Comparison of Central Business District Pedestrian Characteristics in Canada and Sri Lanka

JOHN F. MORRALL, L. L. RATNAYAKE, AND P. N. SENEVIRATNE

Characteristics of pedestrians in the central business district of Colombo, Sri Lanka, are described. The characteristics measured included walking speed, flow, and density for sidewalks of varying widths. Comparisons are made with results from Calgary, Canada, and from other Asian studies. The findings indicate that Asian speeds for all groups are significantly lower than those observed in Calgary, Canada. Implications of the findings with respect to the technological transfer of pedestrian planning techniques between the two countries are also discussed. The differences in pedestrian characteristics are caused not only by differences in speed, flow, and density relationships, but also by cultural differences. Problems common to both countries are lack of pedestrian data and difficulties involved in collecting pedestrian data. Suggestions concerning low-cost methods of updating pedestrian count data are provided.

A study was undertaken with the main objective of developing facility planning and design standards for Colombo, Sri Lanka. Basic pedestrian movement characteristics such as walking speed were compared between Colombo and Calgary to determine and explain differences that would affect the direct transfer of Western planning practices and design standards to Asian cities. Calgary was chosen for comparison purposes for three principal reasons. First, both Colombo and Calgary have concentrated central business districts (CBDs). Both cities have active plans to develop a system of elevated walkways. Calgary (1), for example, has 44 pedestrian bridges totaling over 9 km of elevated walkways that provide access to office, retail, and cultural facilities as well as to indoor and outdoor public spaces. Colombo has plans for an elevated walkway network in the CBD and in the vicinity of congested arterials. Both cities have been assembling a data base of pedestrian characteristics. The second objective of the study was to compare the pedestrian characteristics of Colombo with those of other Asian cities.

DATA COLLECTION

Pedestrian speed and flow characteristics were measured at three different locations in Colombo during peak and off-peak periods in July 1988. Walking speeds were determined by manually timing pedestrians over a test section. In Calgary, walking speeds were measured on six different facilities using time lapse photography, manual observations, and the moving-

J. F. Morrall, University of Calgary, Calgary, Alberta, Canada T2N1N4. L. L. Ratnayake, University of Moratuwa, Moratuwa, Sri Lanka. P. N. Seneviratne, Concordia University, Montreal, Quebec, Canada H3G 1M8.

observer technique. In Colombo, sidewalk widths at the observation sites varied from 1.65 to 3.73 m, whereas in Calgary sidewalk widths varied from 3 to 4 m.

WALKING SPEED STUDIES

Tables 1 and 2 present the results of the speed measurement studies in Colombo and Calgary (2,3), respectively. The walking speeds for both cities were measured for 3-m sidewalks. Walking speeds for Singapore (4) and Bangkok, Thailand, (see paper by Tanaboriboon and Guyano in this Record); are presented in Tables 3 and 4, respectively. Mean walking speeds for Riyadh, Saudi Arabia, are as follows (5): men, 70 m/min; women, 53 m/min; both, 65 m/min.

COMPARISON OF WALKING SPEEDS

Average Walking Speeds

A comparison of mean walking speeds for Colombo and Calgary, as well as for Singapore, Bangkok, and Riyadh, is as follows:

City	Mean Walking Speed (m/min)
Riyadh	65
Bangkok	73
Singapore	74
Colombo	75
Calgary	84

The mean walking speed of 75 m/min for Colombo is considerably lower than the value of 84 m/min shown for Calgary. However, the Colombo walking speed is similar to the values of 73 and 74 m/min reported for Bangkok and for Singapore by Tanaboriboon (4; paper in this Record). Although the mean walking speed for Calgary is not intended to represent the range of walking speeds in North American cities, it does indicate that walking speeds in Western cities are higher than those in Asian cities.

Walking Speeds of Men and Women

In both Colombo and Calgary, men were observed to walk faster than women. In Colombo, the average walking speed of men was measured at 81 m/min, or 3 m/min faster than women. In Calgary, the corresponding mean walking speeds

TABLE 1   COLOMBO WALKING SPEEDS FOR 3-m SIDEWALKS

| Group | Statistics (m/min) | | | |
	Mean	Standard Deviation	High Value	Low Value
Men	81	5	87	71
Women	78	4	84	68
Total	75	14	87	66
Elderly	72	4	78	66

TABLE 2   CALGARY WALKING SPEEDS FOR 3-m SIDEWALKS

| Group | Statistics (m/min) | | | |
	Mean	Standard Deviation	High Value	Low Value
Men	86	13	123	50
Women	81	11	120	43
Total	84	12	123	43

TABLE 3   SINGAPORE WALKING SPEEDS (4)

| Group | Statistics (m/min) | | | |
	Mean	Standard Deviation	High Value	Low Value
Men	79	12	123	44
Women	69	11	101	38
Total	74	12	123	38
Elderly	54	8	69	36

TABLE 4   BANGKOK WALKING SPEEDS

| Group | Statistics (m/min) | | | |
	Mean	Standard Deviation	High Value	Low Value
Men	76	9	99	55
Women	70	7	94	51
Total	73	8	99	51
Elderly	50	8	68	31

SOURCE: Preceding paper in this Record.

were 86 and 81 m/min for men and women, respectively. The difference was determined to be significant at the 1 percent level. Compared with Singapore's mean walking speed of 79 m/min for men and Bangkok's mean of 76 m/min, Colombo has the highest average walking speed. Similarly, the highest average walking speed for women was recorded in Colombo at 78 m/min, compared with Singapore and Bangkok at 69 and 70 m/min, respectively.

Walking Speeds of the Elderly

The elderly were observed to walk more slowly than the general population. The walking speeds of elderly people were 72, 54, and 50 m/min for Colombo, Singapore, and Bangkok,

respectively. Comparisons of walking speeds of elderly people were difficult to make, because age was not recorded during the field surveys.

Walking Speed Summary

In the tabulation of mean walking speeds reported above for five cities, the mean walking speed ranges from 65 m/min in Riyadh, Saudi Arabia, to 84 m/min in Calgary, Canada. Mean walking speeds for the three Asian cities of Bangkok, Singapore, and Colombo were observed to be 73, 74, and 75 m/min, respectively. The differences in walking speeds between Calgary and Colombo are attributed to the physical differences among pedestrians (e.g., in height), cultural differences (e.g., in dress and shopping habits), and attractions (such as pavement hawkers) located along sidewalks. Similar findings have been reported for Singapore (4), Bangkok (see preceding paper in this Record), and Riyadh, Saudi Arabia (5).

SPEED, RATE OF FLOW, AND DENSITY

Speed, rate of flow, and density measurements were made at all three survey sites in Colombo.

Speed Versus Rate of Flow

Figure 1 shows speed versus rate of flow. Over the flow range of 2.0 to 16.0 ped/m-min, speed varied between 70 and 80 m/min. However, no discernible relationship was observed over the range. The independence of speed and flow was also observed in Calgary (2). Attempts to fit linear models to the data were unsuccessful for Colombo data.

Speed Versus Density

Figure 2 shows speed versus density for Colombo. Off-peak travel has a density range of 0.1 to 0.2 ped/m² and speed varies from 70 to 80 m/min, without a decrease in speed as density increases. This is because off-peak travel is mainly for shopping. However, during the peak the speed drops from 80 to 50 m/min for a density range of 0.2 to 0.3 ped/m², because these trips are mainly for business.

Rate of Flow Versus Density

The rate of flow versus density is shown in Figure 3. At densities from 0.20 to 0.25 ped/m², the flow rate decreased from 8 to 3 ped/m-min. The rate of flow was measured at 2 ped/m-min and density was about 0.1 ped/m². Again, off-peak and peak travel have different purposes (shopping and business, respectively) and the values should be considered separately.

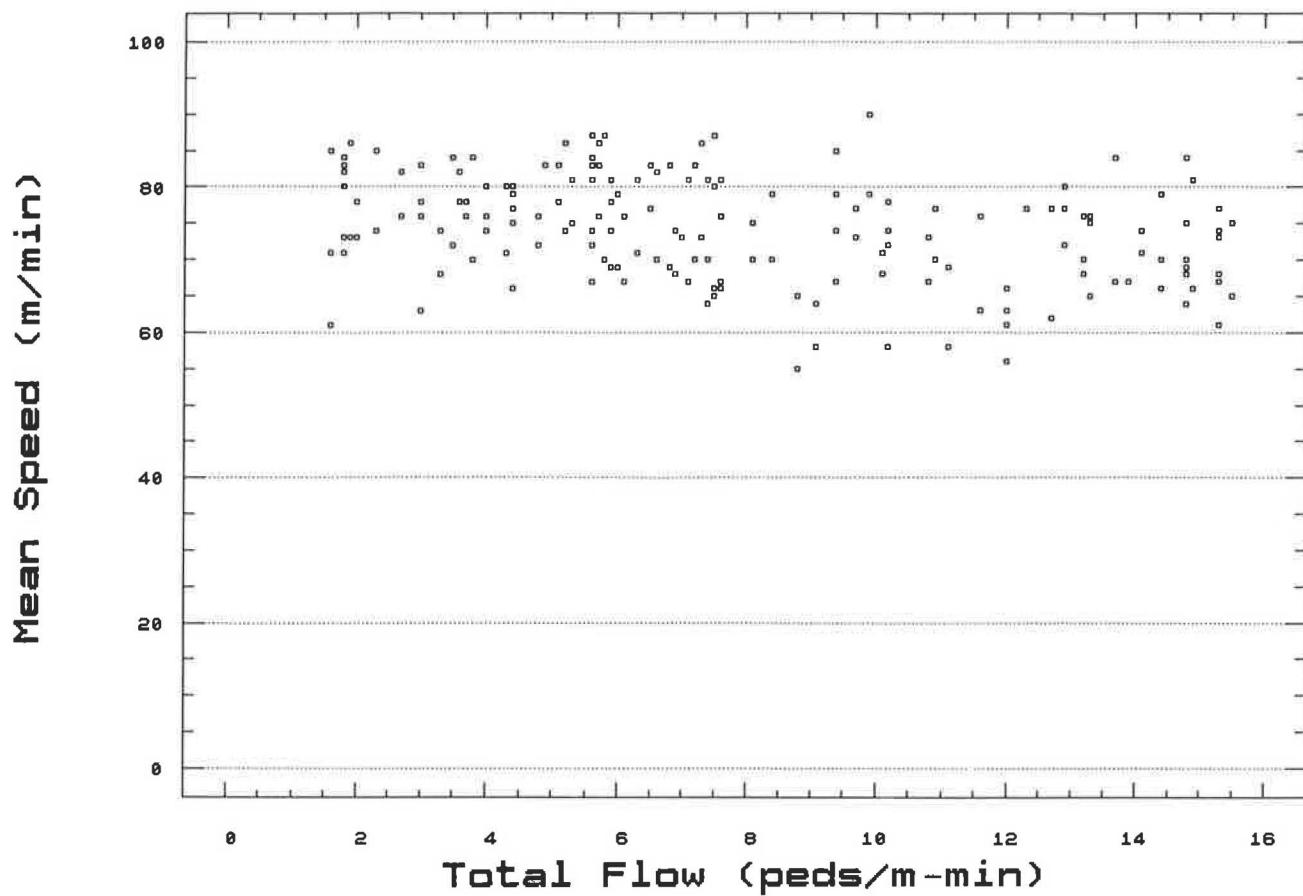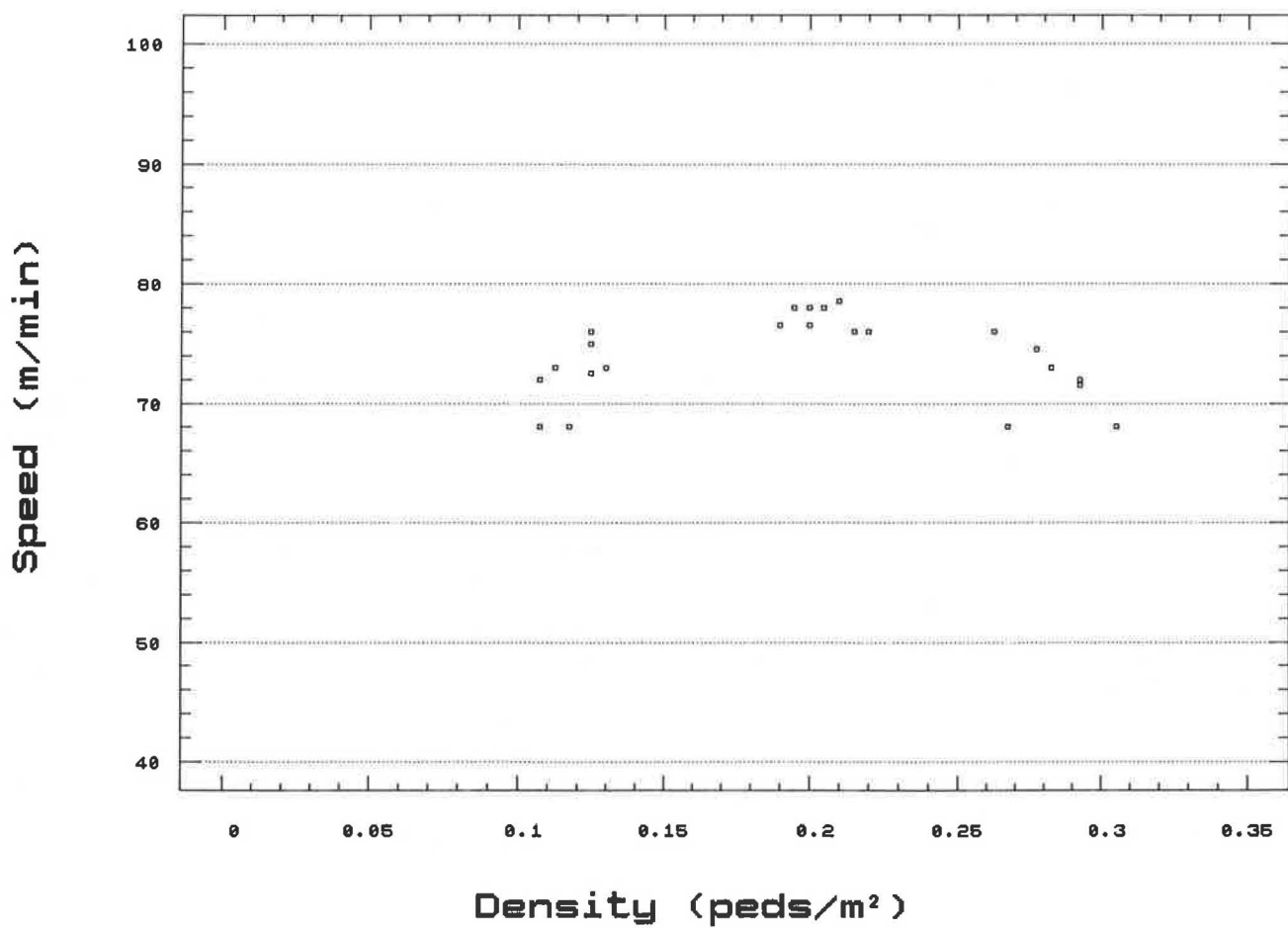FIGURE 1   Plot of mean speed versus total flow.

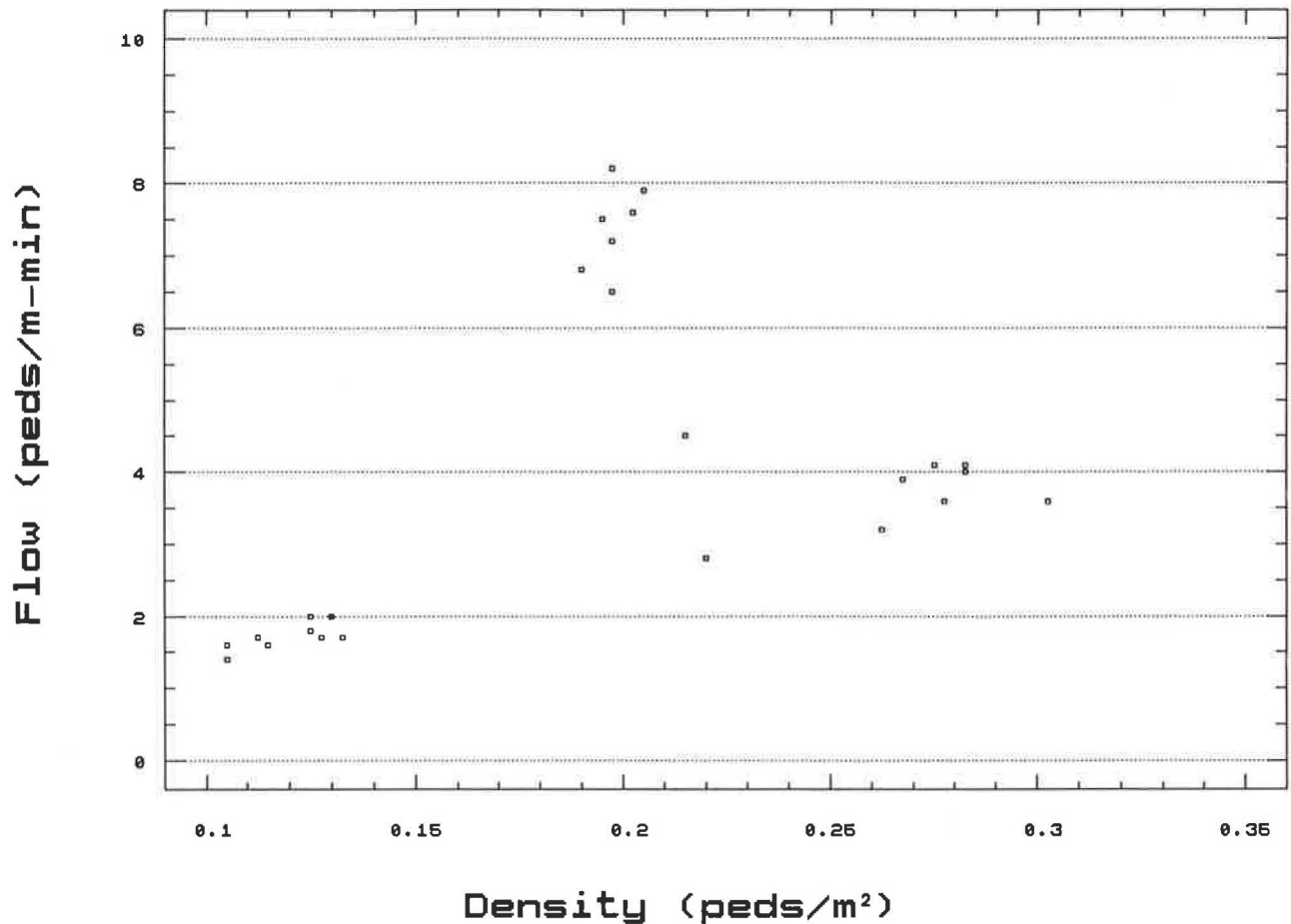FIGURE 2   Plot of speed versus density.

FIGURE 3 Plot of flow versus density.

ESTIMATION OF PEDESTRIAN FLOWS, CHARACTERISTICS, AND SAMPLING TECHNIQUES

As noted at the outset, the difficulties associated with collecting pedestrian data have limited the ability to establish standard pedestrian planning procedures. The collection of pedestrian flow data, which are fundamental for evaluating facility performance, is usually done manually and hence is highly labor-intensive. Even though this may not pose severe problems in developing countries, the costs of data collection in industrialized countries are substantial.

In order to minimize manpower costs, several estimation procedures have been used in previous studies. One of these is the method of expansion factors proposed by Seneviratne and Morrall (*6*). This procedure enables the expansion of long-term flow data. However, sufficient information is required to identify the appropriate short-term count to be expanded.

Pedestrian flow data collected in Calgary and Montreal have demonstrated that counts during periods as short as 5 min are sufficient for estimating hourly volumes. Nevertheless, the short-term variations render it difficult to obtain a representative 5-min count. Bayesian estimates, which recognize the variations in flow, are obtained by combining sam-

ple counts during very short time periods using the experience and judgment of the analyst.

SUMMARY AND CONCLUSIONS

1. Free flow pedestrian speeds for all groups in Asian countries are significantly lower than those observed in Calgary.

2. The main explanation for the difference in speeds between Colombo and Calgary may be physical (e.g., height) and cultural (e.g., dress) differences, and attractions (such as pavement hawkers) located along sidewalks. Similar findings have been reported for Singapore (*4*), Bangkok (see preceding paper in this Record), and Riyadh, Saudi Arabia (*5*). The lower walking speeds for Singapore were partially attributed to physical and cultural characteristics, whereas dress and extreme temperatures were cited as reasons for lower walking speeds in Riyadh.

3. Pedestrian planning techniques for Asian countries such as Colombo should be based on local pedestrian characteristics rather than on pedestrian characteristics from cities with dissimilar cultures such as Calgary.

4. Despite the importance of the pedestrian mode in large cities like Colombo or Calgary, pedestrian data collection has been largely ignored because of the cost of data reduction.

A sampling technique based on Bayesian theory for obtaining the best estimates as well as updating short-term counts is suggested as one additional means of enhancing pedestrian flow data banks.

5. The pedestrian mode is the most important means of travel in Sri Lanka, yet it has been largely neglected in urban transportation studies conducted in Colombo. Neglect of planning for the pedestrian mode is manifested in terms of the lack of sidewalks and poor maintenance of existing walkways. In many areas of Colombo, pedestrian and vehicular traffic must share the same roadspace. In view of the neglect of the pedestrian mode, future urban transportation studies should include pedestrian studies and facilities on an equal footing with the vehicular modes.

ACKNOWLEDGMENT

REFERENCES

1. G. Lyons and D. Sinclair. Calgary +15, Twenty Years of Development. *Plan Canada*, Vol. 27, No. 10, 1988.

2. P. N. Seneviratne and J. F. Morrall. Level of Service on Pedestrian Facilities. *Transportation Quarterly*, Vol. 39, No. 1, 1985.

3. P. N. Seneviratne and J. F. Morrall. Analysis of Factors Affecting the Choice of Route of Pedestrians. *Transportation Planning and Technology*, Vol. 10, 1985, pp. 147–159.

4. Y. Tanaboriboon, S. S. Hwa, and C. H. Chor. Pedestrian Characteristics Study in Singapore. *Journal of Transportation Engineering*, Vol. 112, No. 3, 1986.

5. P. A. Koushki. Walking Characteristics in Central Riyadh, Saudi Arabia. *Journal of Transportation Engineering*, Vol. 114, No. 6, 1986.

6. P. N. Seneviratne and J. F. Morrall. Estimates of Pedestrian Flow for Classifying and Evaluating Pedestrian Facilities. *Journal of Advanced Transportation*, Vol. 24, No. 1, pp. 31–46, 1990.