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I hereby declare that we have checked this thesis and in our opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Master of Civil Engineering

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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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INVESTIGATION OF PEDESTRIAN CROSSING FACILITIES ALONG JALAN AMPANG

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Thesis submitted in fulfillment of the requirements for the award of the degree of Master of Civil Engineering

> Faculty of Engineering Technology UNIVERSITI MALAYSIA PAHANG

> > October 2017

DEDICATED TO

Mу

Parents;

Brothers and sisters

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# LIST OF SYMBOLS

tc	Estimate a Critical
Sp	Pedestrian Speed
L	Length
ts	Start Time
MOY	Motorist Yield
PVI	Pedestrian Vehicle Interaction
GH	Gleneagles hospital
AC	Ampangmuir condo
SJC	Sulajelatek condo
BST	Bus stop near traffic light
SJCS	Ampangmuir Condo to School
EVC	Embassy View Condo
EBK	Embassy of Korea
SERC	Suites Embassy row condo
VAC	Villa Ampang condo
SMC	Sri Mahkota condo
SCC	Shahzan court condo
EM	Great Eastern Life (offices, Mall)
BSS	Bus stop school
MB	My Bank Branch
LS	Libyan School
VMC	Villa Aman condo
BSG	Bus Stop Gleneagles
A971C	Ampang 971 condo
BSE	Bus stop near Great Eastern

# LIST OF ABBREVIATIONS

NHTS	National Highway Transportation Safety Administration
ITE	Institute of Transportation Engineers
MUTCD	Manual on Uniform Traffic Control Devices
ADT	Average Daily Traffic
ADA	Americans with Disabilities Act
LRT	Light Rapid Transit
HCM	Highway Capacity Manual
PGA	Pedestrian Gap Acceptance
VRU	Deaths by Vulnerable road user
ISI	Intersection Safety Indices
AKLEH	Ampang-Kuala Lumpur Elevated Highway
LOS	Level of Service
MRR2	KL Middle Ring Road

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#### ABSTRACT

Most individual journey no matter what the basic user mode, starts or ends with walking section; so, walking is an essential element of all travel. Walking Behavior the pedestrian flow characteristics lay the foundation for planning and design walking facilities. Therefore, needs must be access to pedestrian facilities in the design of transport facilities. Includes pedestrian facilities Sidewalks, tracks, corridors, and stairs, reduction of cuts and ladders, and transit positions. These facilities should be carefully assessed for mitigation Congestion and enhanced walking in the central business area and sustainable society. But traditional valuation methods are flawed, new the approach to improving the current assessment must be constantly investigated Methods. The study assesses corridors and passages in the city Kuala Lumpur, Jalan Ampang. The results for traffic volume flow with the pedestrian crossing account at signalized and illegal indicated that the number for all vehicles, motorcycle, adult male, adult female, pedestrian signalized crossing and pedestrian illegal crossing varies considerably depending on the time range (30 minutes). The total number of 4-wheel vehicles were more than the total number of motorcycles. Also, the total number of pedestrians on the signalized and crossing in relation to the pedestrians crossing street, pedestrian crossing behavior (walked/origin time or waiting/crossing time to walked/destination time) were recorded and analyzed video graphic survey methods was used for pedestrian counts, having advantage over the manual method. Flow, speed, density and effective width of the walkway were the variables measured. Some on the positions identified, or office after extracting the data from the video. Hand tape, masking tape, stop watch and video camera/ tripod stand were the tools/apparatus used on various positions for collecting data. The flow rate calculated, in conjunct ion with HCM were used to estimate LOS. Analysis was conducted on the flaws identified so as to improve on the current method of estimation.

#### ABSTRAK

Kebanyakan perjalanan individu tidak kira mod pengguna asas, bermula atau berakhir dengan bahagian berjalan; Jadi berjalan adalah unsur penting dalam semua perjalanan. Berjalan Perilaku ciri aliran pejalan kaki meletakkan asas untuk perancangan dan reka bentuk kemudahan berjalan kaki. Oleh itu, keperluan perlu akses kepada kemudahan pejalan kaki dalam reka bentuk kemudahan pengangkutan. Termasuk kemudahan pejalan kaki Sidewalks, trek, koridor, dan tangga, pengurangan potongan dan tangga, dan kedudukan transit. Kemudahan ini harus dinilai dengan teliti untuk mitigasi Kesesakan dan berjalan kaki yang lebih baik di kawasan perniagaan pusat dan masyarakat yang mampan. Tetapi kaedah penilaian tradisional adalah cacat, pendekatan baru untuk meningkatkan penilaian semasa harus sentiasa disiasat Kaedah. Kajian ini menilai koridor dan laluan di bandar Kuala Lumpur, Jalan Ampang. Keputusan untuk aliran jumlah lalulintas dengan akaun penyeberangan pejalan kaki di isyarat dan haram menunjukkan bahawa jumlah untuk semua kenderaan, motosikal, lelaki dewasa, wanita dewasa, pejalan kaki yang diselaraskan pejalan kaki dan persilangan pejalan kaki yang menyalahi undang-undang berbeza-beza bergantung pada jarak masa (30 minit). Jumlah kenderaan 4 roda lebih daripada jumlah motosikal. Selain itu, jumlah pejalan kaki yang diselaraskan dan menyeberang berhubung dengan pejalan kaki yang menyeberang jalan, tingkah laku pejalan kaki pejalan kaki (berjalan kaki / masa asal atau masa menunggu / melintas untuk berjalan / masa destinasi) telah direkodkan dan dianalisis kaedah tinjauan grafik video digunakan untuk Bilangan pejalan kaki, mempunyai kelebihan berbanding kaedah manual. Aliran, kelajuan, ketumpatan dan lebar berkesan laluan adalah pembolehubah yang diukur. Sesetengah di kedudukan yang dikenalpasti, atau pejabat selepas mengeluarkan data dari video tersebut. Pita tangan, pita pelekat, berhenti menonton dan kamera video / tripod berdiri adalah alat / alat yang digunakan pada pelbagai jawatan untuk mengumpul data. Kadar alir dikira, dalam ion conjunct dengan HCM digunakan untuk menganggarkan LOS. Analisis telah dijalankan ke atas kelemahan-kelemahan yang dikenalpasti untuk memperbaiki kaedah anggaran semasa.

#### REFERENCES

- Al-Azzawi, M., & Raeside, R. (2007). Modeling pedestrian walking speeds on sidewalks. Journal of Urban Planning and Development, 133(3), 211-219.
- Alhajyaseen, W. K., Li, M., Nakamura, H., & Daamen, W. (2011). Effectiveness of Signal Coordination for Pedestrian Flows Considering Bi-directional Flow Impacts.
  Paper presented at the Proceedings of the Eastern Asia Society for Transportation Studies The 9th International Conference of Eastern Asia Society for Transportation Studies, 2011.
- Ariffin, A. H., Rahman, M. K., Solah, M. S., Kassim, K. A. A., & Voon, W. S. (2012). Stability of High-Deck Buses in a Rollover and Contact-Impact with Traffic Barriers.
- Bahari, N., Arshad, A., & Yahya, Z. (2012). PEDESTRIANS'PERCEPTION OF THE SIDEWALK FACILITIES IN KUALA LUMPUR'S COMMERCIAL AREAS. Int Sustain. Civ. Eng. J, 1(2), 28-36.
- Brewer, M., Fitzpatrick, K., Whitacre, J., & Lord, D. (2006). Exploration of pedestrian gap-acceptance behavior at selected locations. *Transportation Research Record: Journal of the Transportation Research Board*(1982), 132-140.
- Burden, D. (1996). Walkable and Bicycle-Friendly Communities. Florida Dept. of Trans.
- Chik, A. A., Ismail, C. R., & Hainin, M. R. (2000). Midblock Signalled Pedestrian Crossing-Alternative Controller Algorithms. *Journal of the Civil Engineering*, *12*(1).
- Clauses, A. (2012). Malaysian Institute of Road Safety Research.
- Congiu, M., Whelan, M., Oxley, J., D'Elia, A., & Charlton, J. (2006). *Crossing roads safely: an experimental study of age and gender differences in gap selection by child pedestrians.* Paper presented at the Proceedings of the Australasian road safety research, policing and education conference.
- Daud, N., & Malek, H. (1974). Modelling on Pedestrian Accidents in Malaysia.
- Demiroz, Y., Onelcin, P., & Alver, Y. (2015). Illegal road crossing behavior of pedestrians at overpass locations: Factors affecting gap acceptance, crossing times and overpass use. Accident Analysis & Prevention, 80, 220-228.
- Devkota, B. P. (2014). Walking speed based on pedestrians' behavior at mid-block cross in Kathmandu.

- Ekman, L., & Hyden, C. (1999). Pedestrian Safety in Sweden 1999. University of North Carolina, Highway Safety Research Center.
- Goh, B. H., Subramaniam, K., Wai, Y. T., Mohamed, A. A., & Ali, A. (2012). Pedestrian crossing speed: the case of Malaysia. *International Journal for Traffic and Transport Engineering*, 2(4), 323-332.
- Guidebook, P. F. (1997). Incorporating Pedestrians into Washington's Transportation System. *Prepared by Otak for Washington State DOT, Olympia, WA*.
- Hakkert, A. S., Gitelman, V., & Ben-Shabat, E. (2002). An evaluation of crosswalk warning systems: effects on pedestrian and vehicle behaviour. *Transportation research part F: traffic psychology and behaviour*, 5(4), 275-292.
- Hamed, M. M. (2001). Analysis of pedestrians' behavior at pedestrian crossings. Safety science, 38(1), 63-82.
- Hamidun, R. (2015). Pedestrian Crossing Risk Assessment (PedCRA) Model. International Journal Of Science And Advanced Technology, 5(1), 17-22.
- Hamidun, R., Ishak, S. Z., & Endut, I. R. (2014). Pedestrian crossing scenario model using Petri Nets. *Procedia-Social and Behavioral Sciences*, 129, 406-413.
- Hamidun, R., Kordi, N. E., Endut, I. R., Ishak, S. Z., & Yusoff, M. F. M. (2015). Estimation Of Illegal Crossing Accident Risk Using Stochastic Petri Nets. *Journal Of Engineering Science And Technology. Special Issue On ACEE*, 2015, 81-93.
- Hanan, S. A., Said, N. F., Kamel, A. A. M., & Che, S. A. F. (2015). Factors that Influences Pedestrian Intention to Cross a Road While using Mobile Phone. *International Journal of Economics and Financial Issues*, 5(1S).
- Ishaque, M. M., & Noland, R. B. (2008). Behavioural issues in pedestrian speed choice and street crossing behaviour: a review. *Transport Reviews*, 28(1), 61-85.
- Jain, A., Gupta, A., & Rastogi, R. (2014). Pedestrian crossing behaviour analysis at intersections. *International Journal of Traffic and Transportation Engineering*, 4(1), 103-116.
- Jiang, N., Shi, M., Xiao, Y., Shi, K., & Watson, B. (2011). Factors affecting pedestrian crossing behaviors at signalized crosswalks in urban areas in Beijing and Singapore. Paper presented at the Proceedings of the 1st International Conference on Transportation Information and Safety: Multimodal Approach to Sustained Transportation System Development—Information, Technology, Implementation, Wuhan, China.

- Kadali, B. R., & Perumal, V. (2012). Pedestrians' Gap Acceptance Behavior at Mid Block Location. *International Journal of Engineering and Technology*, 4(2), 158.
- Kadali, B. R., Rathi, N., & Perumal, V. (2014). Evaluation of pedestrian mid-block road crossing behaviour using artificial neural network. *Journal of traffic and transportation engineering (English edition)*, 1(2), 111-119.
- Kadali, B. R., & Vedagiri, P. (2013). Modelling pedestrian road crossing behaviour under mixed traffic condition. *European transport*, 55(3), 1-17.
- Keegan, O., & O'Mahony, M. (2003). Modifying pedestrian behaviour. Transportation Research Part A: Policy and Practice, 37(10), 889-901.
- Khalifa, N. A., & Zulkiple, A. A Simple Method on Measuring Road Pavement Damage For Access Road.
- Kruszyna, M., Mackiewicz, P., & Szydlo, A. (2006). Influence of pedestrians' entry process on pedestrian delays at signal-controlled crosswalks. *Journal of transportation engineering*, 132(11), 855-861.
- Lam, W. H., & Cheung, C.-y. (2000). Pedestrian speed/flow relationships for walking facilities in Hong Kong. *Journal of transportation engineering*, 126(4), 343-349.
- Laxman, K. K., Rastogi, R., & Chandra, S. (2010). Pedestrian flow characteristics in mixed traffic conditions. *Journal of Urban Planning and Development*, 136(1), 23-33.
- Lee, J. Y., Goh, P., & Lam, W. H. (2005). New level-of-service standard for signalized crosswalks with bi-directional pedestrian flows. *Journal of transportation engineering*, 131(12), 957-960.
- Lipovac, K., Vujanic, M., Maric, B., & Nesic, M. (2013). The influence of a pedestrian countdown display on pedestrian behavior at signalized pedestrian crossings. *Transportation research part F: traffic psychology and behaviour*, 20, 121-134.
- Manual, H. C. (2000). Transportation research board. National Research Council, Washington, DC, 113.
- Manual, H. C. (2010). Washington, DC: Transportation Research Board; 2000: ISBN 0-309-06681-6.
- Marisamynathan, S., & Vedagiri, P. (2013). Modeling pedestrian delay at signalized intersection crosswalks under mixed traffic condition. *Procedia-Social and Behavioral Sciences*, 104, 708-717.
- Minhans, A., & Moghaddasi, A. (2013). Transport Cost Analysis of City Bus and Private Car Usage in Johor Bahru, Malaysia. *Jurnal Teknologi*, 65(3), 25-31.

- Nazir, M., Al Razi, K., Hossain, Q. S., & Adhikary, S. (2014). Pedestrian flow characteristics at walkways in Rajshahi metropolitan city of Bangladesh. Paper presented at the Proceedings of the 2nd International Conference on Civil Engineering for Sustainable Development.
- NHTS. (2016). Pedestrian. 2016, from http://ww.nhtsa.gov/pedestrians
- Oxley, J. A., Ihsen, E., Fildes, B. N., Charlton, J. L., & Day, R. H. (2005). Crossing roads safely: an experimental study of age differences in gap selection by pedestrians. *Accident Analysis & Prevention*, 37(5), 962-971.
- Papadimitriou, E., Lassarre, S., & Yannis, G. (2016). Introducing human factors in pedestrian crossing behaviour models. *Transportation research part F: traffic psychology and behaviour, 36*, 69-82.
- Papadimitriou, E., Yannis, G., & Golias, J. (2009). A critical assessment of pedestrian behaviour models. *Transportation research part F: traffic psychology and behaviour*, 12(3), 242-255.
- Pawar, D. S., Patil, G. R., Chandrasekharan, A., & Upadhyaya, S. (2015). Classification of gaps at uncontrolled intersections and midblock crossings using support vector machines. *Transportation Research Record: Journal of the Transportation Research Board*(2515), 26-33.
- Polus, A., Schofer, J. L., & Ushpiz, A. (1983). Pedestrian flow and level of service. *Journal of transportation engineering*, 109(1), 46-56.
- Raghuwanshi, A. K., & Tare, V. (2016). Assessment of Pedestrian Level of Service for Mixed Lane. *Research Journal of Engineering and Technology*, 7(1), 11.
- Rastogi, R., Chandra, S., Vamsheedhar, J., & Das, V. R. (2011). Parametric study of pedestrian speeds at midblock crossings. *Journal of Urban Planning and Development*, 137(4), 381-389.
- Rastogi, R., Thaniarasu, I., & Chandra, S. (2010). Design implications of walking speed for pedestrian facilities. *Journal of transportation engineering*, *137*(10), 687-696.
- Ren, G., Zhou, Z., Wang, W., Zhang, Y., & Wang, W. (2011). Crossing behaviors of pedestrians at signalized intersections: observational study and survey in China. *Transportation Research Record: Journal of the Transportation Research Board*(2264), 65-73.
- Roads, U. (2008). Study Compares Older and Younger Pedestrian Walking Speeds.
- Sa'a, Z. W. T. A. (2007). Modeling Pedestrian Behavior on Pedestrian Crosswalks. An-Najah National University.

- Sarkar, S. (2003). Qualitative evaluation of comfort needs in urban walkways in major activity centers. *Transportation Quarterly*, *57*(4), 39-59.
- Schroeder, B. J., & Rouphail, N. M. (2011). Empirical behavioral models to support alternative tools for the analysis of mixed-priority pedestrian-vehicle interaction in a highway capacity context. *Procedia-Social and Behavioral Sciences*, 16, 653-663.
- Serag, M. (2014). Modelling pedestrian road crossing at uncontrolled mid-block locations in developing countries. *International Journal of Civil and Structural Engineering*, 4(3), 274.
- Sinclair, M., & Zuidgeest, M. (2015). Investigations into pedestrian crossing choices on Cape Town freeways. *Transportation research part F: traffic psychology and behaviour*.
- Singh, K., & Jain, P. (2011). Methods of assessing pedestrian level of service. Journal of Engineering Research and Studies, 2(1), 116-124.
- Sun, D., & Benekohal, R. (2003). Modeling and Simulation of Pedestrian-Motorist Interaction at Uncontrolled Mid-block Crosswalks. Paper presented at the Institute of Transportation Engineers (ITE) 2003 Technical Conference and Exhibit.
- Tanaboriboon, Y., & Satiennam, T. (2005). Traffic accidents in Thailand. *IATSS* research, 29(1), 88-100.
- TENC, I. T. E. C. C., & Zegeer, C. (1998). *Design and safety of pedestrian facilities*: the Institute.
- Wan, B., & Rouphail, N. (2004). Using arena for simulation of pedestrian crossing in roundabout areas. *Transportation Research Record: Journal of the Transportation Research Board*(1878), 58-65.
- Wang, T., Wu, J., Zheng, P., & McDonald, M. (2010). Study of pedestrians' gap acceptance behavior when they jaywalk outside crossing facilities. Paper presented at the Intelligent Transportation Systems (ITSC), 2010 13th International IEEE Conference on.
- Xiao-qiang, C. K.-m. L., Hai, J., & Yang-dong, Z. (2010). Towards the pedestrian delay estimation at intersections under vehicular platoon caused conflicts. *Scientific Research and Essays*, 5(9), 941-947.

- Yang, J., Li, Q., Wang, Z., & Wang, J. (2005). Estimating pedestrian delays at signalized intersections in developing cities by Monte Carlo method. *Mathematics and Computers in Simulation*, 68(4), 329-337.
- Yannis, G., Papadimitriou, E., & Theofilatos, A. (2013). Pedestrian gap acceptance for mid-block street crossing. *Transportation planning and technology*, 36(5), 450-462.
- Zegeer, C. (2002). *Pedestrian facilities users guide: Providing safety and mobility*: diane publishing.
- Zegeer, C., Stewart, J., Huang, H., & Lagerwey, P. (2001). Safety effects of marked versus unmarked crosswalks at uncontrolled locations: analysis of pedestrian crashes in 30 cities. *Transportation Research Record: Journal of the Transportation Research Board*(1773), 56-68.
- Zhu, X., & Srinivasan, S. (2011). A comprehensive analysis of factors influencing the injury severity of large-truck crashes. *Accident Analysis & Prevention*, 43(1), 49-57.