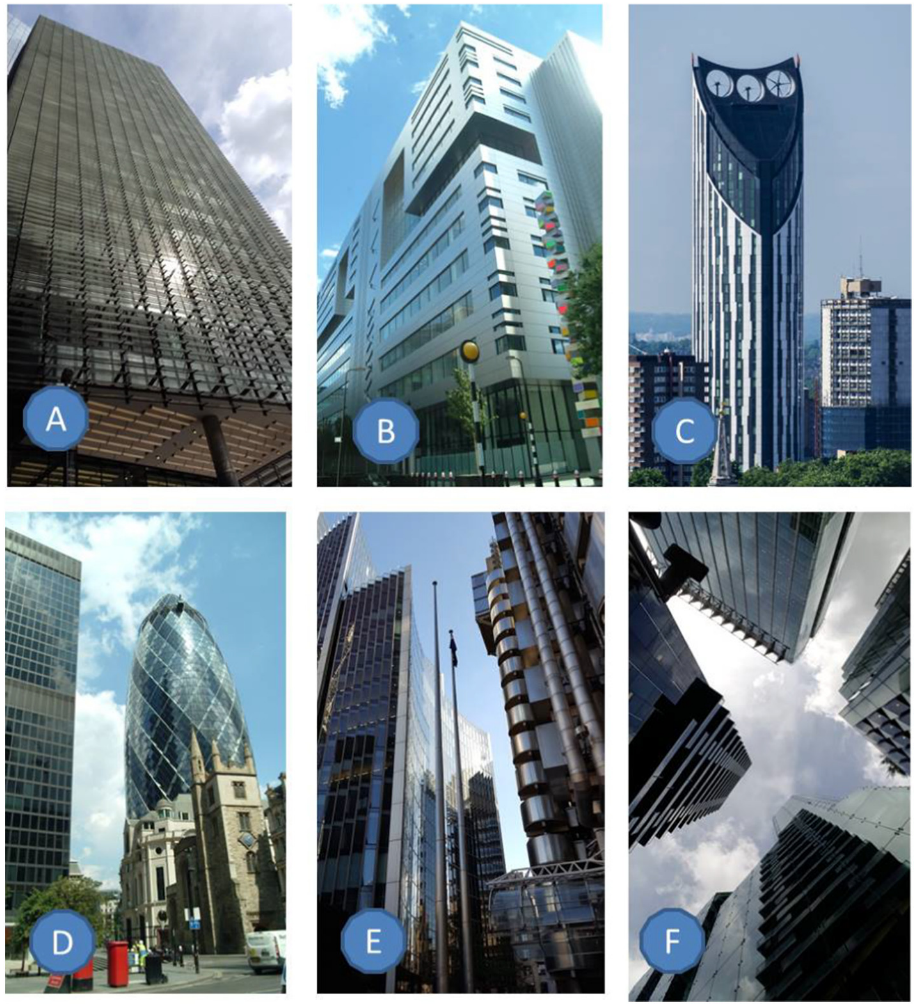

Fig. 1. A) 25 Ropemaker Street –full length brise-soleil to offset passive gains to south facing glazed facade; B) 5 Broadgate, highly polished surface reflects energy back into surrounding setting; C) The Strata Tower (©User: Colin / Wikimedia Commons / CC BY-SA 4.0) residential; renewable energy technology reliant on unobstructed access to resource currently not protected; D) 30 St Marys Axe -modern building form inserted into low lying setting; E) Proximity of 1 Lime Street (Lloyd's building) to 51 Lime Street (The Willis building) intercepts afternoon solar glare and creates wind tunnelling effects; F) Ropemaker Place dense cluster of tall buildings limit levels of solar receipt at ground level!

on the urban environment is limited in current assessment methodologies and potential benefits and costs that accrue to the public realm from individual buildings are largely ignored (Erell & Williamson, 2006).

In this paper, we explore some of the consequences of the current stand-alone BEM strategy using case study developments from the City of London, which is undergoing significant change as tall and very tall buildings are inserted into a low-rise and historic urban landscape.

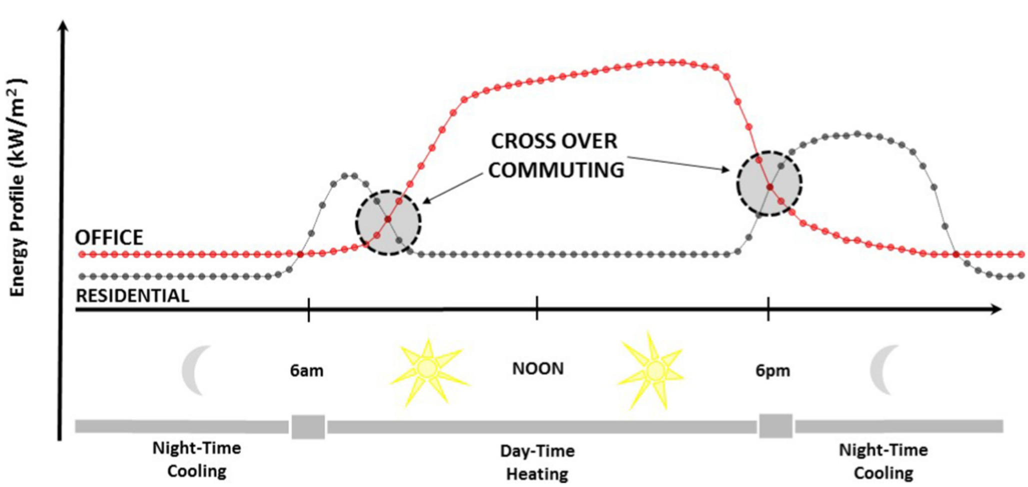

Fig. 2. A schematic view of the likely daily energy demand profiles for typical 'Residential' and 'Commercial' buildings.