transport

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REPUBLIC OF SOUTH AFRICA

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Title	**Position Paper on Tactile Ground Surface Indicators (TGSI's)**
Submitted by	Amanda Gibberd, Director: Universal Design in Public Transport Projects
On behalf of	Public Transport Network Development
For	Municipalities accessing the Public Transport Network (PTN) Grant for Integrated Public Transport Networks (IPTNs)
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1. BACKGROUND

Municipalities receiving funding for public transport projects must comply with grant guidelines, requirements and conditions on infrastructure elements. The Public Transport Network Grant, refers to Part S (SANS10400: 2011) of the Building Regulations 1997, (revised 2008). Thus the Network Infrastructure Component of the PTN grant for 16/17, condition 4, still reads:

'IRPTN/IPTN projects must meet the minimum requirements of the South African Bureau of Standards (including Part S of the Building Regulations)'

The annual Guidelines and Requirements for Integrated Public Transport Networks (I(R)PTNs) are release each year. The Guidelines and Requirements include a section which relates these minimum SANS standards to IPTN projects.

It is important for municipalities to note that these standards have been a compulsory minimum since 2011, and apply to all building work from 2011. In 2012 the condition was expanded in the grant to apply Part S to all elements of infrastructure, not to the stations (building work) alone.

In order to achieve compliance with the minimum standard Part S, a competent person (environmental access) must sign off on the plans before construction. This person is the access consultant appointed for the project. A compliance check (access audit) carried out by a universal access consultant is also required on completion of construction before handover, and is advisable during construction, at particular stages.

Universal access must be included in the project brief. In particular, an access appraisal must be undertaken at the concept and detailed design stages. There are obvious cost savings to the municipality by removing barriers to passengers before the project commences. Any increased costs to the municipality for engineering work in the short term should be within 0.5-3% of the project cost, as long as universal access was really considered from the project briefing stage. Over the medium to long term, any increased costs are recouped with increases in passenger flow and preference choice for the form of transport, which is easier to use, due to the universal design principles that were incorporated at the beginning.

Municipalities should also note the difference between cost and benefit to the citizens who live in the municipality, and the subsequent ability of other Departments (such as Health or Education) to then meet their targets, due to the fact that vulnerable people are able to access clinics, schools and other facilities. Further cost benefit analysis of universally accessible features, such as pedestrian crossings, will form the basis of on-going research by the Department of Transport.

All municipalities should now be aware of the need to include universal design. It is expected that engineering and architectural firms will be briefed accordingly, and contractual conditions put in place to ensure that the municipality is not burdened with inflated costs due to late consideration of access issues or non-compliance with Part S by implementing agents.

Public transport projects include a significant element of non-motorised transport, because this is the first element of reaching or leaving a public transport stop, or reaching accessible urban public space.

Tactile indicators form part of a suite of standards in SANS 10400 Part S1[1] required to create infrastructure that is accessible to everyone. Simple kerbcuts are included in this standard. More complex layouts are included in SANS 784 (2007) Design for Access and Mobility: Tactile Indicators. The South African National Council for the Blind was not consulted during the original development of SANS 784, due to a technical oversight. In addition, historical problems led to an out-of-date Australian standard being adopted by SABS.

Although the principles and basic use of TGSIs provided in SANS 784 were (and are) supported, there remain problems with the layouts, which are unsuitable for South African public transport environments. In addition, the SANS 784 refers to other Australian standards, for example on slip-resistance and colour and luminance contrast, where there is no South African equivalent.

During 2010-2011, Tshwane Municipality[2] developed guidelines showing engineers how to place SANS 784 TGSI's at pedestrian crossings. These guidelines were produced in conjunction with the Department of Transport and the South African National Council for the Blind (SANCB), and included changes to the SANS 784 layout which have since been implemented in Australia and elsewhere.

In 2015, discussions and research carried out on public transport projects resulted in changes to the Tshwane Guidelines by Working Group on TGSI's, a SABS Part S working group. The research was made possible by Ekurhuleni and Tshwane Municipalities, for which the DoT and the SABS Working Group are extremely grateful. The results of the Working Group's research are contained in this position paper. A more in depth study is underway and will lead to a new SANS standard in due course.

DoT will release a National Technical Requirement under the NLTA on pedestrian crossings towards the end of 2016. (NTR 1). The contents of this position paper will form part of that document, and it will include a great deal more information. However, the general layout of the TGSIs included in this position paper will not change. Until NTR 1 is published, this position paper has been written by Public Transport Network Development to guide infrastructure projects that include pedestrian crossings.

This paper includes three annexures A, B, and C which include a number of diagrams to illustrate the text, which should be read in conjunction with the main body of the document.

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[1] South African Bureau of Standards (2011). *The application of the National Building Regulations Part S: Facilities for persons with disabilities*. SANS 10400-S: 2011. Edition 3. South African National Standard. Page 3.
[2] City of Tshwane. (2011). *Standard Construction Details and Design Standards for Intersections. Pedestrian crossings affected by the Bus Rapid Transport Infrastructure*. Gibb.

2. REASONS FOR REQUIRING TGSI'S AND SAFE PEDESTRIAN CROSSINGS

Recent accident facts quoted by the Minister of Transport[3] indicate that:

- 14 000 people die on South African roads each year.
- Pedestrians are the most vulnerable constituting just under 40% of fatalities in both urban and rural areas.
- Women are most likely to die on the roads as passengers especially in public transport vehicles while children are affected as passengers and pedestrians.

The figure of 14,000 deaths per year is greater than the number of people lost to the Ebola virus in West African countries during the 2014/2015 outbreak.[4] These are unnecessary deaths. It is therefore of upmost importance that pedestrian road environment is made safer, to reduce the number of people lost on the road each year.

2.1 Reasons for requiring TGSI layouts within the given perimeters

- **Maximum and minimum gradients:** the maximum and minimum gradients provided are those indicated in building standards throughout the world as acceptable ramp gradients. Gradients steeper that 1:12 are generally experienced as being dangerous for users, and are not permitted in SABS standards. In a road environment a gradient of 1:15 is required on kerb cuts the reasons for this are two-fold:

  1) It is difficult to wait at a crossing on a kerb ramp by the edge of a busy road
  2) Construction standards vary. 1:15 gives an acceptable tolerance for error on the finished product. If the finished gradient is over 1:12, the crossing is non-compliant.

- **Movement on a ramped surface:** movement on a ramped surface for people in wheelchairs, guiding or pushing trolleys or prams is influenced by three factors. These are; the strength of the person, the weight of the load (the person plus their wheelchair), and the cognitive ability of the person to guide the load (whether a person's own wheelchair or the person assisting the person in the wheelchair).

  People with the same disability can therefore perform very differently on a sloping surface, and the effect of different impairments has very different impact on a person's performance. Age plays a significant part in influencing strength, and therefore children and elderly people, if they are able to move themselves in a wheelchair, or if they are moving a load on a ramped surface, perform differently to a person between the ages of 14-55.

- **Optimum as opposed to maximum:** it therefore makes sense from a functional perspective to use an optimum (1:15-1:20) rather than a maximum gradient (1:12). Frequently, space is not an issue, although it is perceived to be. The maximum gradient is used from supposed knowledge and habit.

- **TGSI layout:** The Tshwane Guideline (Tshwane: 2011) is now 5 years old. It includes layouts with, significantly more tiles than the minimum required in SANS 784. It was expected that further research would be required on the Tshwane Guideline, and this position paper reports on the first stage of that research.

[3] Address by the Minister of Transport, Ms Dipou Peters. 2nd National Road Safety Summit, Ratanga Junction, Cape Town. 13 November 2015.
[4] World Health Organisation. Ebola Situational Report January 2016. http://www.who.int/csr/disease/ebola/en/. Accessed 25 January 2016.

- ***Withdrawal of the old standard in Pedestrian Facility Guidelines: Manual to plan, design and maintain save pedestrian facilities. 192/92/196. 1993 South African Roads Board.*** Members of the SABS Part S Sub-Committee identified problems with the design and layout of the old municipal standard 'bubble ramp' still in use in metros. Given its hemispherical profile, it is slippery when wet or when worn, and frequently laid in such a manner that it sent users into the middle of the road, or created a trip hazard in the path of travel. This profile is now obsolete. Effectively, this guideline has already been replaced by the Department of Transport Roads Branch NMT Guidelines 2014, which refer to SANS 784 2007.[5]

3. DEFINITIONS

Item	Definition	Description
TGSI tiles	Tactile Ground Surface Indicators, known as Tactile Guidance Surface Indicators, or Tactile Indicators	Raised tactile surface tiles designed in accordance with SANS 784 2007. These may be warning or directional tiles. A standard tile is 400mm x 400mm in an external pedestrian environment. An internal tile is generally 300mm x 300mm. See **Annexure A**
TGSI layout	A layout of TGSI tiles to suit a particular environment. An L-shaped layout is placed over the entire kerbcut on a typical pedestrian crossing	The L-shaped layout is two tiles deep at the base. The width of the base of the L depends on the width of the kerbcut, and must cover the entire kerbcut. The standard width for a controlled crossing is 2.4m wide and for an uncontrolled crossing, is 1.6m wide. The stem of the L is two tiles wide. The length of the stem of the L depends on the width of the sidewalk. See **Annexure B.** Internally, the L-shape would not be used, as this layout is only for pedestrian crossings. But the width of a tile path use to provide guidance internally would be 600mm. (Two tiles wide)
Controlled and Uncontrolled pedestrian crossing at intersections or mid-block	**Controlled Crossing** Where a control is included in the form of robots/traffic light at an intersection or zebra crossing	The robot/traffic light must be placed at the base of the L where the stem meets the base. The stem of the L is normally placed on the outside of the junction. In exceptional circumstances, (for example, existing services), the stem of the L would be placed on the inside of the junction.
	Uncontrolled Crossing Where there are no controls (robots/traffic lights) at the intersection on zebra crossing.	The L shape TGSI layout remains the same; the width of the crossing is the same as the L shape. The width of the crossing in both controlled and uncontrolled crossings depends on the volume of pedestrians.
Kerb cut	Also called pedestrian scoop or dropped kerb	A kerb cut may have a gradient of 1:15- 1:20, depending on the space available. The preferred gradient is 1:20. The required maximum gradient is 1:15. A gradient steeper than 1:12 is non-compliant with SANS 10400 Part S 2011.
Buffer Strip	A strip between the sidewalk and the road	The buffer strip between the sidewalk and the road is usually a Figure 1 or a Figure 3 kerb laid flat. Both kerbs are already 300mm deep and

[5] Republic of South Africa. (2014). *NMT Facility Guidelines.* Department of Transport

		are readily available. In most scenarios, using either of these kerbs is an easier and quicker construction option than the cast-in-situ option. It should be fitted level with the road (≤ 5mm) and not create an additional trip hazard.
Landing	A level landing forming part of the sidewalk behind the kerbcut or behind the TGSI layout	A level landing may contain a cross camber or fall, but only up to 1:50, which is level for people to wait or move on, but also allows water drainage. The landing should be 1500mm deep, which provides enough space for a wheelchair user to turn 90 degrees or wait on the level, as an alternative to waiting on the kerbcut, if this is too difficult. A sidewalk with an effective width of 4.4m can accommodate a 1:20 gradient, when using a Figure 3 kerb (with a +/- 140mm sidewalk height). When using a Figure 7 kerb (with a +/- 180mm sidewalk height), 5.1m is required to achieve a 1:20 gradient. See **Table 1: Gradients vs Kerb Heights**
Lowered side walk	Where the entire sidewalk is lowered due to the scenario where it is impossible to provide kerb cuts and landings at the correct gradient	This is common in historical areas of urban centres where the sidewalk kerbs are higher than normal, the side walk is narrow or the building line is close to the road. Ensure that the intersection is well-drained. Lowering the entire sidewalk may be preferred in other areas, however, the costs of relocating services must be considered, if affected. A raised 280mm kerb is required at the intersection to provide protection. See **Annexure C**.
Kerb radius	Where two sidewalks meet at the corner of a road at an intersection	The kerb radius should be as small as functional, to enable the traffic to slow down sufficiently so that it is safe for pedestrians to cross the road. If the kerb has a radius that makes it easier for traffic to turn, it must also be safe for pedestrians to cross and the TGSI layout must be adapted accordingly. Once the kerb radius becomes greater than 10m it is impossible to achieve safe passageway for pedestrians.
Adapted TGSI layout	Placement of TGSIs on a kerb radius	If an adapted TGSI layout is used, it may not result in more than 3 tiles used on one side and one tile on the other side of the kerbcut.
Dangerous pedestrian crossing	An unsafe pedestrian area	Where the kerb radius is greater than 10m and traffic flows around the corner in an uncontrolled manner. This should not form part of an IPTN system.

4. DOT SUPPORTED TGSI LAYOUTS

The TGSI Layouts described below are supported by the Department of Transport, the SABS working group on TGSI’s and the South African National Council for the Blind.

4.1 Kerbcut

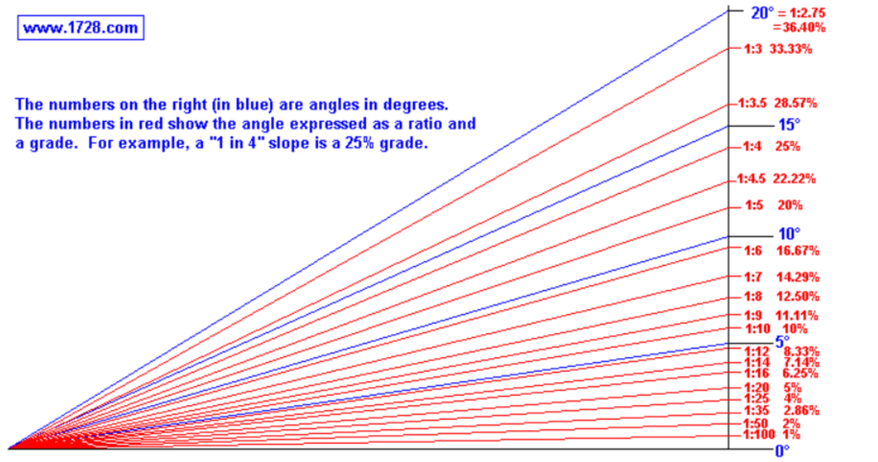
A gradient of 1:15 – 1:20 prevents the accumulation of roadside debris where pedestrians have to stand. A level landing, at least 1500mm deep at the top of the kerbcut, is required. This depth of sidewalk at the top of the kerbcut allows someone in a wheelchair or with a double-buggy or single-buggy pushchair to turn onto the kerbcut. It allows space for people to walk past the kerbcut, whether by foot, wheelchair, or with a pram without being influenced by the slope on the kerbcut. Without this allowance a wheelchair user may be drawn down the kerbcut and physical power is needed to counteract gravity, which is an additional strain on people in wheelchairs, and unsafe for elderly people or small children.

In order to reach the required gradient of 1:15-1:20, it may be easier to drop the entire sidewalk or crossing point on the approach to the crossing before reaching the crossing point, maintaining the 1:50 crossfall to enable water drainage. This is a particularly useful practice where the sidewalk is very narrow and there are physical constraints limiting width. This design solution is already covered in SANS 10400 Part S 2011, Page 13. Where space is available, it is also possible to increase the size of the sidewalk sufficiently to allow space for the kerbcut and circulation space at the required gradients and this may be a cheaper option if moving services would be more expensive.

Kerb block used	Kerb height	Gradient	Effective ramp length	Landing	Total footway width
Figure 7	140mm	1:20	2.8 m	1.5 m	4.3 m
		1:15	2.1 m	1.5 m	3.6 m
Not recommended		1:12	1.7 m	1.5 m	2.2 m
Figure 3	180mm	1:20	3.6 m	1.5 m	5.1 m
		1:15	2.7 m	1.5 m	4.2 m
Not recommended		1:12	2.2 m	1.5 m	3.7 m

Table 1: Gradients vs kerb heights

Different formats for gradients are in common usage. **Table 2: Gradients**, provides the terms commonly used and conversions to other formats of gradients.



Source - http://www.1728.org/gradient.htm

Table 2: Gradients

4.2 Storm water

Primary concerns for people waiting to cross the road is that they do not wish to wait in pools of water when it is raining, nor to get soaked by passing cars whilst waiting for the traffic lights to change. For these reasons it is important that whether the kerb is raised or lowered at the crossing point, there is adequate storm water drainage and protection from accumulated water or debris in the road space and on the footway.

Storm water should not drain over the kerbcut or landing areas. Other than creating an undesired waterlogged crossing point, this results in silt and debris settling on the pedestrian crossing that detracts from the effectiveness of the tactile surface as well as creating a maintenance issue.

It is expected that engineers will ensure that adequate storm water drainage has been put in place, and that the municipality will put a regular maintenance schedule in place to make sure that the storm water drains are kept clear throughout the year.

4.3 Protection of pedestrian space from vehicles

It is a commonly held belief that by making it easier for pedestrians to cross the road, cars will be encouraged to use the pavements for parking. It is quite apparent that even with the current poor infrastructure standards for pedestrians in public space, drivers of cars frequently use the pedestrian sidewalk environment as they choose.

This is dangerous, and a change of behaviour in drivers is necessary Law enforcement and education are essential. Bollards in some circumstances are suitable, and their design and use can be advised by a universal access consultant. Please find examples of their inclusion in **Annexure C**. Designers and contractors should act with caution not to clutter footways with extruanious bollards, whilst acknowledging that they can be useful in preventing vehicles from abusing side walk space for pedestrians.

4.4 Basic layout

The findings of the preliminary research are:

- That an 'L' shaped profile is required at the crossings on reciprocating sides of the road.
- That the pedestrian push button control, synchronised with the traffic lights to be situated on controlled crossings, at the foot of the L.
- That the stem of the L consists of directional tiles, and the base; warning tiles.

On un-controlled crossings, the same basic L shape is required so that someone who is blind or partially sighted can find the correct crossing. There are some circumstances where the tail of the L is not required. These are:

- Where there is a defined sidewalk with a distinct edge on each side, and where there is a crossing point in only one direction. An example of this is the old-fashioned wood-floated concrete walkways in some city centres. See **Annexure C**.
- Where a driveway crosses the sidewalk: no TGSI's are required if the driveway is raised to the same height as the sidewalk. See **Annexure C**.

4.5 Layout of directional tiles

Directional tiles should be 800mm (2 blocks) wide. They should lead the pedestrian from the building or boundary wall to the crossing, in most circumstances. Where the side walk is exceptionally wide and there is no boundary line within easy reach, a rational design approach should be taken. It must be understood that most engineers and architects are unaware of a rational design in these circumstances unless they have received training from recognized qualified professionals in universal design and therefore their designs as competent people will NOT automatically be accepted by the Department of Transport.

In internal environments, such as BRT stations, a width of 600mm is acceptable (two tiles at 300mm wide). The reason for this is that internally, a smoother surface is more achievable and the directional tiles are easier to locate. HOWEVER in both circumstances, the smoothest friction-free profile of surrounding surface, which is also slip-resistant, is required.

4.6 Layout of warning tiles
Where a kerbcut which is parallel to the road (where the intersection is at 90 degrees) and has a straight roadside edge, two rows of warning are required, in line with the path of travel. This completes the base of the 'L' shape. It provides an area where most people who are blind or partially sighted are able to sense the change in tile profile and are able to stop and relocate if a particular danger or change of direction lies ahead.

Audible environmental information (vehicles on the road) informs the user that they are at the side of the road, waiting to cross it. If the kerb of the intersection contains a disproportionately wide radius due to other municipal preoccupations (to enable freight or other vehicles to travel around the corner with ease or at speed, such as in a left slip lane) there is a safety conflict due to high volumes of heavy traffic. This is not a safe pedestrian area.

Where these wide radii have been incorporated into high volume pedestrian areas, where public transport is being introduced; or in any urban centres, it is strongly recommended that the radii of the kerb is reduced to as small as practically possible. This makes the crossing safer and makes it possible to use the minimum number of TGSI tiles. Inserting more tiles into wide radii kerbs makes wayfinding more confusing. The maximum kerb radii in a public transport environment is 10m.

Additional speed calming and speed restrictions can be introduced on the road to prevent vehicles of any type speeding at corners and enabling pedestrian safety. Please see **Annexure C** for an example of a suitable *Adapted TGSI Layout*.

Where for some reason the municipality or province feels that these measures are impossible, an application for an exemption must be made to DoT, and a competent person (environmental access) be consulted on an alternative. The layout of tiles on wide radii will be the subject of a more in depth research study which the Working Group on TGSIs will carry out.

Municipalities should note that the South African Council for the Blind (SANCB) have formed an active part of the research and discussions to date, and its members are in support of the findings outlined in this position paper.

It is expected that the new research programme will take no longer than a year, however, funding is being sort for it and therefore this process may take longer if funding does not become available.

Please direct any queries to:
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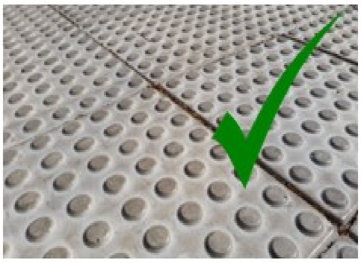
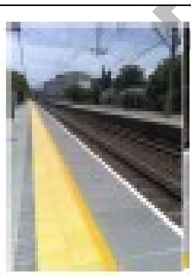
5. ANNEXURE A: EXAMPLES OF TGSI TILES THAT DO AND DO NOT COMPLY WITH SANS 784 2007

	Old municipal standard in 192/92/196 SANS 784 Warning and Guiding block profile. **THIS TILE DOES NOT COMPLY.** The use of this was discontinued when DOT released the new Non-Motorised Transport Guidelines in 2014.
  	Examples of warning tiles that comply with SANS 784 2007 **COMPLIES**
 	Examples of directional tiles that comply with SANS 784 2007 **COMPLIES**
Figure 1: Examples of SANS 784 complient and non-complient tiles	

NOTE: it is anticipated that further research will examine the use of a more pronounced profile for hazard warning tiles in open station environments (rail platforms, open median BRT stations).

6. ANNEXURE B: KERB CUT SITING AND DIESGN CONSIDERATIONS

6.1 Kerbcut placement or location

The desire line for the pedestrian is a critical element in the placement of the kerbcut, however so is the size of the junction radius and the sight lines for vehicles. The two examples below give the options for different size junctions.

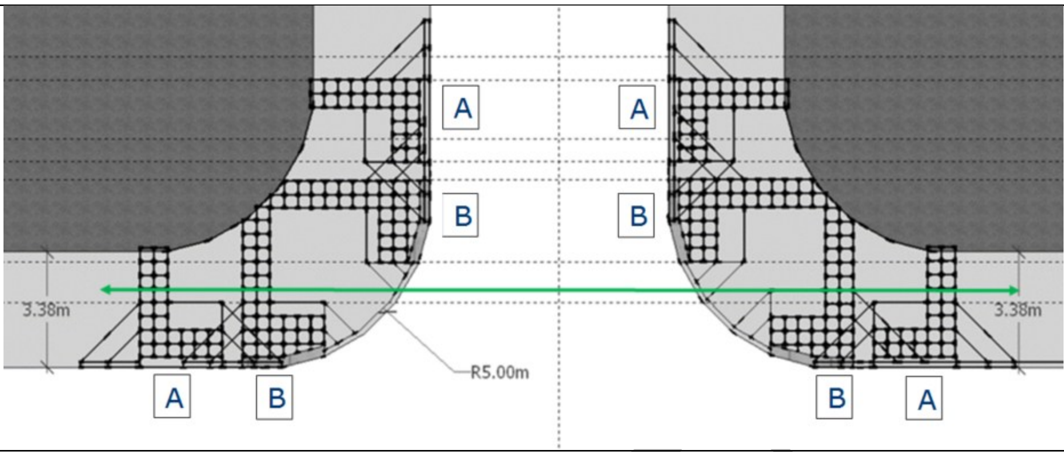


Figure 2; Regular kerbcut with a 5m kerb radius. Option B is the preferred compromise

During construction warning tactile blocks should be placed in the configuration shown in the drawing and filled in towards the front against the buffer. This requires cutting the blocks near the kerb radii for a neat finish (highlighted in blue).

Figure 3: Photo Example of ramp moved onto the kerb radius. (Note Blue filled in section)

When the kerb radius becomes larger, the kerbcut must be located as close as possible to the direct line of travel for pedestrians, balancing this with the effective tactile layout and usability. Sound engineering judgment is necessary.

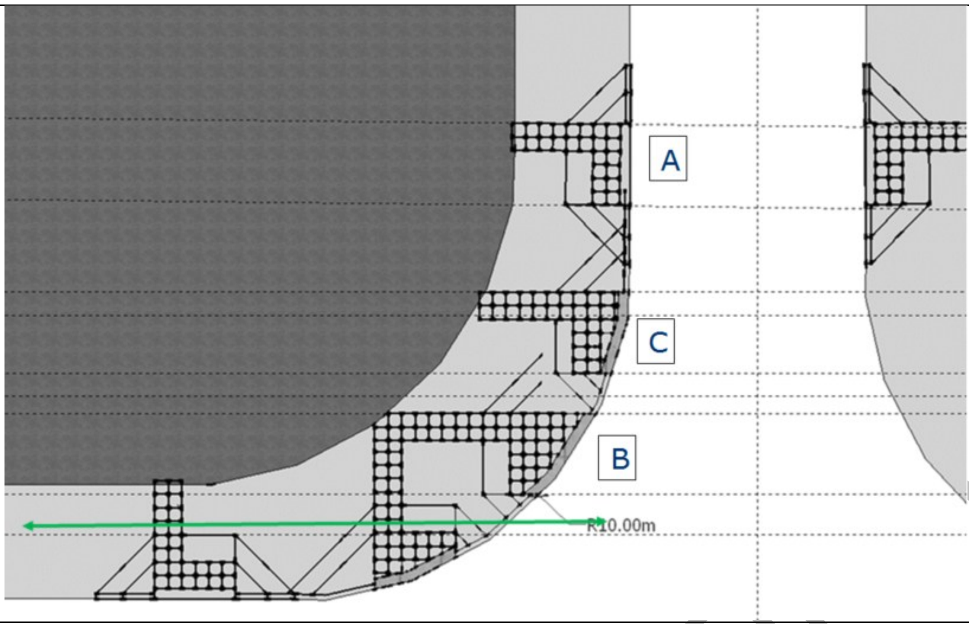


Figure 4; Regular kerbcut with a 10m kerb radius. Option C is the preferred option

6.2 Effective and practical ramp construction

When constructing pedestrian crossings with a kerbcut on a straight edge kerb or on a kerb with a wider radius, the following two elements are important to note:

- Effective ramp construction
- Practical ramp construction

The **effective ramp**, is larger than the TGSI layout. Its size depends on the kerb height. See **Table 1 Gradients vs kerb heights.** With ample space available, a kerb cut using gentle gradients at 1:20 can be accommodated.

The **practical ramp**, the physically "smaller" ramp, is the same as the kerb crossing width. See **Figure 2: Effective and Practical ramp construction.** These two elements form the compliant ramp layout. In most cases, the surrounding footway area is shaped or "rolled" down to the practical ramp through the effective ramp area. This results in a smooth transition from top of footway level down to the ramp incorporating all required gradients.

Figure 5: Effective and practical ramp construction.
The gradient starts further back than the placement of the warning tiles. The surrounding footway has been or "rolled" down to the practical ramp through the effective ramp area

ANNEXURE C: EXAMPLES OF TGSI LAYOUTS

C1 Regular Kerbcut combinations for constrained and unconstrained space, controlled and uncontrolled crossings

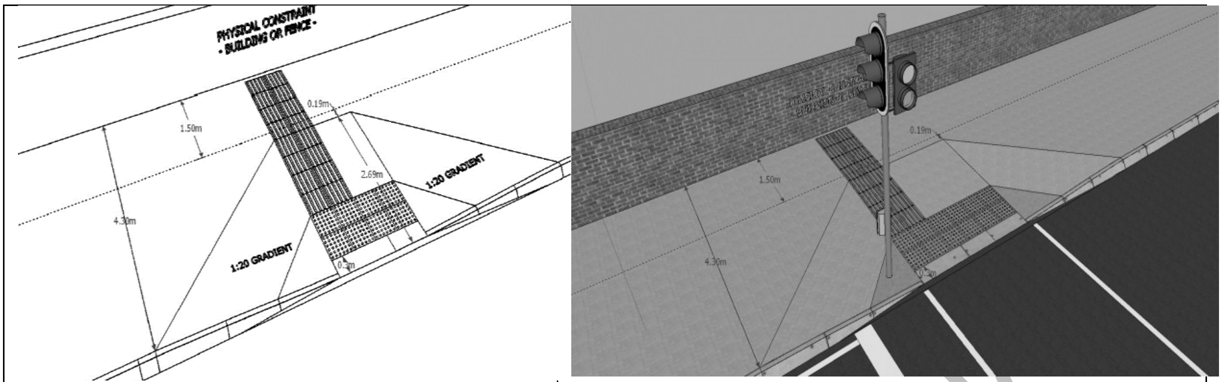


Figure C1.1: Regular kerbcut, unconstrained space, controlled and uncontrolled crossing

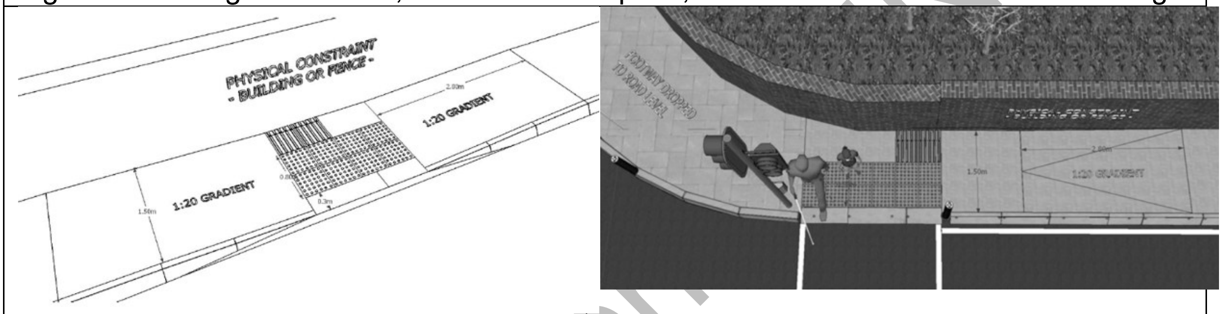


Figure C1.2: Regular kerbcut constrained space, controlled and uncontrolled crossing

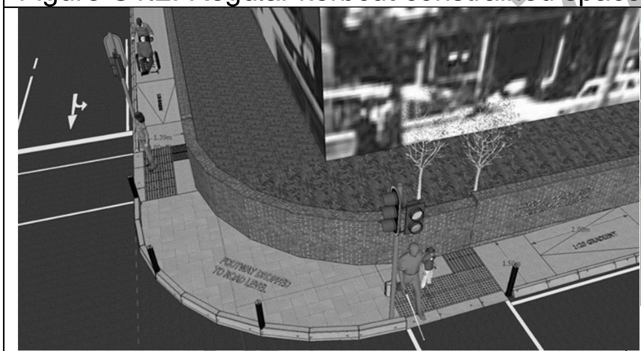


Figure C1.3: Controlled intersection, constrained space, sidewalk lowered

Figure C1.4: photo of uncontrolled intersection, entire sidewalk lowered

C2: TGSI layouts with no directional tails, or no TGSIs required at all

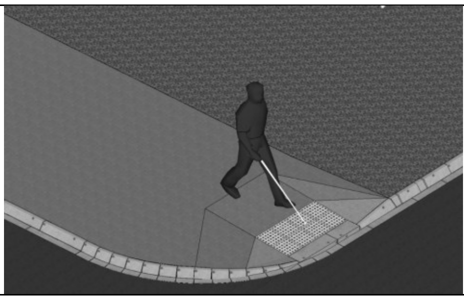


Figure C2.1: Where no directional tail is required (there is no other road crossing)

Figure C2.2: Photo no TGSIs required; vehicle access raised to walkway

C3 Adapted TGSI layouts, constrained and unconstrained space, controlled and uncontrolled crossings

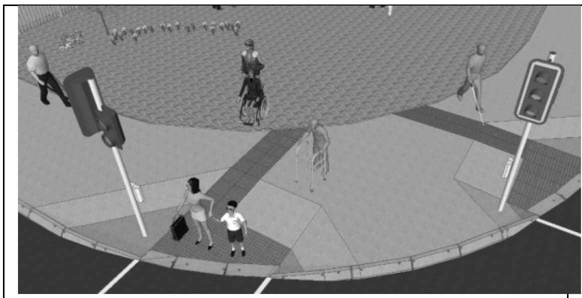


Figure C3.1: Adapted L-Shaped layouts, large kerb radius

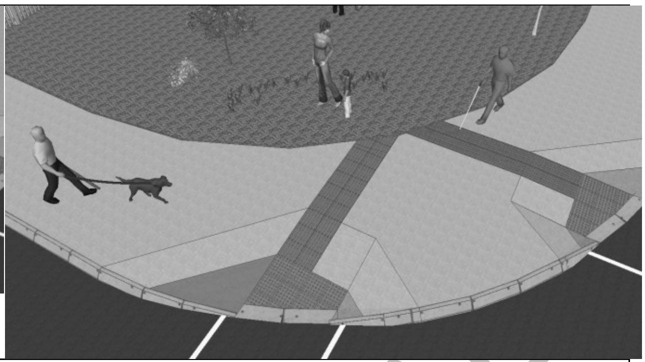


Figure C3.2: Adapted L-Shaped layouts on kerb radius

More TGSI's than those shown is not recommended and the kerb radii would therefore be reduced by building out the intersection.

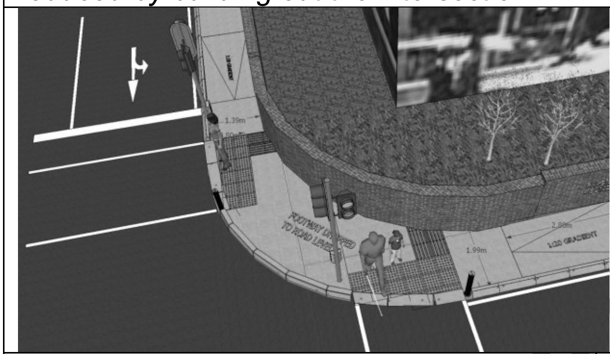


Figure C3.3: Layouts on controlled intersection with constrained space showing the entire sidewalk lowered

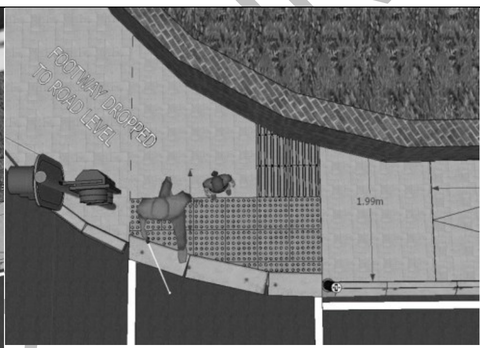


Figure C3.3: Layouts on controlled intersection with constrained space showing the entire sidewalk lowered

C4: TGSI layouts in unconstrained spaces

Figure C4.1: Regular kerbucts (Controlled & Un-Controlled)

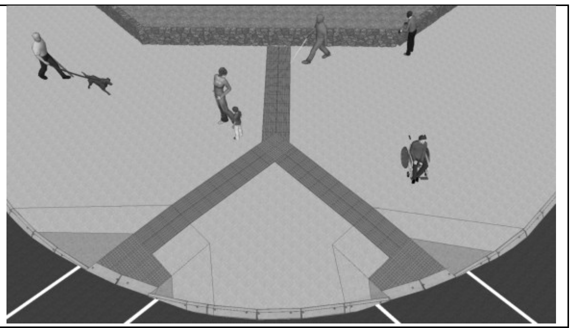


Figure C4.2: Where two guidance tail sections meet at the back of the footway

C5 Kerbcuts with bollards

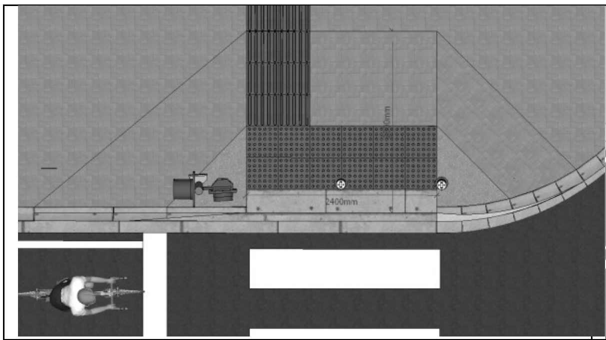
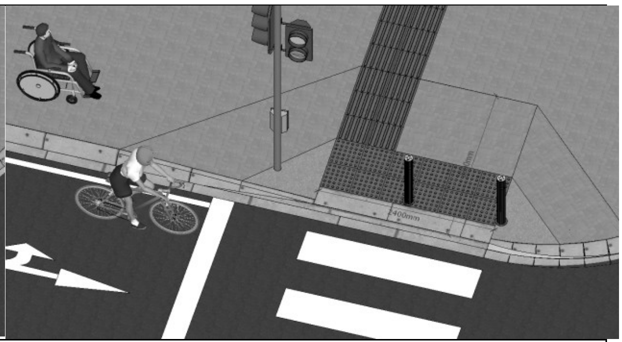
	

Figure C5.1: Regular kerbcut, controlled crossing (Lamp column functions as additional bollard)	Figure C5.2: Regular kerbcut, controlled crossing (Lamp column functions as additional bollard)

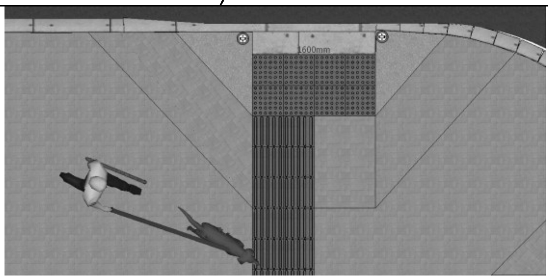
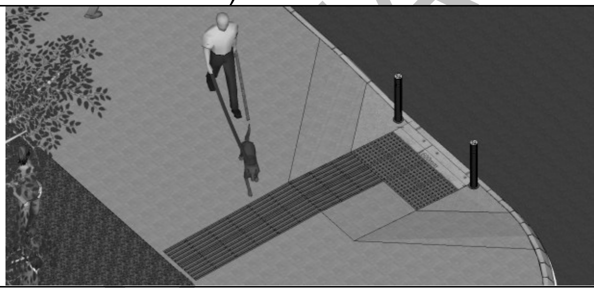

	

Figure C5.3: Regular kerbcut, uncontrolled crossing (plan view)	Figure C5.4: Regular kerbcut, uncontrolled crossing (3D View)

7. REFERENCES

TO BE COMPLETED

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