

Survey of Occupant Response in Wind-Excited Tall Buildings

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Abstract

Occupant comfort and habitability performance within wind-excited tall buildings are critical in the structural design process. Population survey is a useful tool to gain an understanding of occupant response to building motion. This paper outlined the process used in collecting data on occupant response to wind-induced tall building motion through a general population survey in Sydney.

Introduction

In recent years there has been a trend towards taller buildings made from high strength materials and incorporating advancements in structural designs. As modern day buildings continue to increase in height, they become more sensitive to the effects of wind. As a result occupant comfort and habitability performance within these tall buildings has become more critical in the structural design process.

The majority of past research has focused on human perception of motion and psychological response to wind-excited building motion. Evidently, human perception to building motions in low frequency ranging from 0.1 to 1.0 Hz is not only dependent upon the psychological but also physiological factors (e.g. Burton et al., 2006). A number of building vibration acceptability and occupant comfort criteria have been commonly used to assess the serviceability performance of wind-excited building in terms of occupant comfort (e.g. Kwok et al., 2009).

This project aims to investigate occupants' motion perception and comfort in wind-excited tall buildings through collaborative research conducted in Sydney, Wellington and Hong Kong. This paper provides an overview of the method of research used in assessing the occupant comfort in wind-excited tall buildings, and describes the methodology adopted and the experience gained in conducting a general population survey in the Sydney Central Business District (CBD).

Survey Methodology

Previous research has been predominantly done in laboratories in a controlled environment with the aid of motion simulators. This research approach facilitates the study of human perception of motion, cognitive performance and task performance in a simulated motion environment under varying frequency, acceleration and exposure duration. In contrast, general population data on prior experience of and response to building

motion are comparatively rare and to the best of the authors' knowledge, no such data have been collected for major population centres in Australia and New Zealand.

The first objective was to identify potential locations where data could be collected and to determine which government and regulatory authorities that needed to be consulted and notified. Survey areas that were selected contained the highest density of tall building in Australia in order to gain an insight of people who have experienced tall building motion.

Most CBDs housed a dense population of tall buildings and are situated along a coastal region where the coastal winds facilitate interaction with buildings. Population growth in the CBDs also resulted in an increase in the number of people who are currently working and/or living in tall buildings throughout the CBDs.

Several potential methods of gathering survey data were examined. Alternatives included 'on the spot' interviews, survey handouts with reply-paid envelopes, letterbox drops of surveys, online web enhanced survey and surveys conducted on a portable touch screen devices such as an iPad. After consideration of the methods used to survey the public in Wellington and Hong Kong, it was concluded that the best method that would likely to achieve the highest rate of return and generate the best quality data would be to handout survey packs with a reply-paid envelope.

The use of survey packs allows for a quick distribution and also allows the participant to answer the questionnaire at their leisure, making it the most efficient method of gathering data. "On the spot" interview is time-consuming and even highly-trained interviewers are unlikely to capture any sizable sample in a time-poor environment in any typical CBD. The fact that participants were able to take the survey with them and complete it in their own time as opposed to being stationary while being asked a series of questions was a great advantage in reaching out to a large sample. Therefore, instead of taking up a substantial amount of time simply to capture a participant to conduct a one-on-one interview, the distributors were able to speak to potential participants briefly to explain the purpose and nature of the survey, enabling them to take the survey pack with them. This is an efficient method to distribute a large number of survey packs in a short time and allows potential participants to consider their decision to complete the survey at their leisure. In practice the return rate of completed survey depends largely on the proportion of people who accepts a survey pack simply to be "left alone" to continue his/her business.

Survey Design

The survey was designed to examine the effect of wind-induced building motion on occupants working in tall buildings and the impact on their day to day activities. The survey also attempted to measure how workplace productivity is affected during building vibration. The survey enquired about a person's experiences with building motion and also examined the person's prior experiences, if any, of motion sickness in their everyday life. Details of the survey questionnaire are presented in Lamb et al. (2012)

The survey pack consists of seven different sets of information:

1. Cover letter
2. Information letter
3. Consent form
4. Survey questionnaire

5. Incentive
6. Reply paid envelope
7. Enclosed envelope

Potential participants who took survey packs were able to complete them at their leisure and return it in the freepost return envelope. It is noteworthy that the each survey pack contains a significant amount of printed information which should preferably be packed compactly for ease of handling by both the distributors and participants.

Human Research Ethics Approval Process

Every research project that requires human interaction has to abide by the rules and regulations set out in the National Ethics Application Form (NEAF) Version 2008 - V2.0 and approved by UWS Human Research Ethics Committee (HREC). These regulations are used by the HREC to protect the participants involved in the research. Protection of participants can vary from their health and safety to privacy so that no personal information is revealed publicly.

For the proposed survey in this project to be approved, HREC examined detailed information supplied by the project team which included:

1. Title and summary of project
2. Researchers/Investigators
3. Resources
4. Prior review
5. Project
6. Participants
7. Confidentiality/privacy

It is not uncommon for the approval process to undergo a number of revisions before HREC acknowledges that the project will not pose any threat to the participants or cause any conflicts of interest, prior to approval given for the survey to proceed. One of the major issues was the offer of incentive to participants to complete the survey, which caused a significant delay in securing approval by HREC.

Incentives

To compensate individuals for their time and efforts participants were offered an incentive. It has been found that within the range of incentives offered, the greater the incentive, the greater the difference in response rates between the lowest and the highest incentive conditions. Incentives are therefore considered to increase the survey response quantity but not necessarily increase the quality of the response (Church 1999).

Although a substantial incentive of 3 iPads was initially proposed as a raffle/draw to attract participants to the survey, the UWS Human Research Ethics Committee (HREC) considers raffles/draws an inducement to participant rather than reimbursement and can be perceived as potentially coercive, and only approves reimbursement that is offered to all participants equally.

An incentive in the form of a \$1 lottery ticket with a prize of \$20,000 is relatively inexpensive and is an attractive inducement to encourage participation. However, this was disallowed by HREC who considered offering a lottery ticket as encouraging/promoting gambling and hence is inconsistent with concerted efforts to remedy problem gambling at state and national level.

A free cup of coffee was finally adopted as an incentive to promote the survey and encourage participation. The coffee incentive was offered to all participants and included in each survey pack. The project received approval by HREC on 12 July 2011 to proceed with the survey.

Although the cost of a cup of coffee is relatively inexpensive, the cost associated with supplying up to 4000 cups of coffee is substantial. Hence the following criteria were used in selecting a vendor:

- The cost of each redeemed cup of coffee.
- The location of the coffee vendor which should be easily accessible by the general public.
- The flexibility of the coffee vendor to take into account redemption-based payment in drawing up the contract.

Major fast-food chains and convenience stores have many outlets in the CBDs, but surprisingly none was able or willing to supply coffee vouchers at bulk discount. Although the exact reasons are unclear, this may be due to the franchise nature of these stores with different franchisees/owners, franchise restrictions, and/or marketing and profit models used by these different outlets. Specialty coffee chains were also unable to offer coffee at bulk discount. As a result, smaller coffee vendors who satisfied the above criteria were approached to supply the coffee incentive vouchers.

The negotiation with a number of shortlisted coffee vendors was conducted face to face to secure the best possible supply contract. It was highlighted to the coffee vendors the opportunity for marketing and to gain publicity for being part of a government-funded research project. Over the course of 3 days, 11 people will distribute 4000 survey packs all over Sydney and North Sydney CBDs. With each survey pack containing a coffee voucher with company logo, the vendor achieved wide-spread advertising for a product in the CBDs at a small fraction of the normally expensive associated with advertising at such a scale.

The contract was finally awarded to a coffee shop in one the biggest shopping complexes in the heart of Sydney CBD. The shop supplied 4000 coffee vouchers in the form of a business card at a cost of \$5000, agreed to offer a "regular" coffee for the first 2000 vouchers presented, and reimbursed by the project \$2.50 for each additional voucher over 2000. Although it was felt unlikely that 2000 vouchers would be redeemed, i.e. a 50% redemption rate, and 1000 redemptions, i.e. a 25% redemption rate, would be a more realistic target, the cost was considered justified based on the coffee shop satisfying all the required criteria, the high overheads in Sydney CBD, and time constraint.

Other logistical and unauthorised usage issues were dealt with effectively by placing an expiry date of 31 October 2011 on the coffee vouchers, approximately 6 weeks after the distribution of the survey packs. An UWS label was also placed on all vouchers for authentication.

Survey Distribution

In order to conduct the research through distribution of survey packs within various CBDs, relevant state, local and private regulatory authorities needed to be contacted to obtain official approval. These authorities include the Roads and Traffic Authority (RTA), relevant local councils, City Rail, the NSW Police Department and management offices of targeted shopping centres within the CBDs. In addition to security and safety clearance required by these authorities, all distributors, in this case UWS students and other paid casual workers, have to undergo an occupational, health and safety briefing in accordance with UWS guidelines governing field work.

The main buildings that were targeted were landmark tall commercial office buildings which are occupied throughout the majority of the work day. The occupants of these tall buildings are likely to have experienced wind-induced building motion.

The time of day when the survey packs were distributed was a key factor. The morning and evening peak hours were found to be the ideal time to distribute the survey packs as most people will be entering or exiting buildings. Another targeted period was from 11 am to 2 pm when most people take a lunch break.

Appearance was a vital component in contributing to the success of the distribution phase of the project. The first impression was critical, as members did not want to be mistaken for a marketing or promotion scheme. All distribution members were dressed in smart casual clothing to look “professional”, this included a neat button up shirt, formal trousers and formal shoes, and wore a student ID for identification purposes. All members found that being smartly dressed and wearing student identification aided them when they approached potential participants.

It was vital that the survey packs were distributed in a manner which gave potential participants a sense of confidence and security that the survey was not a gimmick/con in obtaining information. The ability to build a quick rapport with the person you wanted to hand out a survey pack to was very important, as they were more inclined to take the survey pack and complete the survey later.

Evidently during peak hours, long dialogues are not able to be used as all commuters were in a rush and most were unwilling to stop and speak. Prior to commencing the distribution, members were provided with a sample dialogue to rehearse. This was meant to be used as a guide only when approaching target participants in the field and allowed individual member to personalise the final approach dialogue.

Upon commencement of the distribution process, it soon became apparent that emphasising the incentive of a free coffee was not particularly successful. Most people thought it was a marketing gimmick. Each member has to improvise and experiment with different approaches with mixed results. The approach technique used with the highest rate of success was: “Hi, could you please help with my university research”, and this approach was adopted as the standard approach.

At the start of the distribution process, approximately 1 in 10 people accepted the survey pack. However as the day progressed, members began to develop their individual approach methods and as their experience and confidence grew, so did the survey acceptance rate. By the end of the last day of distribution, most members were achieving a 1 in 4 success rate and some members were able to obtain a 1 in 2 success rate. In total, 4000 survey packs were distributed by 11 distributing members in Sydney and North Sydney CBDs over a period of 3 days.

It is noteworthy that after the targets have expressed an interest in participating in the survey, they often requested further information about the nature of the research, the university conducting the research and instructions of completing the survey. Furthermore, by letting the participants know that they could take the survey to work or home and complete it when they have some free time was beneficial.

The most encouraging aspect of this project was that the majority of participants who accepted the survey packs took them because they appeared to be genuinely interested to contribute their personal experiences to the research, or because they graduated from the same university, i.e. UWS alumni. By adding that they were a group of final year students and this was research undertaken as part of their final project intrigued many

participants and appealed to their compassion in wanting to help the group out with the project.

Although the offer of a free coffee is a goodwill gesture in recognition of the time and effort a participant spent in completing the survey, its real impact remains unclear. Part of the value of an incentive is the gesture of the offer itself, not necessarily the momentary value of the incentive. Studies have shown that people often reciprocate to a higher relative value than the initial offer (e.g. Regan, 1971). In other words, if the value of the coffee was \$5, people might reciprocate with their time, which for arguments sake they might value at \$10. Despite the low rate of redemption, the actual effect of the incentive on the response rate is unclear. Relying on altruism may have been sufficient given this study was for a university project, but given the high costs of printing and survey development, it seems prudent to offer some sort of incentive even if the benefit is not immediately apparent. One exception is large scale government funded surveys (e.g. travel surveys) which attain very high response rates (up to about 85%) and offer no form of incentive, instead employing a time consuming and labour intensive recruitment period.

Conclusions

The process used in collecting data on occupant response to wind-induced tall building motion through a general population survey in Sydney was outlined in this paper. The process consisted of:

1. Identifying potential locations with a high density of tall buildings where occupants are likely to have experienced building motion.
2. Obtaining approvals from relevant government and regulatory authorities to undertake a general population survey.
3. Designing a suitable survey pack that is simple and convenient for participants to carry and complete.
4. Obtaining approval by UWS Human Research Ethics Committee to undertake the survey.
5. Selecting a suitable incentive that entices and rewards participants for their time and effort to complete the survey questionnaire.
6. Distributing the survey pack with a high acceptance rate by establishing a good approach strategy and delivery method.

One of the most time-consuming processes for this project was completing and revising the proposal, and securing the approval by the UWS Human Research Ethics Committee to proceed with the survey. The delays were mostly due to the philosophical differences in offering an incentive to participants to complete the survey. Appointing a suitable coffee vendor to supply the incentive of a free cup of coffee also involved considerable time and effort.

In all, 4000 survey packs were distributed over a 3 day period in Sydney and North Sydney CBDs, of which 771 completed surveys were returned, representing a return rate of just over 19%. There were also 6 survey packs returned intact. 419 coffee vouchers were redeemed, which represents a redemption rate of 54% based on the number of completed survey returned, and just over 10% of the 4000 coffee vouchers distributed. The effectiveness and justification of the cost of an incentive in a general population survey remain unclear and are worthy of further investigation.

Data collected in this project are being analysed and will be presented in future to compare with the findings derived from data collected in Hong Kong and Wellington, and with other published results, to advance the understanding of occupant response to wind-excited building motion under different wind climates and for different ethnic populations.

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