Stairway to health: an analysis for workplace stairs design and use

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Abstract: This paper reflects on a recent workplace design and physical activity study to argue for a radical rethinking of staircase design in office buildings. This paper deploys design analysis of three campus buildings alongside objective physical activity data and survey responses of study participants in these buildings (n=111) to identify limitations to past and current staircase design approaches. Working within a social ecological framework, this paper builds on observations of higher education office-based worker’s physical activity, attitudes to movement at work, and building design. The different approaches to staircase design from each of the three buildings from three different decades (1970s, 1980s, 1990s) within the study demonstrate shifts in architectural attitude to circulation design. Two key findings emerge. Firstly, that current health-focused design guides or staircase design audits do not go far enough in identifying the social-ecological environment which supports stair use. Secondly, that a radical rethinking during the design process of staircase design in office buildings may be needed to support at-work physical activity. This paper is significant in centring architectural design practice as a way of understanding physical activity behaviours within workplaces and finding ways of extending contemporary responses to population health dilemmas.

Keywords: Stairs; design; analysis; movement.

1. Introduction

Australia’s guidelines on physical activity, Australia’s Physical Activity and Sedentary Behaviour Guidelines (Aust. Dep. Health, 2014), have recently been updated to build on recommendations by the World Health Organisation. The new guidelines suggest that we ‘accumulate’ 2 ½ to 5 hours of moderate intensity physical activity each week and that this activity can be achieved in 10 to 20 minute
bouts during the workday. With the contemporary trend towards increased work hours, the idea of accumulating physical activity as part of a normalised workday activity is becoming increasingly important. Current research recognises that sitting for more than three to four hours per day is associated with an increase of health risks associated with sedentary behaviour (van der Ploeg et al., 2012; Chau et al., 2013). While these risks are reduced if a person is regularly engaging in moderate-to-vigorous physical activity (Chau et al., 2013), the risk accumulated by extended sitting is not fully overcome. Breaking up extended bouts of sitting with short spells of physical activity, even light activity such as slow walking or standing, has been shown to reduce the risk associated with sedentary behaviour (Dunstan et al., 2012).

The contemporary office is a site of extended sedentary behaviour. In Australian offices people working in administrative jobs are the most likely to spend over 80% of their time at work sitting (ABS 2011). In particular, workplace staircases have been identified as an opportunity to gain moderate-to-vigorous intensity physical activity within the workday and have been targeted in health promotion schemes such as Australia’s “Take the stairs instead” poster, part of the 2008-2010 “Find thirty every day” campaign. However, often the workplace promotion of stair-use fails to deal with the reality of staircase design within the building type where, often, its primary function is purely as a fire escape. Additionally, the idealised picture of active stairs in the health promotion posters is in stark contrast to the poor quality of workplace fire-exit stairs along with the off-putting requirements for safety signage used in reality (McGann et al., 2013).

In architecture practice, there are moves to explore the significance of staircase design in encouraging movement and the improvement of occupant health and wellbeing (for example, NAB workplace, Melbourne 2013), in supporting staff interaction and active movement (for example, Macquarie Group workplace, Sydney 2011), and in inter-floor connectivity and workplace activation (for example The GPT Group workplace, Sydney 2011). In the context of growing interest in active workplace design, this paper contributes to an growing body of research considering stair use in terms of stair location, accessibility and aesthetics (Bassett et al., 2013), with a particular focus on stair convenience and legibility (Nicol 2007; Jancey et al., forthcoming), stair convenience in relation to elevator availability (Olander and Eves 2011; Nicoll and Zimring 2009) and the interventions around point of decision motivational signs (Bellicha et al., 2015; Dolan et al., 2006; Eves et al., 2012; Grimstvedt et al., 2010; Iversen et al., 2007; Ker et al., 2001; Lee et al., 2012; Ruff et al., 2014).

In this study, interpreting recordings of moderate-to-vigorous intensity physical activities looked to the quality of the workplace staircases, and how embedded these staircases were in the movement patterns of the staff. This research assesses the impact of difference in office design on the physical activity and sedentary behaviour of a cohort of office workers across three campus buildings at the same university. The three buildings studied were designed and built in three distinct time periods and reflect differing approaches to workplace design that is highlighted through the different emphasis put on the stairs within the design.

The purpose of the study is to:

- Compare physical activity behaviour (sitting, standing, walking, step counts) in different buildings of different design era’s with different design approaches to circulatory patterns.
- Determine employees’ perceptions of their workplace environment and their related mental and physical health.
• Contribute to the body of knowledge on the identification of design elements that contribute to physical activity behaviour in workplace design.

2. The Study Buildings

While there is new debate on the design of healthy, productive, collaborative and space-saving workplace design, the vast majority of organisations do not have the opportunity to relocate to custom-designed premises. This research reflects the reality of such organisations occupying workplaces designed to an evolving set of design trends, philosophies, principles and regulations. In this study we engage with three existing, currently occupied and modified buildings across a range of ages and design approaches. In line with the dominant approach within the field, this paper takes a socio-ecological approach (see Zimring et al., 2005), to outline potential connections between the quality and design of building organisation and level of physical activity and sedentary behaviour.

2.1. Comparative Building Analysis

2.1.1. Building 1

Building 1 (Figure 1; top plan) contains approximately 81 academics and 19 administrative staff. The building was built during one of the most recent construction phases of the university, 1995-2005, and is in the north end of the campus. Building 1 is a four-story brick and concrete building built on a north-south axis, with its longest edges facing east and west. The building is organised with a double loaded spinal corridor that narrows at link sections with external views at three key points along its length. The building has three large fire stairs which connect all floors, each with external windows. These staircases are open and brightly lit. There is one lift adjacent to the central fire stairs. In addition, at the ground floor entry there is a grand curved open staircase that connects the foyer to the boardrooms on the next level only. Toilets are located in the middle of the building, on the eastern side. Nearly all rooms have external windows. Print stations are located centrally on the floors. The average floor area per level of the building is 1797m². The average width of the building is 14.3m. The length of the main corridor overall is 59m.

2.1.2. Building 2

Building 2 (Figure 1; middle plan) contains approximately 56 academics and 57 administrative staff. The building was built during one of the middle construction phases of the university, 1986-1985, and is located in the centre of the campus. Building 2 is a four-story brick and concrete building with two ‘wings’ of offices clustered around internal corridors. Between these two wings is an external fire stairs on the south side of the building which is used as the main vertical circulation route for the building and connects all four floors. In the east wing there are two additional internal staircases, one of which connects only the main entry level (second floor) to the next floor (third floor). The lift that runs between all floors is next to this entry staircase. A second fire stairs connects only the third and fourth floors to the outside of the second floor, and it is only possible to enter this staircase from the third and fourth floor. The majority of rooms in building 2 have external windows, although there are some large shared offices on the second and third floor that do not. Toilets are located in the eastern wing of the building on each level. The average floor area per floor of the building is 870m². The average width of the building is 20m. The length of the main corridor overall is 24m.
2.1.3. Building 3

Building 3 (Figure 1: bottom plan) contains approximately 50 academic staff and 30 administrative staff. The building was built during one of the oldest construction phases of the university, 1966-1975, and is located in the south of the campus. Building 3 is a four story building constructed from off-form concrete. It is long and slim with the longer sides facing north and south. A narrow corridor runs through the building lengthways, and rooms are accessed from both sides of this corridor. Three internal concrete fire stairs and one external lift provide the vertical circulation. The three staircases are located on the north side of the building equidistant along its length. The lift is positioned adjacent to the main entry on the north side. Toilets are located at the centre of each floor. The average floor area per floor of the building is 1160m². The average width of the building is 12m. The length of the main corridor overall is 62m. The office fit-out is dated, and was scheduled for a new internal fit-out just prior to the time of the measurement. Most academic staff occupy individual offices, while the majority of
administrative staff are in open plan settings. Each floor has several narrow print rooms. On the second floor there is one larger staff kitchen with a large balcony overlooking a basketball court.

3. Methodology

3.1. Participants

A total of 111 university staff from three campus buildings were recruited at three time periods between October 2013 and April 2014. The times were selected for similarity in outside weather conditions and in work duties (such as semester weeks). Participants were required to be aged 18 years and older, working at least three days per week in an office-based role at the university campus and with the majority of that time spent in their allocated office building. A participant profile is provided in table 1. An invitation to participate was sent via internal email to all staff in the three selected buildings. All individuals participating in the study were coded to allow for individual and group comparison. More than three quarters of participants were female (76.6%), and the mean age was 45. Table 1 shows the demographics, employment status, and employment type by building.

<table>
<thead>
<tr>
<th>Building 1 (n= 36)</th>
<th>Building 2 (n= 33)</th>
<th>Building 3 (n=30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age</td>
<td>43</td>
<td>44</td>
</tr>
<tr>
<td>% female</td>
<td>77.8</td>
<td>78.8</td>
</tr>
<tr>
<td>% born in Australia</td>
<td>66.7</td>
<td>54.5</td>
</tr>
<tr>
<td>% university educated</td>
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<td>Employment status</td>
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<td></td>
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<tr>
<td>% full time</td>
<td>75.0</td>
<td>81.8</td>
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<tr>
<td>% part time</td>
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<td>Employment type</td>
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<td></td>
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<tr>
<td>Professional</td>
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<td>45.5</td>
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<td>Admin support</td>
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<td>27.3</td>
</tr>
<tr>
<td>Technical/other</td>
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<td>6.1</td>
</tr>
<tr>
<td>Academic</td>
<td>44.4</td>
<td>21.1</td>
</tr>
</tbody>
</table>

3.2. Architectural Methods

Diagrammatic analysis of building plans were used to identify the current structural, interior component and organisational layouts of the interior. In addition, a new hybrid approach was used where participant data from the accelerometer was mapped onto the building plans. A photo survey was conducted of each of the buildings involved in the study. Circulation paths, view lines and spatial quality were a particular focus of the photographic recording.
3.3. Measuring instruments.

Both self-report (questionnaire) and objective (accelerometers) measures were used to determine sitting, standing and walking behaviours (Jancey et al., 2014). Self-reported mental and physical health and environment quality and demographic data was also collected. The questionnaire used was a combination of validated instruments; the Occupational Sitting & Physical Activity Questionnaire (OSPAQ) (Chau, Van der Ploeg, Dunn, Kurko, & Bauman, 2012) the SF-8 Health Survey (QualityMetric Incorporated, 2013) and the Indoor Environment Quality (IEQ) Survey (Zagreus, Huizenga, Arens, & Lehrer, 2004). Participants required approximately 10 minutes to complete the survey.

The ActiGraph GT3X+ accelerometer was used to objectively measure time spent in sedentary, light, moderate and vigorous activity. Accelerometers are a type of motion sensor used to quantify activity intensity and distinguish between low, moderate, and vigorous physical activity levels, and sedentary behaviour which can indicate sitting, standing, walking and stair climbing. Participants wore the accelerometers on their right hip during office hours for three to five consecutive workdays. Data was collected at one-minute intervals over the course of workday (Jancey et al., 2014).

3.4. Statistical analysis.

Descriptive statistics were used to summarise participants’ demographic, health characteristics, and the outcome variables (sedentary behaviour, physical activity intensity, step counts). Comparisons were made by building, floor, gender, and age. All data was analysed using SPSS version 22.0.

4. Findings

This paper aims to draw connections between aspects of workplace and building design, and movement in the workplace. Figure 2 highlights measured sedentary, light, moderate and vigorous activity. In a workplace setting moderate activity is generally associated with stair use.

![Figure 2: Accelerometer measured physical activity in three buildings by percentage of time in the workplace.](image)

On average the participants across the three campus buildings:

- spent less than 22 min per day in moderate to vigorous physical activity,
- spent less than 60 min per day in light physical activity,
- sat for more than 80% of their workday,
- sat for maximum bouts over 40 min in duration.
Recordings within the accelerometer and survey data compared to the building analysis suggests the four key findings as follows:

- **F1.** The physical activity and sedentary behaviour patterns of participants matches profiles of other Australian studies and compares poorly to the recommended physical activity and sedentary guidelines for health.
- **F2.** Territorial and unwelcoming corridors and stairs may contribute to workplace sedentary behaviour.
- **F3.** Well-designed and good quality circulation spaces (corridors and stairs) such as in building 1 may support moderate intensity physical activity.
- **F4.** Participant values (such as health-aware users in building 1) and building design influence the way people choose to move through a building.

### 4.1. Spatial Typology and Floor Plate Size

Building 2 offers a significant contrast in building organisation and floor plate dimension in comparison to buildings 3 and 1. Building 2 is clustered tightly into itself, with branched corridors leading from the main corridor which runs between the two sides of the building. This affects the path distance from the ends of the corridors to the middle. As, in all three buildings the toilets are located roughly in the centre, the maximum length of corridor end to centre correlates from workstation to toilet area. Building 1 has the longest main corridor length, and the higher end of distances to destinations such as print stations and kitchen/tea prep. While building 3 has the furthest typical distance to toilet areas from workstations.

### 4.2. Quality of Staircase

Building 1 has attractive, well lit and comfortable staircases (figure 3). Buildings 2 and 3 in contrast have stairs which are more problematic to use. All three staircases in building 1 have an excellent spatial quality and attractiveness. These are brightly lit by large windows and have views to the outside. The staircases are spacious and open feeling. Attractive fixtures and finishes have been used. The staircases are clean and well maintained. However, the doors from the central corridor which lead to the staircases are not immediately apparent. They are painted in the same colour as the hallway, and are not aggressively signed. The lift is far easier to locate as a new-comer to the building.

*Figure 3: Most used fire stairs in building 1.*
Building 2 has one main staircase; external to the building; and two secondary internal staircases (figure 4). One of these joins level two to level three. The second stair joins levels three and four to the outside of level two. This last staircase is somewhat hidden down one of many corridors rather than located on a major thoroughfare: as a result it is not much used. The main, external, staircase has some aesthetic quality, being open to views, fresh air (although also rain, cold or heat depending on the season). The stair treads are of a comfortable size. The two internal stairs are narrow and dark with no natural light or attractive quality. All three stairs are in reasonable condition and cleanliness.

![Staircases building 2: the main external stair (left) two internal stairs (centre and right).](image)

Building 3 staircases are accessed from narrow corridors which branch from the main corridors of the building (figure 5). The door to the staircase is painted the same emergency red as the door to the fire equipment cabinet. Inside the staircase is lit artificially as there are no windows. The aesthetic is in keeping with the ‘brutalist’ architectural style–which with its simple and raw materials and form (in combination in this case with a lack of windows) is unlikely to appeal to a lay audience. The inside of staircase doors have signs which explain what to do if you become locked in, suggesting that this has happened with some frequency.

![Typical concrete staircases building 3.](image)

5. Discussion

Participants in building 1 recorded the highest mean level of moderate physical activity, and the highest mean step count per day. Moderate physical activity is consistent with the exertion of walking quickly or going up and down stairs. Of the three buildings in this study building 1 has by far the best quality staircases and corridors; it also houses workers likely to have the most working knowledge of the risks of
sedentary behaviours. It seems likely that there is a link between the quality of these circulation spaces and the higher levels of moderate physical activity recorded for building 1 participants. One criticism of the staircases in building 1 was highlighted in a survey response. In building 1 not all staircases connect to level one—it is only possible to access level one from the central stair (adjacent to the lift).

In contrast the stairs in buildings 2 and 3 present several barriers to use and this may correlate with the lower total mean step count per day and lower recorded percentage of participant time in the workplace spent in moderate intensity physical activity. The two internal stairs in building 2 are limited in the number of floors they reach, they have no access to natural light or outlook and have few aesthetic qualities to recommend them. The external staircase also presents a deterrent to some, in particular a survey response by a participant in building 2 highlights the safety issues with building 2’s main staircase, which is fully external and becomes wet when it rains. The brutalist architectural design style of building 3, of which the staircases are a particularly clear example, is not considered attractive by the study participants who described it as "pretty ugly". In particular the "grey concrete is not pleasant." In another survey response, a participant identifies that the poor lighting in the three identical stairwells in building 3 is a safety concern. In addition the doors to the stairwells are painted 'emergency red.' This forms a visual deterrent to opening these doors, especially to anyone who has ever accidentally set off a building fire alarm.

Nicoll (2006) identifies five factors of stair use: convenience, legibility, appeal, comfort and safety. All staircases in building 1 perform well against these categories, with the possible exception of legibility. Participants were asked to nominate the top five factors that affected their decisions regarding paths choices within the office building. For participants from all buildings, choosing the ‘fastest route’ was an important factor, as was the ‘preference to use the stairs,’ and a desire ‘not to wait for the lift.’ Participant response aligns with Nicoll’s (2007) identification of convenience and legibility being the key factors in workplace stair use.

6. Conclusion
This study opens avenues for future research and practice. Further exploration into movement behaviours of workers viewed through a lens combining both health and design perspectives is needed. Such a move would inform recommendations, for both office and building design and health promotion strategies, that support increased levels of physical activity within workplaces. In particular, multiple offices of different sizes and in different industries should be analysed in order to gain a better understanding of the impact of workplace design on staff physical activity. However, this initial study does provide an opportunity for reimagining workplaces as sites for increasing levels of physical activity as part of supporting healthy lifestyles.

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References


