Analysis of Pedestrian Movements in Bangkok

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Walking rates of pedestrians in Bangkok, Thailand, are analyzed. Data were collected using a photographic technique with the aid of a video camera on selected walkways such as sidewalks, stairways, and crosswalks. Walking rates on the pedestrian facilities in Bangkok were determined and compared with those of Western standards as well as with findings obtained in other Asian countries. The findings of the study confirmed that Asian pedestrians walk slower compared with their Western counterparts, so local design standards are needed for pedestrian facilities in Asian countries.

Facilities provided for pedestrians should be well planned to ensure pedestrians against overexertion, vehicular-pedestrian conflict, and accidents. These physical facilities must support the physiological, psychological, and social needs of pedestrians to encourage walking, especially in central business districts (CBDs) where vehicular congestion has arisen. Although pedestrian facilities are present in Bangkok that serve the needs of the Thai people, most of these facilities are either designed with reference to Western standards or arbitrarily designed by the concerned officials.

The necessity for adopting standard design parameters for planning and design of transportation facilities is not in doubt, but, unfortunately, not all developing countries have determined their own suitable standard parameters. Often, parameters and values recommended for the design of transportation and traffic facilities are simply adopted from other countries and used in Asian countries. These parameters have been well defined, tested, and deemed acceptable as design standard values specifically for Western countries. Because of environmental and local conditions together with the various cultural differences affecting these parameters, not all of these design standard values should be used directly by Asian countries.

This recommendation does not imply that the authorities concerned in the Asian countries did not use correct design standard parameters, but rather that they lacked their own suitable design values. In some cases, this lack may not have resulted from the unavailability of locally known parameters but from lack of confidence in using anything but Western design standard values. In other cases, no attention had been paid to these parameters. Even in Bangkok, there has been no attempt yet to study the local characteristics and behavior of Thai pedestrians that could justify the plausibility of adopting Western standards. Before local design standards are formulated, research on the characteristics of local pedestrian movement and the environments of local pedestrian facilities should be carried out. Thus, the intent here is to present an analysis of the walking rates of Thai pedestrians, which later can be compared with Western walking standards to determine which rate is slower. The existing pedestrian facilities in Bangkok and the manner in which the facilities affect the pedestrians are also taken into consideration.

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DATA COLLECTION

Movements of Thai pedestrians were studied in the concentrated areas of the Bangkok CBD. A photographic technique was used to gather the speed data with the aid of a video camera placed in a fixed elevated position (e.g., overpass and building canopy) to obtain an overall view of the selected areas. Random observations were made of pedestrian movements along the major walkways—sidewalks, overpasses, stairways, and a signalized intersection (Table 1). In the areas selected, lengths were measured that served in the analysis of pedestrian walking speeds. The data gathered were then processed on each cassette tape and all timing was counted to 0.01 sec using the timer installed on the screen of the monitor. Pedestrian walking speed was calculated by dividing the length of the area traversed by the time it took the pedestrian to cross the marked-off length. That time was measured directly from the timer shown on the perspective view of the monitor.

RESULTS AND DISCUSSION

Speed Measurements

Speeds reported were the mean walking speeds of pedestrians crossing the measured length marked off. The traffic density and conflicts between pedestrians were minimal, and conditions were considered as free flow in which pedestrians could select their desired normal walking speeds.

Sidewalks

The overall average adult walking speed of male and female Thai pedestrians on three selected sidewalks and an overpass was 72.94 m/min. Young Thai pedestrians had a significantly faster walking speed of 74.05 m/min, most likely because of their more energetic movements. The young pedestrian group was selected at random from secondary school students on an overpass in front of their school. In contrast, the average

TABLE 1 OBSERVATION SITES AND DIMENSIONS ON SIDEWALKS, STAIRWAYS, AND SIGNALIZED INTERSECTIONS

Site No.	Site Description	Length (m)	Riser Height (m)	Tread Width (m)	Stair Width (m)	Stair Length (m)	Angle (deg)
Sidewalks							
1	Rachaprarop Road (in front of Thai Daimaru Department Store)	4.0	—	—	—	—	—
2	Phaholyothin Road						
	In front of Northern Bus Terminal	8.0	—	—	—	—	—
	Beside Sunday Market	6.0	—	—	—	—	—
3	Sanam Luang Sidewalk (near Grand Palace)	6.0	—	—	—	—	—
4	Vipawadee Road (overpass in front of Surasak Montri School)	10.0	—	—	—	—	—
Stairways							
1	Phayathai Road (Stairway at Mahboonkrong Overpass)	—	0.20	0.30	1.20	5.00	34.00
2	Phaholyothin Road (Stairway I in front of Northern Bus Terminal)	—	0.15	0.30	3.00	5.00	35.00
3	Phaholyothin Road (Stairway II in front of Chatuchak Park)	—	0.14	0.30	1.20	4.40	28.61
4	Ratchaprarop Road (Stairway at Indra Overpass)	—	0.13	0.30	1.40	4.50	27.57
Signalized Intersection							
Phaholyothin-Yan Phaholyothin Intersection near Sunday Market		11.13					

walking speed of the elderly Thais (49.54 m/min) was much slower than that of both the adult and the young pedestrians. The elderly pedestrians were those who appeared to be over 60 years old and thus were chosen subjectively in this study.

Further analysis on the basis of sex showed that Thai adult as well as young male pedestrians generally walked faster than female pedestrians. These results were significant at the 5 percent level. To verify the findings between the adult and young pedestrian mean walking speeds, tests of significance (t-tests) at the 5 percent level were carried out for men and women of both pedestrian groups. It was known that young female pedestrians walked significantly faster than adult female pedestrians. However, the same was not true for male pedestrians. Tests indicated that there was no significant difference between the walking speeds of young and adult male pedestrians. No significant difference was found at the 5 percent level between male and female elderly pedestrian walking speeds (50.77 and 48.06 m/min, respectively). Table 2 shows the results for all pedestrian walking speeds.

Stairways

Because of the soon-to-be-constructed rail rapid transit system in Bangkok, it has become essential to study stairways as well as other vertical pedestrian modes such as elevators and escalators. Information pertaining to the proper design of stairways being urgently needed, movements on stairways were analyzed and compared with those of Western countries. As mentioned in previous studies (*1,2*), pedestrian walking speeds varied depending on the direction (up or down) and the riser height. Thus, four selected stairway sites with different riser heights were chosen for this study.

Results of the findings are presented in Table 3 for the ascending and descending directions. As in previous studies conducted in the United States, Thai pedestrians also walked faster when descending the stairway than when ascending. These findings held true for all four study sites and were significant at the 5 percent level. Walking speeds also varied from 27.91 to 33.78 m/min for the ascending direction and 34.97 to 37.17 m/min for the descending direction for various riser heights. The t-test at the 5 percent level indicated that even a 1-cm (0.01-m) difference in riser height has a significant effect on the walking speed for both ascending and descending directions. Thus, it can be concluded that riser heights have an effect on Thai pedestrian walking speed.

In a comparison of the walking speed of Thai pedestrians with that of American pedestrians found in previous studies (*1,2*), the results obtained were similar to those for walking speeds on sidewalks. Thai pedestrians walked more slowly than their American counterparts on stairways. Results obtained in the United States (Table 4) indicated that for the

TABLE 2 PEDESTRIAN WALKING SPEEDS

Characteristic	Adult			Young			Elderly		
	Men	Women	Both	Men	Women	Both	Men	Women	Both
Mean walking speed (m/min)	76.44	70.21	72.94	75.96	72.15	74.05	50.77	48.06	49.54
Standard deviation (m/min)	8.71	6.94	7.77	7.1	5.53	6.37	8.52	7.02	7.75
Range									
High	99.34	93.75	99.34	103.5	93.75	103.50	67.80	67.37	67.8
Low	54.55	50.55	50.55	56.00	52.45	52.45	35.12	31.16	31.16
Sample size	238	304	542	298	298	596	51	43	94
Significance at 5% level between sexes of age group	Significant			Significant			Not significant		

TABLE 3 PEDESTRIAN WALKING SPEEDS ON STAIRWAYS

Characteristic	Study Site 1	2	3	4
Ascending				
Mean walking speed (m/min)	27.91	29.81	32.30	33.78
Standard deviation (m/min)	2.29	3.42	3.27	4.13
Riser height (m)	0.20	0.15	0.14	0.13
Range				
High	45.76	40.76	42.04	45.76
Low	20.90	20.39	23.46	23.77
Sample size	222	561	168	202
Descending				
Mean walking speed (m/min)	34.97	35.90	36.58	37.17
Standard deviation (m/min)	4.31	4.37	3.62	3.90
Riser height (m)	0.20	0.15	0.14	0.13
Range				
High	52.45	49.18	48.91	53.59
Low	23.29	26.11	26.37	27.55
Sample size	205	307	140	215

TABLE 4 SPEEDS OBSERVED IN UNITED STATES FOR ASCENDING AND DESCENDING DIRECTIONS (*2*)

Stairway Characteristic	Ascending		Descending	
	Speed (ft/min)	Speed (m/min)	Speed (ft/min)	Speed (m/min)
7-in. (0.178-m) riser and 11-in. tread	96	29.26	121	36.89
6-in. (0.1524-m) riser and 12-in. tread	108	32.92	144	43.89

6-in. (0.1524-m) riser heights, walking speeds of American pedestrians were 108 ft/min (32.92 m/min) and 144 ft/min (43.89 m/min) for ascending and descending directions, respectively. Although it may not be valid to compare walking speeds for which the riser heights are not exactly the same, at the selected study site in Bangkok (Site 2) the riser height was 0.15 m, which was close to the 6-in. riser height used in the U.S. studies. Results found at Site 2 (Table 3) indicated slower walking speeds for Thai pedestrians of 29.81 m/min (97.8 ft/min) and 35.90 m/min (117.8 ft/min) for ascending and descending directions, respectively.

Effect of riser height on the design of the stairway should be given more serious consideration, especially in Bangkok. The riser height of 0.20 m (7.87 in.) for the stairway at Site 1 resulted in the lowest climbing speed, 27.91 m/min. This riser height was greater than the maximum height recommended by Fruin (*1*), who in one of his studies, recommended for the design of stiarways that "riser height should be kept below 7 in. (0.178 m) to increase the traffic efficiency. "Although one could argue that Thai pedestrians have the same ability to climb stairs as do Westerners, design of suitable riser heights should not be ignored.

Signalized Crossings

Planners and engineers must address the problem of pedestrians at intersections in which the primary concern is to pro-

vide adequate walking time for crossing the street safely. A walking speed study was conducted at crosswalks in Bangkok. A total of 525 observations was made; the results are presented in Table 5.

The mean speed of pedestrians crossing the signalized crossing was found to be 76.52 m/min, which was relatively faster than normal walking speed on walkways. The reason for this difference could be the greater danger involved in crossing the road. Likewise, results also indicated that men walked faster than women (significant at the 95 percent confidence level).

The *Highway Capacity Manual* (*3*) recommends a walking speed of 82 m/min (4.5 ft/sec) to calculate the crossing time in the design of pedestrian traffic signals. Although it is believed that these values are applicable throughout the United States, they may not be valid locally. Thus, only local practitioners and designers can affirm or deny them, and this must be taken into consideration in the design of a pedestrian traffic signal system.

Comparison of Walking Speed Among Countries

Table 6 presents the walking speeds of pedestrians from different countries in Asia and in England, the United States, and Canada (*4–8*). Walking speeds are ranked from as slow as 65 m/min in Saudi Arabia (*9*) to as fast as 88 m/min in Pittsburgh (*8*). Except for Israelis, Asians walk slower than do their Western counterparts. Caucasians may walk faster because of their cultural attitude and their generally bigger size. However, Israelis (*10*), who with a walking speed of 78.8 m/min are perhaps similar physically and in walking characteristics to Western pedestrians, walk faster than Asians. On the other hand, the slower walking speeds of Saudi Arabian pedestrians are caused by the extreme daily temperatures prevailing during at least 6 months of the year. Higher average temperatures are expected to be experienced by the Saudis, especially during the summer months, compared with those in other Asian countries. Those who walk long distances are traveling in pursuit of their daily activities when other means of transportation are unavailable.

The mean free flow walking speed of Thai pedestrians, which is 73 m/min, was found to be relatively comparable with the walking speeds of other Asian pedestrian walking speeds [72, 74, and 75 m/min in India (*11*), Singapore (*12*), and Sri Lanka (*4*), respectively]. This pedestrian movement study conducted in Bangkok has further confirmed the findings in other Asian countries that Asians walk slower than their Western counterparts. It is therefore recommended that walking rates of the Thai and other Asian pedestrians be further examined to derive suitable pedestrian design standards solely for Asian needs.

TABLE 5 PEDESTRIAN WALKING SPEEDS AT SIGNALIZED CROSSINGS IN BANGKOK

Characteristic	Men	Women	Both
Mean walking speed (m/min)	78.45	73.99	76.52
Standard deviation (m/min)	7.10	6.28	6.76
Range			
High	95.25	87.87	95.95
Low	60.27	57.57	57.57
Sample size	298	227	525

GENERAL COMMENTS AND SUGGESTIONS

In the foregoing section, the most common speed measurements that are used in the analysis of pedestrian movements on sidewalks, stairways, and crosswalks were discussed.

In the CBD of Bangkok, it is common to witness traffic jams when pedestrian and vehicular movements are at their peak. On sidewalks, the walkway width has been tremendously reduced, mostly by the presence of sidewalk vendors or vending stands, and pedestrians spill onto the road. Obstructions such as planting boxes and trees used to beautify the sidewalk have been left untended and also reduce the width of the sidewalk, resulting in inconvenience to pedestrians. Inappropriate installation of traffic signs also causes interference and blocks the walkway available to pedestrians. Other obstacles such as type of walking surface, pavement obstructions, and amount of vehicular traffic along the pavement also affect the safety and convenience of pedestrians.

Lack of coordination in the proper placement of telephone booths on pathways has hindered and confused pedestrians, sometimes causing them to take a crooked or meandering path.

Traffic safety devices and improvements for pedestrian facilities should be planned. On sidewalks, barriers are needed in areas of high pedestrian-vehicular conflict to discourage pedestrians from crossing the road. Alternatively, an attractive and safe overpass or underpass should be provided. Corrective measures are also needed for obstacles such as unsafe pavement surfaces, unnecessary trees and planting boxes, and inappropriate placement of traffic signs.

Increased attention is also required to foot placement and maintenance of balance on stairways. Stair dimensions and configurations are important elements of stairway designs that have received very little attention, despite the greater demands on human energy and concerns for the safety of pedestrians. Inadequacy of stairways in and around transport terminals and other trip generators affects the entering and exiting capacity of other traffic.

Likewise, pedestrians crossing the road often run at crosswalks, especially on the Go signals, and some vehicles stop

TABLE 6 COMPARISON OF PEDESTRIAN WALKING SPEEDS IN DIFFERENT COUNTRIES

Country	Mean Walking Speed (m/min)
Asia	
Riyadh, Saudi Arabia	65.0
Madras, India	72.0
Thailand	73.0
Singapore	74.0
Colombo, Sri Lanka	75.0
Israel	78.8
England	78.6
United States	
Columbia	79.0
New York	81.0
Pittsburgh	88.0
Calgary, Canada	84.0

in the center of the crosswalk area, thus threatening the crossing pedestrians. In this respect, a nationwide effort should be made to encourage the enforcement of pedestrian and traffic laws.

CONCLUSION

Although a simple study was carried out, it is hoped that the results will have more far-reaching effects, especially as a base guideline for the more serious consideration of the design of pedestrian facilities. From these results, it is concluded that Bangkok pedestrian facility design standards should conform with local standards and authorities should try to refrain from directly adopting Western pedestrian design standards.

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