

Road User Safety Investigation for Pedestrian Priority Zones (Shared Zones) on the Gold Coast

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Abstract

In 2015, Point8 was engaged by the City of Gold Coast to develop a methodology to assess the relative safety of Pedestrian Priority Zones (PPZ). A PPZ is defined as a low speed, shared zone environment that prioritises pedestrian movements over vehicle movements and encourages pedestrian activity. The successful design of PPZs requires careful consideration of engineering elements, urban planning and landscape architecture. As a result the design of PPZ environments is complex, unique to each location and non-standardised.

Recognising the difficulty in quantifying the road safety risk of such complex environments, an assessment tool has been developed based on the Safe Systems approach. A range of safety performance outcomes related to pedestrian and cyclist safety were identified that consider both tangible engineering design aspects and less tangible environmental design considerations. The resulting tool is a PPZ safety scorecard that can be applied to existing or potential PPZ at both the concept and detailed design stages. Output scores from the tool can be used to evaluate design options for a specific site or compare the proposed design against benchmark PPZ examples to determine fitness for purpose.

The principles and general approach may have a wide range of uses to develop a similar “safety scorecard” for lower risk situations that have: limited research; unavailability of crash data to allow quantitative assessment of risk; or limited information on treatment options or design guidelines. Such a tool may be appropriate where a prescriptive design situation is not desirable (i.e. each scenario will have a unique context). Other than pedestrian priority zones, this approach may be relevant to assess the design and planning of: internal road networks within private property (e.g. mixed use developments); event management (e.g., walking or cycling event); or industrial applications (e.g. warehouses, freight depots).

Introduction

This paper outlines the development of a methodology to assess the relative safety of Pedestrian Priority Zones (PPZ). The success of PPZs requires careful consideration of engineering elements, transport and urban planning and landscape architecture. The design of PPZ environments is therefore complex, unique to each location and requires bespoke, non-standardised design. Recognising the difficulty in statistically quantifying the safety of such complex environments, an assessment tool (a “PPZ safety scorecard”) has been developed based on the Safe Systems approach.

For the purpose of developing the scorecard, PPZ are defined as a low speed, shared zone environments where priority is given to pedestrian movements over vehicle movements and the focus is on promoting pedestrian activity. Elements of urban design, place making, societal factors and commercial considerations that contribute to the design of a successful PPZ are well documented. However, limited information is available to guide the design and assessment of a PPZ to ensure road user safety. As these zones are by definition very low speed, and are not distinguishable in crash data, no research was identified that evaluates the quantitative safety of such zones.

The PPZ safety scorecard can be applied to existing or potential PPZ at both the concept and detailed design stages. While the tool has been developed to reflect the specific requirements of the City of Gold Coast (the City), the same framework can be applied to a range of similar contexts. These include situations where it is desirable to compare the assessment of risk but quantitative or subjective assessment is unfeasible due to the lack of available data and unique characteristics of each scenario. At the time of writing this PPZ safety scorecard has not been endorsed by the City.

Overview

The project brief was to develop an appropriate mechanism for assessment and comparison of risk at different project stages (e.g. existing conditions, feasibility studies, detailed design). Such a tool would assist the City in decision making, informing stakeholders when concerns are raised and ensuring assessments are impartial and consistent.

Assessment of any risk requires consideration of two fundamentals: probability and consequence. As PPZ environments typically have vehicle speeds in the order of 10km/h, in general both the probability and consequences of the potential vehicle/pedestrian conflict are significantly reduced comparative to traditional roads at higher speeds and volumes. However, while PPZ are slow speed environments, there is still an inherent risk in establishing a formalised area where vehicles and pedestrians interact. The Safe Systems approach also implies that risks other than vehicle interactions must be considered such as risks from cyclists, slips trips and falls, and accommodating mobility impaired users. In addition, to ensure the success of a PPZ in promoting a pedestrian friendly environment, the users' perception of safety must also be given a high priority.

A range of issues relevant to PPZ were researched including design features and road safety for slow speed environments, traffic rules for shared zones, and various risk assessment methodologies. Notably, no road safety research was found with regard to evaluation of risk (i.e. crash statistics) within PPZ areas. This includes comparable environments where a balanced movement of vehicles at slow speeds interact in the same physical space as pedestrians such as carparks. Because these zones are relatively low speed the incidence of serious injury or fatality in these zones is expected to be very low, and therefore is unlikely to be a topic that would attract road safety research. In the context of road safety in relation to the broader road network, the risk to road users in a PPZ (the probability of an injury occurring and the likely severity of an injury) is expected to be lower than for the majority of other urban pedestrianised environments.

As road safety literature and traffic engineering design guidelines focus on high speed environments, and the physical design of PPZ environments is inherently bespoke, there is limited guidance on design principles for these environments particularly with respect to safety. No literature could be identified that would assist designers to assess the relative safety of design options or assess a proposed location to determine suitability for a 'safe' PPZ.

From a legal perspective, Section 83 of the Queensland Road Rules states that a vehicle in a shared zone must give way to any pedestrian in the zone. With regards to implemented speed, the Queensland Road Rules do not include a legally defined maximum speed limit within a shared zone, however the Manual of Uniform Traffic Devices Part 4 recommends a speed limit of 10km/h. The City indicated anecdotal concerns with the perception of safety at particular locations where speed compliance was low and pedestrians felt at risk. During site inspections for the study, it was observed that these zones frequently see pedestrians yielding to vehicles due to safety concerns and users' unfamiliarity with the road rules in shared zones. Ensuring that all users are aware of the need for drivers to give pedestrians priority in these environments was an important objective for the project.

Considered Approaches

Based on the review of available information (including road safety and design) a range of assessment methodology options were considered to assess the relative safety of PPZ. These approaches included:

- Statistical evaluation / trend analysis. This approach is useful where significant detailed data is available that allows regression analysis or similar to establish key variables or isolate particular aspects that can be controlled. For PPZ there is limited appropriate data given the lower severity crash types and the inconsistencies in coding and reporting crashes as shared zones are not a recorded factor in crash reporting.
- Risk assessment approach / road safety auditing approach. This type of approach uses an individual's experience to subjectively assess a location. For PPZ, this type of approach limits those who can consider PPZ safety and results cannot be compared particularly given audits are done in isolation and by different people.
- Prescriptive design standard approach. This approach is suitable for situations where the same standards can be accommodated in the majority of sites. PPZ vary considerably and a 'one-size-fits-all' design solution cannot be applied. If prescriptive design standards were adopted, it is likely that relaxations would be frequently required to accommodate innovation and bespoke design options.

Framework

The assessment tool ("PPZ safety scorecard") developed combines commonly accepted road safety auditing principles and a planning scheme approach to identify desirable outcomes. The adopted road safety principles (referred to as safety traits herein) are: Warn, Inform Guide, Control and Forgive. A 'Context' safety trait was also added which underpins all the other traits by encouraging PPZ to be located in appropriate locations to manage the risk exposure of PPZ users. That is, high pedestrian numbers and low vehicle numbers reduce the likelihood of an incidence and further reinforce all other design aspects of a PPZ.

The PPZ safety scorecard adopts a familiar 'planning scheme' style where performance outcomes are identified and then corresponding acceptable solutions are provided for assessment. Each safety trait has functional characteristics and related performance outcomes which identify the strategic aims for each road user type (see Figure 1). Based on the functional characteristics and related performance outcomes, specific elements are then detailed with the absence or presence of features that contribute to safety performance categorised as desirable, acceptable and undesirable (see Figure 2). This criteria based assessment limits the subjectivity that an assessor can apply. The criteria for each element have been carefully selected to limit the need for detailed data collection while avoiding subjective assessment by the user.

The scorecard uses a weighted scoring system based around a zero average with positive and negative scoring to reflect the relative importance of elements and benefits/disbenefits to the resultant road safety outcome. The scores are tallied and each assessed site has a resultant 'safety score' that can be used to compare to other sites or other design scenarios for the same site. Weightings were refined by calibrating the scorecard to a list of existing sites that were ranked subjectively from high to low. As the scoring is based around a zero average, scores below zero highlight that further consideration should be given to the identification and improvement of unsafe elements. The scorecard allows designers to identify features that can be improved to increase safety but how these improvements are achieved is non-prescriptive.

Summary

Typical approaches for considering risk of a design of any road environment include: quantitative assessment, experienced-based qualitative assessment or compliance with prescriptive standards. In the case of a PPZ, a subjective approach was undesirable, prescriptive standards do not suit the bespoke environmental design required and statistical analysis cannot be undertaken due to lack of data. The scorecard framework is based on the Safe Systems approach and considers a range of factors that contribute to safety outcomes while acknowledging the fundamental contributors to risk are speed and exposure. This approach allows a balanced combination of design requirements and subjective assessment while providing a quantifiable comparison between different scenarios for decision making purposes.

This scorecard framework may be applied to similar situations that require a quantifiable score for comparison purposes. Such environments have risks which are not easily assessed quantitatively

and prescriptive standards are not appropriate.

SAFETY TRAIT	FUNCTIONAL CHARACTERISTICS	PERFORMANCE OUTCOMES
Context	Establish in an appropriate environment	<ul style="list-style-type: none"> Vehicle volumes are low in comparison to pedestrian volumes. Existing speeds are at a reasonable level for further reduction within the PPZ environment Placement with the light rail corridor is avoided
Warn	Effective warnings and entry treatments.	<ul style="list-style-type: none"> Pedestrians and cyclists are warned of the presence of a PPZ and are made aware of the presence of vehicles. Vehicle users are warned of the presence of a PPZ and that pedestrian and cyclist movements should be anticipated.
Inform	Regulatory signage, environmental signals and clear design.	<ul style="list-style-type: none"> Pedestrians are informed that they have priority, and should anticipate the presence of vehicles operating at low speeds. Cyclists are informed that they are in a PPZ, the road is shared with vehicles at low speed, and that pedestrians have priority. Motorists are informed that they are in a PPZ with an enforced speed limit, pedestrians have priority, and they must share road space with cyclists. The PPZ environment is free of distractions that introduce significant safety concerns. Use of regulatory control devices (signs, pavement markings) is limited within the PPZ to reduce necessary information that is to be processed by users.
Guide	Directional signage and alternative route information.	<ul style="list-style-type: none"> Pedestrians are given clear direction within the PPZ. Cyclists are informed of where they are permitted to ride a bicycle within the PPZ and are offered an alternative route around the PPZ. Direction of travel through the PPZ is established for vehicle users and alternative route options are given for travel around the PPZ.
	Unimpeded visibility	<ul style="list-style-type: none"> Users are aware of and have visibility to other PPZ users at all times.
Control	Minimised length	<ul style="list-style-type: none"> Vehicle speeds remain at an appropriate speed within the PPZ. The PPZ is sufficiently long to allow for expected pedestrian demands but not excessively long such that there are sections without pedestrian movements.
	Speed reduction and compliance.	<ul style="list-style-type: none"> There is raised awareness of approaching PPZ and reduction of approach speeds prior to the PPZ. Pedestrians are given time to assess potential conflicts and delay crossings or evade if necessary, but vehicle speeds are low to provide pedestrian confidence that drivers will have sufficient time to stop. Cyclists understand that the PPZ is a low speed environment and adjust their speed accordingly. Vehicle users have adequate time to assess and avoid potential conflict scenarios and speeds are sufficiently slow to achieve a reduction in risk of injury to other PPZ users in the event of conflict.
	Optimised cross section width	<ul style="list-style-type: none"> All anticipated users are afforded adequate space for desirable movements. Vehicle users have adequate manoeuvring space to avoid conflicts. Undesirable movements (e.g. u-turns) are prevented by geometric design. Turning paths are unimpeded and the PPZ is easy to navigate.
	Limited movements and conflict points	<ul style="list-style-type: none"> Movement across PPZ is encouraged due to perceived short crossing lengths. Vehicle travel speeds are lowered due to perceived narrow travel path widths. Vehicle movements are perceived to be constrained within defined turning paths.
	Appropriate vertical geometry	<ul style="list-style-type: none"> Pedestrians and cyclists are not physically impeded by steep grades. Vehicle speeds are not increased by steep grades.
Forgive	Unimpeded movement for non-vehicle users	<ul style="list-style-type: none"> Corridor movements and PPZ activity can occur without conflicting with each other. There is adequate provision for unimpeded movement of impaired persons within the PPZ.
	Appropriate surfaces, drainage and lighting	<ul style="list-style-type: none"> Reduction of pedestrian incidents that occur through slips, trips and falls. Luminance contrast of pedestrian surfaces and slip resistance provided between adjacent surfaces. Reduction of cyclist and motorcyclists incidents that occur through lack of pavement friction. Lighting fixtures provide adequate visibility for all PPZ users and adequate illumination of all surfaces at night. Water ponding is prevented.

Figure 1. Draft Performance Outcomes

Functional Characteristics	Elements	SAFETY CHARACTERISTICS				Rating	
		Desirable	Score	Acceptable	Score		Undesirable
Establish in an appropriate environment	Pedestrian Volumes	Pedestrian volumes are more than 1,000 per day	5	Pedestrian volumes are 500-1000 per day	0	Pedestrian volumes are less than 500 per day	-10
	Vehicle Volumes	Vehicle volumes are less than 1,000 veh/lane/day	5	Vehicle volumes are 1,000-2,000 veh/lane/day	0	Vehicle volumes are greater than 2,000 veh/lane/day	-10
	Approach Speed	Existing posted speed limit is 40km/h or less	3	Existing posted speed limit is 50km/h	0	Existing posted speed limit is 60km/h or greater	-10
	PPZ Speed	The posted speed within the PPZ is 10 km/h	5	The posted speed within the PPZ is 20 km/h	0	The posted speed within the PPZ is greater than 30 km/h	-5
	Proximity to Light Rail Corridor	There is no light rail within the road reserve.	0	A light rail corridor is located adjacent to the PPZ and there is a noticeable physical change in environment between the PPZ and the light rail corridor.	0	A light rail corridor is located adjacent to the PPZ and there is no clear distinction between the PPZ and the light rail corridor.	-7
	Transport Network Alternative Routes	The transport network provides multiple alternative through routes.	1	The transport network provides one alternative through route.	0	The transport network does not provide an alternative through route.	-3
Effective warnings and entry treatments.	Differentiation of Environment	A number of physical changes are located at entry points to create an awareness of entering a low speed environment e.g. pavement thresholds, landscaping treatments, change in pavement width and signage.	3	There is only one physical change located at entry points to create an awareness of entering a low speed environment e.g. pavement thresholds with signage.	0	There are no physical changes at the entry points of the PPZ.	-5
	Shared Zone Signage and Pavement Markings	Shared Zone signage and pavement markings are present at the start of the PPZ (i.e. Shared Zone 100m ahead warnings and threshold treatments) as well as advance warning signage and pavement markings	1	Shared Zone signage is present at start and end of the PPZ.	0	No Shared Zone signage is present.	-4
Regulatory signage, environmental signals and clear design.	Narrow Perceived Width	Perceived vehicle travel paths are narrow (2.5-2.8m lane widths) through the use of methods such as pavement marking, surface and landscaping treatments.	3	Perceived vehicle travel paths are 2.8m-3.5m wide.	0	Perceived vehicle travel paths are greater than 3.5m wide.	-7
	Delineation	Landscaping/environmental treatments are implemented and provide obvious visual clues for identification and delineation of user corridors.	3	Treatments are implemented for delineation of user corridors, but delineation is not obvious at all times.	0	No treatments are implemented for delineation of user corridors.	-5
	Pavement Surface and Kerb	Both elements are provided in the PPZ: - A differential pavement surface for clear identification of a different road environment. - Flush footpaths and carriageway (no kerb profile) to help reinforce the message of changed priorities.	5	One of these elements is provided in the PPZ: - A differential pavement surface for clear identification of a different road environment. - Flush footpaths and carriageway (no kerb profile) to help reinforce the message of changed priorities.	0	The shared space can be perceived as a regular road environment, with standard asphalt surfacing and kerb profile highlighting a verge area.	-5
	Distractions	There are few driver distractions within the PPZ and the potential for distraction is considered very low risk.	2	Driver distractions are present within the PPZ, but infrequent, and the potential for distraction is considered low risk.	0	Frequent driver distractions exist within the PPZ and/or the potential for distraction is considered to be high risk.	-3
	Visual Impairment	Tactile Ground Surface Indicators are provided at all pedestrian crossing locations.	1	Tactile Ground Surface Indicators are provided at some pedestrian crossing locations.	0	No Tactile Ground Surface Indicators are provided.	-3
Directional signage and alternative route information.	Directional Signage	Wayfinding signage is provided to identify key destinations and directions of travel for both pedestrians and vehicles	1	Minimal wayfinding signage is provided to identify key destinations and directions of travel for pedestrians and vehicles	0	No wayfinding signage is provided to identify key destinations and directions of travel for pedestrians or vehicles.	-1
	Awareness of alternative routes	An attractive alternative route exists for all vehicle through movements within 400m of the PPZ and is identified to road users prior to entering the PPZ.	2	An alternative route is available for vehicles but is not attractive and/or is further than 400m away.	0	No alternative route exists.	-1
Unimpeded visibility	Sight distance	All road users can see all other road users at all times	2	Some areas have limited visibility	0	Limited visibility for one or more road user	-2
Minimised length	Length	Length is less than 50m	2	Length is 50-150m	0	Length is 150m+	-5
Speed reduction and compliance.	Approach threshold treatment and geometry	Various traffic calming treatments or geometry that slows vehicle speeds is implemented prior to and at the entry to the PPZ.	4	Traffic calming treatments are only located at the entry of the PPZ.	0	No traffic calming treatments or geometry that encourages low vehicle speeds is implemented.	-4
Optimised cross section width	Crossing Points	PPZ avoids establishing pedestrian refuge areas that reinforce vehicle priority (e.g. zebra crossings with pedestrian refuge)	2	PPZ establishes pedestrian refuge areas with provisioned pedestrian crossing facilities (e.g. zebra crossing across zebraed carriageway)	0	PPZ has established areas that may be perceived as pedestrian refuges, reinforcing vehicle priority.	-5
	Manoeuvring space	The PPZ has sufficient space to allow for design/service vehicle movements but restricts ability to undertake undesirable movements such as u-turns.	1	The PPZ mostly limits undesirable movements such as u-turns	0	Sufficient space is given within the PPZ to allow for undesirable movements such as u-turns.	-3
Limited movements and conflict points	Restriction of movements	Traffic within the PPZ is restricted to one way movement and no opportunities are given to exit the carriageway within the PPZ.	3	Traffic within the PPZ is bi-directional and no opportunities are given to exit the carriageway within the PPZ, aside from property access.	0	Traffic can travel in more than one direction within the PPZ i.e. T-junction and four-way intersections.	-3
	Delineation of crossing locations	Pedestrian desire lines are clearly highlighted within the PPZ.	3	Pedestrian desire lines are somewhat highlighted within the PPZ	0	Pedestrian desire lines are not highlighted within the PPZ.	-1
	Cyclists	Multiple measures are implemented to reduce cyclist speeds within the PPZ i.e. signage and pavement level changes and thresholds.	1	Limited measures are implemented to reduce cyclist speeds within the PPZ.	0	No measures are implemented to reduce cyclist speeds within the PPZ.	-1
	Parking	No parking allowed within the PPZ.	1	Limited parallel parking available, away from key pedestrian crossing points.	0	Angle parking provided, and/or located adjacent to key pedestrian crossing points.	-3
	Servicing	No servicing allowed within the PPZ.	2	Limited servicing available, away from key pedestrian crossing points.	0	Servicing provided near key pedestrian crossing points and/or along majority of PPZ.	-2
	Public Transport	Public Transport stops are located outside of the PPZ area.	2	Public Transport stops are located within the PPZ area and do not constrain movement corridors.	0	Public Transport stops are located within the PPZ area and constrain movement corridors.	-3
Appropriate vertical geometry	Grades	PPZ area is level throughout entire zone	1	Majority of the PPZ is level, however one approach or section is more than 5% up or down grade	0	All of the PPZ is located within a grade that is greater than 5%	-3
Unimpeded movement for non-vehicle users	Persons with disability	Facilities that specifically cater for unimpeded movement of persons with disabilities are provided.	1	The movement of persons with disabilities will not be impeded within the PPZ.	0	PPZ facilities are inadequate to allow for all possible movements of persons with disabilities.	-4
	Physical space	There is a clear segregation between PPZ activities (see Report for definition) and vehicle movements, and sufficient space is available for emergency manoeuvring i.e. seating and store frontages have sufficient clearance to through traffic	2	PPZ activities (see Report for Definition) can occur without conflicting with vehicle movements.	0	Reasonably anticipated PPZ activities (see Report for definition) will conflict with vehicle movements.	-3
Appropriate surfaces, drainage and lighting	Pavement type	All surfaces and elements are slip resistant and cycle-friendly.	1	Some elements of the surfaces are prone to slip incidents and/or some elements are unfriendly to cyclists.	0	Pavement surfaces are prone to slip incidents	-1
	Lighting	Adequate illumination of PPZ	1	Lighting provided does not give adequate illumination	0	No lighting present.	-1
	Drainage	Drainage is adequate and localised ponding is avoided.	1	Localised ponding occurs after heavy rain fall	0	Extensive ponding occurs and/or accessibility is restricted after heavy rain fall.	-1

Figure 2. Draft PPZ Safety Scorecard

References

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