Safety Science 47 (2009) 131–137

Contents lists available at ScienceDirect

Safety Science

journal homepage: www.elsevier.com/locate/ssci

Development and evaluation of a risk management methodology for pedestrian surfaces

Alison Hunt-Sturman [a,*], Neale Jackson [b]

[a] University of Melbourne, Faculty of Medicine, Dentistry and Health Sciences, Australia
[b] RMIT University, School of Applied Science, OH& S Unit, Australia

ARTICLE INFO

Article history:
Received 1 September 2006
Received in revised form 12 June 2007
Accepted 21 February 2008

Keywords:
Pedestrian
Surface
Hazard
Risk
Slip
Trip
Fall
Disabled access

ABSTRACT

This paper describes the development and evaluation of the Pedestrian Surface (PS) priority indicator (*PS priority indicator*). This tool was developed to comply with Australian Standard AS 4360: 2004 (Risk Management). Pedestrian surfaces should be evaluated to identify hazards and assess the level of risk calculated in order to ensure that the surfaces do not have a significant level of risk. If a significant level of risk is present, then control measures should be implemented. Pedestrian surfaces for the purposes of this research are classified as same level surfaces (excluding stairways) where pedestrians on foot (or by wheelchair) travel from one place to another.

1. Introduction

There is a duty of care to ensure (so far as is reasonably practicable) that the working environment is safe and without risks to health (OHS Act, Vic., 2004). This requires a strategic approach to conduct risk management activities on all aspects of workplace safety, including assessing the surfaces that pedestrians use to move through the environment.

Pedestrians can be injured when using pedestrian surfaces in a number of ways, by slipping, tripping or falling, by colliding with a vehicle on a shared pedestrian/car roadway, or be injured if a pedestrian surface does not accommodate the special needs of pedestrians with disabilities.

Injuries to pedestrians using pedestrian surfaces are on the increase. Data collected from the VWA Statistical Summary, reports that slips, trips and falls (STFs) account for approximately 18% of Workcover claims (VWA, 2001/2002). This figure has been increasing since 1992/1993 when just over 13% of claims recorded were from STFs. Also, pedestrians are one of the most vulnerable road users, and the largest road user group (Royalauto, 2005). Seventy-five percent of pedestrian fatalities occurred on metropolitan roads. Traditionally the design of road safety infrastructure has not taken the specific needs of pedestrians into account (Royalauto, 2005).

The process for identifying hazards, assessing risks and evaluating control measures should comply with the requirements in the Risk Management standard (AS 4360: 2004). The key to the standard is that hazards with high risk levels, must have control measures implemented. The identification of hazards must incorporate information gathered from a variety of sources and involve consultation with users. The assessment of risk must be systematic. An assessment tool should calculate a level of risk for the identified hazard. High scores will indicate to the assessor that an appropriate control strategy is required to control the problem. Then, the implementation of control measures should be based on the hierarchy of control relevant to the degree of risk.

The aim of this research was to review existing hazard identification and risk assessment tools and use their methodology to develop the *PS priority indicator*. This tool is a comprehensive risk assessment methodology to be used on pedestrian surfaces that priorities areas of significant risk. This tool will assist in the identification and assessment of surface hazards, and environmental

* Corresponding author. Tel.: +61 3 8344 9982.
E-mail address: asturman@unimelb.edu.au (A. Hunt-Sturman).

0925-7535/$ - see front matter © 2008 Elsevier Ltd. All rights reserved.
doi:10.1016/j.ssci.2008.02.005

hazards on pedestrian surfaces. It is anticipated that the tool will be flexible and will have potential for use in a range of locations and surface types.

2. Evaluation of current hazard identification and risk assessment methodologies

2.1. Current approaches

Checklists are used widely for assessing manual handling activities, plant, workplace inspections and dangerous goods. Checklists are effective at highlighting problems that a simple walkthrough inspection may not identify. Checklists and audit tools are beneficial for this reason.

An example of a checklist used to identify hazards on pedestrian surfaces is the Slips, Trips and Falls Checklist (Version 1.02, Worksafe, 2004). This checklist itemizes key factors which assist in identifying common problems with surfaces. Using the checklist on an area may identify issues through a series of questions. The YES and NO answers to each of the questions can quickly highlight an issue. However, checklists identify the hazards, but do not assess the level of risk.

Measurement of the 'slip resistance' of surface materials is an accepted methodology to determine the appropriateness of materials used in paving and other walkway surfacing operations (Di Pilla and Vidal, 2002). AS/NZS 4586 lists the five accepted test methods for determining the slip resistance of existing pedestrian surfacing materials.

However, as an example, two of the methods; the wet/barefoot ramp test and the oil-wet ramp test use human based testing of surfaces. Subjects walk barefoot or wearing shoes, along an inclined surface which is gradually raised to increase the degree of the slope, until it is too steep to walk on. The level of slip resistance is recorded by the subject when they slip on the surface or continue to walk on the steeper incline. Slipmeters may be used to measure the slip resistance or slipperiness of a surface, but these measurements only assess a single identified hazard.

One other method for controlling hazards on pedestrian surfaces is to stipulate footwear controls. A recent publication on safety in the hospitality industry (Workcover Corporation South Australia, 2004) has an information sheet about slips, trips and falls. The suggested controls in this publication highlight the requirement to wear footwear appropriate to the floor surface. Although this may be good practice in controlled environments, it is not possible in most public areas.

Behavioural management programs are also used as a pedestrian surface management tool. These programs aim to encourage pedestrians to take greater care when walking. Bimonte (1996) places a heavy reliance on the TAKE Principle (Talk, Actions, Knowledge, Equipment) to persuade individuals to take the time to think before walking across a hazardous surface in order to prevent incidents.

Checklists, slipmeters, footwear restrictions and behavioural management programs fall short of compliance with the Risk Management Standard (AS 4360: 2004). They either do not assess the level of risk on a surface, or ignore the hazard identification process completely and require the implementation of controls that may not be appropriate to the surface activities. Therefore novel approaches were investigated to determine whether there was a better risk management process.

2.2. Novel approaches

A study to evaluate the safety of staircases (Nikolic, 1999) used a checklist. Each question was allocated a numerical risk score which enabled ranking of the staircases in order of greatest risk. This risk management methodology both identified hazards and assessed the risk in a single step.

The Slips Assessment Tool produced by the Health and Safety Executive (HSE), 2004 also used a numerical assessment of factors using a set of weighted questions. However, this tool was limited; it could not be used on carpet, did not assess trip hazards, disabled access or pedestrian safety, and used a gripmeter to measure the slip resistance of the surface. This gripmeter required frequent calibration and stringent cleaning of the surface prior to use.

Both of these novel tools combine a checklist with a risk assessment tool. The tools use checklist questions and allocate to each question a numerical risk score. Each checklist item is separately risk assessed. The advantage in this approach is that the scores from each of the questions add up to a risk score which is a profile of the surface.

2.3. The PS priority indicator approach

Methods currently available to identify hazards and assess risks on pedestrian surfaces are not doing so comprehensively and therefore there is a gap in current control strategies to ensure a systematic approach to risk management. There is a need to develop a tool that does identify all hazards on pedestrian surfaces, assess their risks and suggest appropriate control strategies.

The aim is to develop a tool that will assess pedestrian surfaces for the risk of a STF, and for other hazards such as vehicles and bicycles. The project will not investigate stairways, working at heights, roadways (unless used by pedestrians) or other manual handling related issues.

The *PS priority indicator* was developed in several stages:

1. Collation of hazard criteria into categories and preparing a risk score calculator.
2. Identification of pre-existing hazards (very high risk).
3. Implementation of elimination of very high risk hazards.
4. Evaluation of the hazard criteria and risk score calculator using a series of tests:
    a. Validation of the *PS priority indicator*.
    b. Flexibility of the *PS priority indicator*.
    c. Reliability of the *PS priority indicator*.
5. Determination of an action point (level of significant risk).
6. Collation of suggested control criteria and development of a control actions table.
7. Evaluation of the control actions table after implementation of suggested controls.

3. Development of the *PS priority indicator*

3.1. Collation of identification factors

In order to assess a pedestrian surface, it is necessary to identify the hazards specific to that surface. Using the novel approach of the staircase safety project (Nikolic, 1999), a list of risk factors will be selected. These factors are the conditions on a pedestrian surface that represent categories of hazards.

Checklists and audit tools used for pedestrian surfaces already contain a number of very relevant hazard identification factors. The checklist criteria were evaluated for their content and application. Criteria which were valid and applicable were selected for further evaluation. The review revealed a number of criteria commonly used in the identification of hazards on pedestrian surfaces. The slip hazard audit produced by King (1999) included a number of relevant factors. Disabled Womens' Network Ontario (DAWN)