



Information Sheet - Misstep Hazards

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Summary

Misstep occurs when the walker encounters an unexpected change in level of the walking surface which results in a loss of balance and a fall. This change in height can occur on ramps, stairs and other surfaces and does not need to be abrupt. Any unmarked deviation of 12mm or more represents a misstep hazard to pedestrians.

Human Gait

Information on human gait is provided on a separate information sheet¹ that describes the various phases and events of gait. The study² of human gait shows that persons walking in a built environment have an expectation to place each foot on a surface that is the same as the last step. In respect to misstep, the principal relationship is the movement of the foot at or near 'initial contact'. However:

- If the surface level is higher than expected then contact between the foot and the surface will be premature. 'Initial contact' will actually occur at a time in the gait cycle when 'terminal swing' is still occurring.
- If the surface is lower than expected then contact between the foot and the surface will be late. 'Initial contact' will occur at a time in the gait cycle when 'loading response' is expected. That is, the pedestrian is expecting to shift weight onto the leading leg which is not yet touching the surface.
- If the surface is uneven and does not fully support the foot then the weight shift that normally occurs during 'loading response' will not occur correctly. The receiving leg may not accept the weight transfer if it is not appropriately supported by the surface.

In each case, unsuspected contact of this type is likely to result in a misstep, which will disturb the balance of the pedestrian and may result in a fall.

Misstep Hazards

It is our experience in investigating pedestrian accidents and accident sites that an inconspicuous change of height of 12mm (½ inch) is sufficient to initiate a misstep. This is consistent with other published materials.

Brown & Obenski³ states that *"a small deviation in the flooring such as a one-half inch [12mm] depression can cause a sudden, unexpected loss of balance and a fall"*. Templer⁴ examines misstep in relation to ascending and descending stairs. He identifies the need for uniform riser height in stairs. This is reflected in standards such as AS1657 that limits variation in riser and going dimensions to ± 5 mm.

Civil & Forensic is a firm of civil, structural and accident reconstruction engineers based in Bathurst, New South Wales, Australia. Andrew and Alan Brown are experienced engineers and directors of the firm. You can contact Andrew (andrewb@cnf.com.au) and Alan (alanb@cnf.com.au) by email. This information sheet is available for download at their web site - www.cnf.com.au

¹ Information Sheet - Human Gait, Andrew & Alan Brown, Civil & Forensic Pty Ltd - www.cnf.com.au

² "Gait Analysis- an introduction" Second Edition, MW Whittle, Butterworth-Heinemann, 1996

³ "Forensic Engineering Reconstruction of Accidents", Brown & Obenski, Charles C Thomas Publisher - 1989

⁴ "The Staircase", John Templer, The MIT Press, 1992