Vehicle and pedestrian Level of Service in street designs with elements of shared space

Ioannis Kaparias, Rui Wang

UNIVERSITY OF Southampton
Transportation Research Group

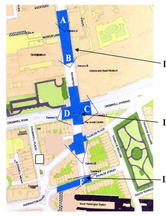
Introduction

In recent years there has been a trend towards "shared space" in urban street design as a means of creating a better public realm, contrasting the traditional approach of segregating pedestrians and vehicles. "Shared space" refers to a variety of streetscape treatments, aiming at **asserting the function of streets as places** rather than arteries. Such designs encourage higher levels of street sharing, enabling pedestrians to move more freely.


Higher levels of sharing, however, may affect the quality of service offered, with potential **increases in pedestrian service quality** being accompanied by **decreases in vehicle traffic capacity**. This highlights the need for an assessment of the **Level of Service (LOS)** of both vehicle traffic and pedestrians on streets with elements of shared space.

Case study

The present work uses the Exhibition Road site in London's South Kensington area as a case study, which has been recently redeveloped to feature a number of elements of shared space.

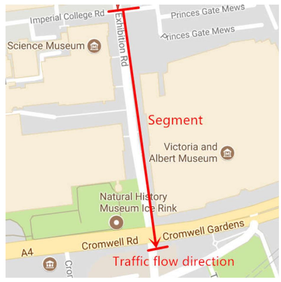
Changes in the LOS for vehicle traffic (VLOS) and pedestrians (PLOS) are investigated during periods **before** and **after** the redevelopment using videos collected from three locations:

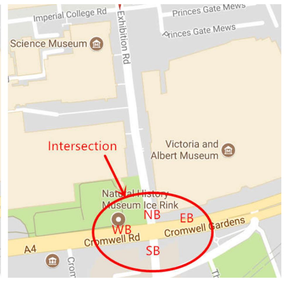
- **L1 (Exhibition Road main body)**, where a single surface allocating more space to pedestrians, has been implemented, replacing the previous conventional dual-carriageway layout;
- **L2 (Cromwell Road junction)**, where the original staggered crossing has been replaced by a wide straight-across crossing;
- **L3 (Thurloe Street)**, where an access-only street has been created, replacing the previous one-way system.

Methodology

VLOS evaluation:

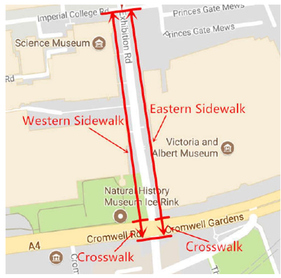
VLOS on Exhibition Road is evaluated according to HCM 2010 in one **segment** and one signalised **intersection** (Locations L1 and L2, respectively). As per HCM 2010, the decision variables determining the relevant VLOS rating for the segment are the **volume-to-capacity ratio** and the **vehicle travel speed percentage**, while for the intersection, it is the **control delay** (as the average delay per vehicle in each of the lane groups in all intersection approaches, weighted by traffic volume).

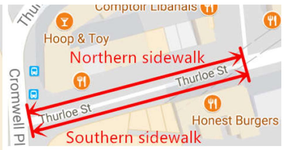




PLOS evaluation:

PLOS on Exhibition Road is evaluated according to HCM 2010 on four **segments**, and specifically the two sidewalks of the Exhibition Road main body (L1) including the relevant crossings (L2), and the two sidewalks of Thurloe Street (L3) (evaluated as an **off-street facility** in the after-case). As per HCM 2010, the relevant PLOS rating is determined on the basis of the **average pedestrian space** and the **pedestrian perception score**.





Results

VLOS evaluation:

Intersection	Morning		Midday		Evening	
	Before	After	Before	After	Before	After
Northern approach (Exhibition Road)						
Traffic volume (veh/h)	477	88	589	203	744	144
Approach delay (s/veh)	20.3	18.6	24.2	30.2	12.6	21.3
VLOS	C	B	C	C	B	C
Western approach (Cromwell Road)						
Traffic volume (veh/h)	1008	1328	997	1008	988	1074
Approach delay (s/veh)	3.9	5.9	6.4	4.2	8.3	5.2
VLOS	A	A	A	A	A	A
Southern approach (Exhibition Road)						
Traffic volume (veh/h)	332	64	308	118	338	136
Approach delay (s/veh)	14.5	18.1	12.0	20.9	8.5	19.6
VLOS	B	B	B	C	A	B
Eastern approach (Cromwell Road)						
Traffic volume (veh/h)	880	916	929	945	1116	1060
Approach delay (s/veh)	5.2	4.0	8.2	3.8	14.4	4.9
VLOS	A	A	A	A	B	A
Intersection TOTAL						
Intersection delay (s/veh)	8.6	5.9	11.3	7.2	11.5	6.8
VLOS	A	A	B	A	B	A

Segment	Morning		Midday		Evening	
	Before	After	Before	After	Before	After
Traffic volume (veh/h)	477	88	589	203	744	144
Control delay (s/veh)	20.3	18.6	24.2	30.2	12.6	21.3
Running time (s)	25.7	35.4	25.9	35.9	26.4	35.7
Travel speed (mph)	14.1	12.0	12.9	9.8	16.6	11.4
Travel speed (km/h)	22.7	19.3	20.8	15.8	26.7	18.3
Travel speed %	49.8%	61.8%	45.7%	50.5%	58.7%	58.6%
V/C ratio	0.37	0.18	0.34	0.61	0.57	0.37
VLOS	D	C	D	C	C	C

Base free-flow speed – Before: 28.3 mph (45.5 km/h); After: 19.4 mph (31.2 km/h)

PLOS evaluation:

	Midday		Evening	
	Before	After	Before	After
Exhibition Road (Western sidewalk)				
Pedestrian volume (ped/h)	1732	2132	1835	2192
Average pedestrian space (ft²/ped)	67.8	122.1	63.9	118.7
Average pedestrian space (m²/ped)	6.3	11.3	5.9	11.0
Pedestrian perception score (segment)	3.60	2.18	3.59	2.19
PLOS	D	B	D	B
Exhibition Road (Eastern sidewalk)				
Pedestrian volume (ped/h)	702	574	771	532
Average pedestrian space (ft²/ped)	146.3	179.1	133.1	208.2
Average pedestrian space (m²/ped)	13.6	16.6	12.4	19.3
Pedestrian perception score (segment)	3.54	2.25	3.69	2.23
PLOS	D	B	D	B
Thurloe Street (Northern sidewalk)				
Pedestrian volume (ped/h)	743	-	824	-
Average pedestrian space (ft²/ped)	116.8	-	105.2	-
Average pedestrian space (m²/ped)	10.9	-	9.8	-
Pedestrian perception score (link)	2.08	-	2.11	-
PLOS	B	-	B	-
Thurloe Street (Southern sidewalk)				
Pedestrian volume (ped/h)	1237	-	1132	-
Average pedestrian space (ft²/ped)	11.8	-	13.6	-
Average pedestrian space (m²/ped)	1.1	-	1.3	-
Pedestrian perception score (link)	2.08	-	2.11	-
PLOS	E	-	E	-
Thurloe Street (Access-only)				
Pedestrian volume (ped/h)	-	2608	-	3030
Average pedestrian space (ft²/ped)	-	125.1	-	107.4
Average pedestrian space (m²/ped)	-	11.6	-	10.0
PLOS	-	A	-	A

Conclusions

The redevelopment has considerably improved the quality of service offered to pedestrians, which is expected given that shared space features are intended to improve the pedestrian environment. What is also interesting, however, is that vehicle traffic quality of service appears to not have been compromised and has, in several locations, even improved. This is an encouraging finding from the point of view of shared space design.

Ioannis Kaparias
Email: i.kaparias@southampton.ac.uk

99th Annual Meeting of the Transportation Research Board, 12-16 January 2020
Paper no.: 20-00652