Quantifying Pedestrian Friendliness – Guidelines for Assessing Pedestrian Level of Service

Nicole Gallin

Abstract

A study was undertaken for Main Roads Western Australia by BSD Consultants and aimed to develop guidelines for assessing the *Level of Service* (LOS) of pedestrian facilities in Western Australia. Guidelines exist for assessing vehicular traffic LOS (Austroads) and cycling LOS (Main Roads WA). The formulation of LOS guidelines for pedestrians completes the LOS framework for vehicular, bicycle, and pedestrian traffic.

Pedestrian LOS is an overall measure of walking conditions on a route, path, or facility. This is linked directly to factors that affect mobility, comfort, and safety, reflecting pedestrians' perceptions of the degree to which the facility is 'pedestrian friendly'.

A unique model based on several factors affecting pedestrian LOS was developed to facilitate LOS measurement. These factors fall into three categories; physical characteristics, location factors, and user factors. These factors were weighted by relative importance and a LOS scale was developed to describe the LOS of pedestrian routes. Pedestrian conditions are described through a LOS grade from LOS A (ideal pedestrian condition) to LOS E (unsuitable pedestrian conditions), based on an assessment of the factors affecting LOS. The assessment includes desktop and on-site assessment of LOS factors.

The development of the model was an iterative process that involved testing and refinement. The research undertaken and the LOS model developed provides a sound basis for the ongoing measurement of LOS for pedestrians. The model not only provides the opportunity to test the LOS provided by a pedestrian route, but also determines which factors contribute to low and high LOS.

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Nicole's work involves a major focus on transport modelling, public transport planning, planning of cyclist and pedestrian networks, and consultative processes.

Nicole was the Project Leader for the Development of Pedestrian Level of Service Guidelines project undertaken for Main Roads WA, upon which the paper is based. Nicole's particular responsibility on this project involved overseeing the project team and development of the model for assessing level of service provided on pedestrian facilities.

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Introduction

The concept of LOS for vehicular traffic is widely recognised in Austroads and other popular traffic engineering publications. Main Roads WA have previously developed LOS guidelines for cyclists on roads and shared paths. The formulation of LOS guidelines for pedestrians completes the LOS framework for vehicular, bicycle, and pedestrian traffic.

LOS for pedestrians is defined as;
An overall measure of walking conditions on a route, path or facility. This is directly linked to factors that affect pedestrian mobility, comfort and safety. It reflects the pedestrians' perceptions of the degree to which the facility is pedestrian friendly.

Background

This paper has come about as a result of a study undertaken by BSD Consultants for Main Roads WA. The purpose of this study was to develop a simple model for determining how well paths and roads cater to the needs of pedestrians. The process involved the formulation of a method for assigning a LOS grade to pedestrian facilities that was based on the interpretation of factors affecting pedestrian LOS and the degree to which these factors are provided (or absent) on selected path segments.

Austroads describes a general framework for the determination of pedestrian LOS and the method described within this paper draws on the Austroads information. Other pedestrian oriented literature was also sourced, although it was found that much of the available literature was not relevant to the Western Australian environment, but instead may be more appropriate to cities with higher densities and pedestrian flows.

Factors Affecting Level of Service

Factors affecting LOS for pedestrians were defined in consultation with key stakeholders. These factors were classified as design, location, or user factors. The factors identified, totalling eleven, included the following.

Design Factors (Physical Characteristics)

- Path Width: a measure in metres of the width of the path that is available to pedestrians.
- Surface Quality: a description of the quality of the surface of the path. Excellent quality means a continuous, smooth but skid resistant surface, without cracks and bumps or weed intrusion.

- Obstructions: a measure of the number of obstructions per kilometre on the path being assessed. Assessment of this factor is essential to determine the access available to people with disabilities. Obstructions may be permanent (e.g. poles, signs, chairs etc.) or temporary (e.g. bins, parked cars etc.). Stairs are considered an obstruction if no alternative is available for people with mobility disabilities.
- Crossing Opportunities: the type and number of facilities provided to assist in the safe crossing of roads and paths by pedestrians. Includes median refuges, pelican crossings, guarded crossings, crosswalks, underpasses, and overpasses. 'Delay in crossing' is also a characteristic of this factor.
- Support Facilities: the presence of facilities that assist pedestrians during their journey and includes tactile paving, colour contrast kerbing, provision of rest stops, kerb ramps, lane markings, signage, landings on long ramps etc.

Location Factors

- Connectivity: the degree to which the path provides a useful, direct and logical link between key departure points and destinations.
- Path Environment: ***a*** measure of the quality of the path environment dictated by its surroundings. The degree of 'pleasantness' of the surrounding environment will often relate to distance from the roadway.
- Potential for Vehicle Conflict: a count of the number of potential vehicle conflict points along the route including intersections and driveways. Conflict points to be measured per path kilometre. The potential for pedestrian conflict increases with increased intersection and driveway frequency.

User Factors

- Pedestrian Volume: a count (or estimate) of the number of pedestrians using the path expressed as an average daily count.
- Mix of Path Users: an estimate of the various groups who use the path as a percentage of total pedestrians. Groups include pedestrians, cyclists, roller-skaters, etc. When assessing this factor, consideration should be given to the various types of pedestrians, including recreational pedestrians and pedestrians 'with a purpose' i.e. people walking to work, to shops etc.
- Personal Security: qualitative measurement of the degree to which the path is safe for users. Characteristics of this factor include the provision of adequate lighting (from both direct and indirect sources), path visibility from the surrounding environment, sight distance etc.

Measurement Process For Factors Affecting Pedestrian LOS

Table 1 describes the measurement process for each of the above factors. Most factors should be measured during site visits, although some can be examined through a desktop assessment.

Level of Service Scale

Within the pedestrian LOS definition there is a range of LOS for pedestrians. Based on this range, a number of 'LOS grades' are defined.

Table 1: Measurement of Factors Affecting Pedestrian LOS

Category	LOS Factor	Method of Measurement	Example
Design Factors (Physical Characteristics)	Path Width	Measure from plans or during site visit	2.5m
	Surface Quality	Examine during site visit	Unsealed, many cracks, bumps
	Obstructions (per km)	Count during site visit	10 obstructions
	Crossing Opportunities	Assess during site visit	None provided and are necessary
	Support Facilities	Examine during site visit	Many provided and well located
Location Factors	Connectivity	Assess from street directory maps and during site visit	Non existent
	Path Environment	Assess from street directory maps and during site visit	Unpleasant, next to kerb (and therefore vehicular traffic)
	Potential for Vehicle Conflict (per km)	Count during site visit	10 driveways and 1 signalised intersection, i.e. 11 potential vehicle conflict points
User Factors	Pedestrian Volume	Local Government statistics or count during site visit	350 pedestrians per day
	Mix of Path Users	Count during site visit	Mostly pedestrians, few cyclists
	Personal Security	Assess during site visit, preferably at night	Poor, i.e. unsafe

These graded definitions relate to the adequacy of facilities for pedestrians and are intrinsically related to the eleven factors affecting pedestrian LOS. For example, LOS A indicates the best operating conditions and environment for pedestrians, which may include a wide path with a good quality surface, no obstructions, limited opportunities for conflict with vehicles, few cyclists to compete for space and a safe, pleasant, open environment with adequate lighting. LOS E, on the other hand, is the opposite end of the scale and may be allocated to a narrow path in an unsafe environment, which is close to vehicular traffic and has many potential vehicle conflict points.

Based on this understanding, and the definition of factors influencing pedestrian LOS, the following LOS grades were defined;

- **LOS A** is a pedestrian environment where **ideal pedestrian conditions** exist and the factors that negatively affect pedestrian LOS are minimal.
- **LOS B** indicates that **reasonable pedestrian conditions** exist but a small number of factors impact on pedestrian safety and comfort. As LOS A is the 'ideal', LOS B is an acceptable standard.
- **LOS C** indicates that **basic pedestrian conditions** exist but a significant number of factors impact on pedestrian safety and comfort.
- **LOS D** indicates that **poor pedestrian conditions** exist and the factors that negatively affect pedestrian LOS are wide-ranging or individually severe. Pedestrian 'comfort' is minimal and safety concerns within the pedestrian environment are evident.
- **LOS E** indicates that the **pedestrian environment is unsuitable**. This situation occurs when all or almost all of the factors affecting pedestrian LOS are below acceptable standards.

When considering the assignment of these LOS grades it is important to note that the safety of pedestrians is never guaranteed, even within a LOS A environment.

Level of Service Model

A model for assessing pedestrian LOS was developed based on the measurement of factors influencing LOS, and the LOS scale described in this paper.

Weightings were developed in consultation with key Stakeholders and are presented in the assessment sheet (Table 2).

Description of the Model

A number of simple steps need to be completed to determine the pedestrian LOS grade for a selected path segment. These steps are presented in the following flow chart and should be read in conjunction with Table 2. Table 2 is an assessment sheet that contains the 11 factors included within the model, a relative weighting for each factor and a range within each factor. This range is described within a number of columns with allocated scores. The column with zero points describes the worst case scenario (eg. unsafe, path less than 1m wide etc). The remaining columns have 1, 2, 3 or 4 points and increase in 'pedestrian friendliness' as the scale increases.

Desktop Assessment of LOS Factors
↓
On-site Assessment of LOS Factors
↓
Calculate Score for Each Factor
↓
Calculate Weighted Score for Each Factor
↓
Calculate Total Weighted Score
↓
Allocate LOS Grade A - E

Figure 1: Description of the LOS Model Stages

Application of the Model

Desktop Assessment of LOS Factors

Initially, desktop investigations are undertaken for each of the factors affecting LOS for pedestrians. Factors such as pedestrian volume, route continuity and path width can generally be assessed, at least initially, through desktop investigations using available data, engineering drawings (to measure path width) and the street directory (to partially assess route continuity).

On-Site Assessment of LOS Factors

Following the desktop assessment, site visits are undertaken to gather information not available through desktop means and to confirm the information determined through desktop assessments. Both desktop and on-site investigations are necessary to gain a comprehensive and accurate understanding of the segment of path under consideration.

Table 2: Assessment Sheet for Model to Determine LOS for Pedestrians

Category	Factor	Weight	0 points	1 point	2 points	3 points	4 points
Design Factors (Physical Characteristics)	Path Width	4	No pedestrian path	0-1m	1.1 - 1.5m	1.6 - 2.0m	more than 2m wide
	Surface Quality	5	unsealed and/or many cracks/bumps, ie very poor quality	poor quality	moderate quality, i.e. some cracks/bumps etc.	reasonable quality, ie acceptable standard	excellent quality (continuous surface with very few bumps/cracks etc)
	Obstructions	3	more that 21 obstructions per km	between 11 and 20 obstructions per km	between 5 and 10 obstructions per km	between 1 and 4 obstructions per km	no obstructions
	Crossing Opportunities	4	none provided, difficult to cross	some provided but poorly located	some provided and are reasonably well located but more are needed	adequate crossing facilities are provided and are reasonably well located OR none are provided as they are unnecessary	dedicated pedestrian crossing facilities are provided at adequate frequency
	Support Facilities	2	non existent	few provided and poorly located	few provided and reasonably well located	several provided and well located OR absent but unnecessary	many provided and well located
Location Factors	Connectivity	4	non existent	poor	reasonable	good	excellent
	Path Environment	2	unpleasant environment, close to vehicular traffic	poor environment, may be within 1m of kerb	acceptable environment, between 1 and 2m of kerb	reasonable environment, between 2 and 3m from kerb	pleasant environment, pedestrians more than 3m from kerb
	Potential for Vehicle Conflict	3	severe, more than 25 conflict points per kilometre	poor situation, between 16 and 25 conflict points per km	moderate, ie 10 to 15 potential vehicle conflict points per km	reasonable, 1 to 10 or less conflict points per km	no vehicle conflict opportunities
User Factors	Pedestrian Volume	3	More than 350 per day	226 to 350 per day	151 to 225 per day	81 to 150 per day	Less than 80 per day
	Mix of Path Users	4	majority of path users are non-pedestrians	approx 51% to 70% of path users are non-pedestrians	between 21% and 50% non-pedestrian path users	less than 20% non-pedestrians	pedestrians only
	Personal Security	4	unsafe	poor	reasonable	good	excellent security provided

Calculate Score for Each Factor

When the information relevant to each factor influencing LOS has been gathered for the test segment, Table 2 is referenced and the appropriate column within the table is identified. A 'score' is given to each factor as it relates to the path under investigation. For example, when assessing the width of a path that is 1.25m wide, the score allocated would be '2', as the range indicated within this column in Table 2 is 1.1m to 1.5m.

Calculate Weighted Score for Each Factor

The score for each factor is then multiplied by the relative weighting assigned to each factor. For example, using the path width example above, the weighted score would be 8 (i.e., weight of 4 multiplied by a score of 2).

Calculate Total Weighted Score

The individual weighted score for each factor is summed to gain a total weighted score for the path segment in question.

Allocate LOS Grade A to E

Following the calculation of the total weighted score, the total score is cross-referenced with Table 3 to determine the actual pedestrian LOS grade to be assigned to the path segment.

Table 3 provides the range of scores determined for the allocation of pedestrian LOS grades. These ranges allow for an even distribution of scores across each LOS grade. For example, the range allows for path segments with an average point score of approximately 1 (or lower) to be awarded an 'E' LOS, and an average point score of 3.5 or above to be awarded a LOS grade of 'A'. The remaining LOS grades lie within these two extremes.

Table 3: Pedestrian LOS Grade Scale

LOS Grade	Range of Scores
A	132 or higher
B	101 to 131
C	69 to 100
D	37 to 68
E	36 or lower

Testing the LOS Model

A number of path segments were selected in conjunction with Main Roads WA for model calibration and to evaluate the LOS model presented within this paper. These test segments were selected as they represent a general cross section of paths in varying environments (residential and commercial). Examples of the segments of paths selected for testing are:

- *Curtis Road in Melville between Marmion Street and Jason Street* - local residential street adjacent to a primary school. Approximate length is 1km.
- *Hay Street West Perth between Havelock Street and Thomas Street* - busy commercial street with high pedestrian traffic during weekdays, particularly during the mid-day period. Approximate length is 700m.

The information relating to each factor affecting LOS within the model was collated for each path segment and was weighted in terms of the relative importance of each factor.

This information is presented in Tables 4 and 5.

Table 4: Curtis Road in Melville between Marmion Street and Jason Street and between Kitchener Road and Canning Highway

Category	Factor	Measurement / Value	Number of Points	Weight	Weighted Score
Physical Characteristics	Path Width	1.2m	2	4	8
	Surface Quality	Many cracks and bumps	0	5	0
	Obstructions	Some low hanging trees	3	3	9
	Crossing Opportunities	Path on one side of the road only, no kerb ramps	0	4	0
	Support Facilities	None	0	2	0
Location Factors	Connectivity	Poor	1	4	4
	Path Environment	Reasonable	3	2	6
	Potential for Vehicle Conflict	Approx 13 (one side of the road only)	2	3	6
User Factors	Pedestrian Volume	Assume less than 80 per day	4	3	12
	Mix of Path Users	Mostly pedestrians, assume approx 80%	3	4	12
	Personal Security	Poor, limited lighting	1	4	4
				TOTAL	**61**

LOS D

Table 5: Hay Street West Perth between Havelock Street and Thomas Street

Category	Factor	Measurement / Value	Number of Points	Weight	Weighted Score
Physical	Path Width	More than 2m but varies	4	4	16
Characteristics	Surface Quality	Brick paved, excellent quality in general although some slabs of lesser quality are provided at the eastern end of the test segment	4	5	20
	Obstructions	Some tables and chairs at cafes obstruct pedestrian traffic, although sufficient room is generally provided	2	3	6
	Crossing Opportunities	Adequate, one crosswalk is provided, although a crossing in the middle of the heavy commercial street would be advantageous	2	4	8
	Support Facilities	Rest facilities, colour contrast kerbing and tactile facilities all provided	4	2	8
Location Factors	Connectivity	Good	3	4	12
	Path Environment	Next to kerb, generally acceptable	2	2	4
	Potential for Vehicle Conflict	Moderate, approx 5 driveways/ intersections	3	3	9
User Factors	Pedestrian Volume	Assume more than 350 per day	0	3	0
	Mix of Path Users	Almost all pedestrians	4	4	16
	Personal Security	Excellent, lighting provided	4	4	16
				TOTAL	**115**

LOS B

Conclusion

Eleven factors affecting LOS for pedestrians have been defined under three categories; physical characteristics, location factors and user factors. These were selected in association with Stakeholders from a comprehensive list of factors that may influence pedestrian LOS.

A model for the assignment of a LOS grade to path segments was developed based on identified factors, liaison with Stakeholders and a best practice review of available literature. The model requires both desktop and on site investigations to gather the appropriate information for each path segment.

The model was calibrated through the testing of several path segments that were selected in consultation with Main Roads WA and illustrate a general cross section of paths within Metropolitan Perth. Two path segments used in the testing process have been presented in this paper and it was found that the LOS for each path varied somewhat (LOS B for Hay Street path segment and LOS D for Curtis Road path segment).

The research undertaken and the LOS model developed for this project provides a sound basis for the ongoing measurement of LOS for pedestrians. The model provides the opportunity to test the LOS provided by a pedestrian path, as well as determining which factors contribute to low and high LOS. This will create the ability to pin-point aspects of paths that may be improved to increase the LOS.