INVESTIGATION OF THE CAPACITY OF THE WHITE HOUSE SIDEWALK FOR ORDERLY DEMONSTRATIONS

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The objective of this study was to determine the maximum number of demonstrators that could congregate in an orderly manner on the sidewalk bordering the south side of Pennsylvania Avenue, N.W., in front of the White House in Washington, D.C., without impeding the normal flow of pedestrian traffic. The procedure used was to estimate the maximum number of pedestrians that would use the White House sidewalk during peak periods of demand throughout the year. Estimates were then made to determine the amount of sidewalk space that could accommodate that maximum pedestrian demand without causing discomfort or loss of mobility. The remaining sidewalk space was then investigated to estimate the maximum number of demonstrators it could accommodate for three different kinds of demonstrations: (a) a "circulating" demonstration, in which a set number of demonstrators would continuously circulate on the sidewalk at varying rates of speed; (b) a "stationary" demonstration, in which a fixed number of demonstrators would stand, without movement, on the White House sidewalk at varying degrees of concentration; and (c) a "walk-by" demonstration, in which large groups of demonstrators would walk by the White House, without returning, at varying rates of speed for certain periods of time.

•PUBLIC sidewalks, especially those located near prominent government buildings, are being used more and more frequently as sites for demonstrations. Public officials, in an effort to satisfy the demands of the groups wishing to demonstrate and at the same time to ensure the use of the sidewalk for regular pedestrian traffic, have in some instances set up limitations on the number of demonstrators allowed to use a site.

The objective of this study is to determine the maximum sidewalk area that can be allocated for use by orderly demonstrators without disrupting the normal pedestrian flow. Given this area, estimates are made of the maximum number of demonstrators that can congregate in the given space for three types of demonstrations: circulating, stationary, and walk-by.

The site chosen for the study was the sidewalk bordering the south side of Pennsylvania Ave., N.W., in front of the White House, in Washington, D.C. This sidewalk is frequently used for demonstrations and at the present time has restrictions on the number of demonstrators allowed to congregate there.

Information on the pedestrian characteristics on the White House side is obtained from the studies conducted by the District of Columbia Department of Highways and Traffic and from observations at the site. The data collected were subjected to statistical analysis, and the results were used to estimate pedestrian flows and densities.

DATA COLLECTION

The dimensions of the White House sidewalk were obtained by on-the-spot observations and from a map supplied by the National Park Service. The sidewalk in front of the White House extends along the south side of Pennsylvania Avenue between East Executive Avenue and West Executive Avenue. It is bordered on the south, or White House

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side, by a stone and iron fence that circles the White House grounds, and on the north, or roadway side, by a concrete curb and at certain places by a 4-ft high, single-strand, heavy wire cable barrier. Two driveways cross the sidewalk: at the east gate, approximately 140 ft west of East Executive Avenue, and at the west gate, approximately 130 ft east of West Executive Avenue. Three trees are located at or near the center longitudinal axis of the sidewalk approximately 31 ft, 44 ft, and 75 ft west of East Executive Avenue.

Figure 1 shows the dimensions of the White House sidewalk as 775 ft long and 37.5 ft wide. However, approximately 45 ft should be subtracted from the length of the sidewalk to account for driveways crossing the sidewalk and for adjacent sidewalk traffic. Approximately 2.5 ft should be subtracted from its width to account for the stone and iron fence and occasional single-strand wire fence that border each side of the sidewalk. The sidewalk area actually available to pedestrians and demonstrators, therefore, is 730 ft long and 35 ft wide—an area of 25,500 sq ft.

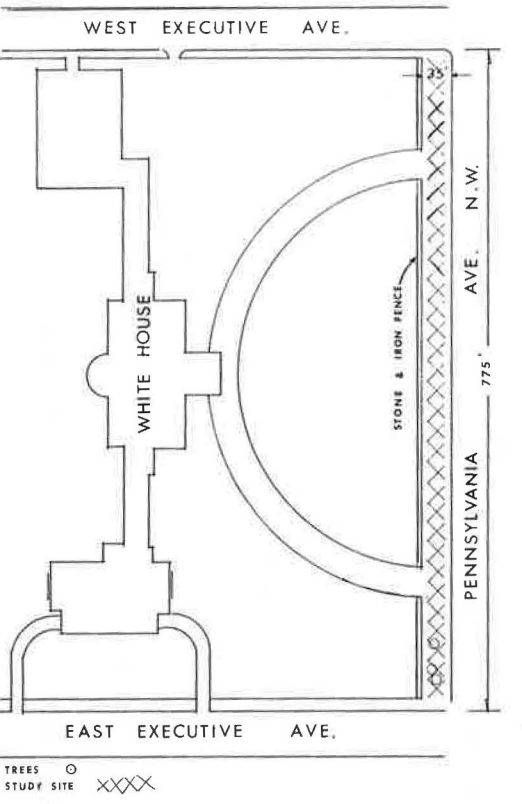

Figure 1.

To determine the number of pedestrians using the White House sidewalk and the rates at which they travel, two observers were stationed on the stone wall bordering the inside of the sidewalk for three consecutive days: Wednesday, October 16, 1968; Thursday, October 17, 1968; and Friday, October 18, 1968. Counts were made during two time periods—10:30 a.m. to 2:00 p.m. and 4:00 to 6:00 p.m. During these time periods, according to District of Columbia Highway Department surveys, the peak volumes of pedestrian traffic in the White House area occur.

To determine the average pedestrian walking speed, one observer randomly selected persons moving along the sidewalk and used a stopwatch to measure the length of time each took to cover a 100-ft course. To determine the number of pedestrians using the sidewalk the other observer counted all pedestrians passing over a certain point on the sidewalk during 15-min intervals. Both observers segregated the pedestrians into two groups: "normal pedestrians" (workers, shoppers, etc.) and "tourists." The factors by which tourists were separated from normal pedestrians are not, of course, clearly and easily articulated. In general, however, persons who wore business or work clothing, walked by themselves, did not look around at the White House or Lafayette Park, did not carry cameras, and moved rapidly as if with some specific destination were categorized as normal pedestrians. Persons who wore casual clothing, walked in groups of women or children, carried cameras, took photographs, or moved in a casual and relaxed manner were categorized as tourists. When persons stopped for some reason after entering the study area, their elapsed time and apparent purpose for stopping was noted. Because these persons were few in number, they were not included in the survey.

The traffic flow patterns of tourists entering and leaving the White House grounds on conducted tours were also noted. All White House tour visitors currently enter the grounds by a side entrance on East Executive Avenue and generally leave by the east gate on Pennsylvannia Avenue. Because the visitors receive a clear view of the White

House during the tour and the tourist parking lots are situated behind the White House in the opposite direction from the sidewalk, very few of them turn left at the east gate and walk along the sidewalk in front of the White House to take pictures or to obtain a different view. On the contrary, the vast majority of visitors turn right at the east gate and walk to the corner of East Executive Avenue to the visitors' parking lot behind the White House grounds. Only a small percentage of tourists observed stopped on the White House sidewalk, and those remained standing only briefly to take one or two pictures.

DETERMINING SIDEWALK SPACE NECESSARY FOR EXISTING PEDESTRIAN DEMAND

One objective of this study was to determine how much sidewalk space is necessary to accommodate the maximum number of pedestrians passing over the sidewalk in an orderly manner during the busiest periods of the day. This space requirement is a function of three basic factors: the number of persons using the sidewalk; the speed at which the average pedestrian travels; and the degree to which pedestrians are concentrated per square foot of sidewalk space (otherwise expressed as the pedestrian "concentration" or "K" factor). These three factors, when combined, may be expressed as the variable "total pedestrian flow," i.e., the number of pedestrians that can cross a certain point on a sidewalk during certain periods of time. For convenience, this figure is normally expressed per foot of sidewalk width. Once these three factors are calculated, the total pedestrian flow per hour per foot of sidewalk width can be determined.

Number of Pedestrians Using Sidewalk During Peak Summer Months

In general, the normal pedestrian flow comprised of workers, shoppers, and local businessmen does not vary during different times of the year. However, the numbers of tourists visiting Washington, and therefore the White House area, are highly seasonal. The actual pedestrian counts conducted for this study were made in October 1968. For this reason the figures obtained must be adjusted upward to account for the substantially higher numbers of tourists that would use the White House sidewalk during the summer months. The normal pedestrian figures are treated as constant throughout the year.

Surveys obtained from the District of Columbia Highway Department indicate that the highest pedestrian flows across intersections in the vicinity of the White House occur from 11:00 a.m. to 1:00 p.m., 1:00 to 2:00 p.m., and 5:00 to 6:00 p.m. (Table 1). Accordingly, the White House sidewalk pedestrian counts obtained for this survey on October 16, 17, and 18 were conducted during these time periods.

TABLE 1

HOURLY VARIATION IN PEDESTRIAN VOLUMES AT PENNSYLVANIA AVENUE AND EAST EXECUTIVE DRIVE

Time Period	Hourly Flow of Pedestrians	
	August 8, 1963	April 6, 1966
7-8 a.m.	146	191
8-9	621	671
9-10	790	668
10-11	1,480	1,124
11-12	1,426	1,674
12-1 p.m.	618	1,697
1-2	600[a]	1,000[a]
2-3	275	472
3-4	217	291
4-5	313	273
5-6	828	188

Source: Pedestrian counts conducted by District of Columbia Department of Highways.

[a]Estimated; 1:00 to 2:00 p.m. was lunch hour for counters.

During the highest 15-min time segment in each of the three time periods for these days in October, 500 pedestrians were counted during the 11:00 a.m. to 1:00 p.m. period, 275 during the 1:00 to 2:00 p.m. period, and 240 during the 5:00 to 6:00 p.m. period. During the 11:00 a.m. to 1:00 p.m. and 1:00 to 2:00 p.m. periods, tourists comprised approximately 20 percent of all pedestrians; during the 5:00 to 6:00 p.m. period, tourists comprised 10 percent of all pedestrians. Of 500 pedestrians counted during the peak 15 min within the busiest 11:00 a.m. to 1:00 p.m. period, therefore, 100 were tourists—a ratio of 4 normal pedestrians to 1 tourist.

Because the number of tourists visiting Washington during October is somewhat less than during certain peak summer months, it was necessary to adjust the October figures. The number of White House visitors during

TABLE 2

NUMBER OF PERSONS VISITING WHITE HOUSE

Month	1967	1968
January	35,000	32,000
February	48,000	56,000
March	127,000	100,000
April	205,000	150,000
May	195,000	100,000
June	240,000	72,000
July	247,000	156,000
August	257,000	191,000
September	115,000	83,000
October	115,000	94,000
November	85,000	77,000
December	70,000	65,000

Source: Joseph A. Bruno, Group Tour Director, The White House. Figures are rounded to the nearest thousand.

TABLE 3

MAXIMUM NUMBER OF PEDESTRIANS USING WHITE HOUSE SIDEWALK DURING BUSIEST TIME OF YEAR

Factor	11 a.m. - 1 p.m.	1 p.m. - 2 p.m.	5 p.m. - 6 p.m.
15-min peak	500	275	240
Percentage of tourists	20	20	10
Number of tourists	100	55	24
Adjustment factor	3	3	3
Projected number of tourists for 15-min peak	300	165	72
Number of normal pedestrians for 15-min peak	400	220	216
Total pedestrians for 15-min peak	700	385	288
Total pedestrians per hour	2,800	1,540	1,152
Design flows	3,260	1,848	1,382

August 1967 was 257,000; the number for October 1968 was 94,000 (Table 2). Accordingly, one can reasonably predict that during an average month of August, 2.7 or 3 (rounded) times as many persons would visit the White House as in October. Assuming that the October peak 15-min period count of 400 normal pedestrians would remain relatively constant throughout the year, the October count of 100 tourists during the same 15-min period must be increased by this factor of 3. Thus, a projected figure for a peak 15-min period during a normal month of August would include 400 normal pedestrians and 300 tourist pedestrians, a ratio of 4 to 3. An hourly figure of 2,800 pedestrians is obtained by multiplying by 4. To allow for future growth, the projected figure of 2,800 pedestrians per hour over the White House sidewalk during the peak summer month of August was further adjusted upward by 20 percent to yield a "design flow" figure of 3,260 pedestrians per hour. The calculations are given in Table 3.

It should be noted that this design flow figure of 3,260 pedestrians per hour over the White House sidewalk is many times greater than the average number of pedestrians actually using the sidewalk during most of the year.

TABLE 4

OBSERVED NORMAL PEDESTRIAN SPEEDS ON WHITE HOUSE SIDEWALK

Time Required to Walk 100 ft (sec)	No. of Persons Walking at Various Speeds (N)	Speed (fps) (S)	S x N
13	4	7.7	30.8
15	25	6.7	167.5
17	27	5.8	156.6
19	48	5.3	254.4
21	47	4.8	225.6
23	29	4.3	124.7
25	17	4.0	68.0
27	9	3.7	33.3
29	3	3.4	10.2
33	1	3.0	3.0
Total	210		1,074.1

Sum of persons observed = 210
Sum of S x N = 1,074.1

$$\text{Average speed} = \frac{\text{Sum of S x N}}{\text{Sum of persons observed}}$$

$$= \frac{1,074.1}{210} = 5.1 \text{ fps}$$

Pedestrian Walking Speeds

Average walking speeds were first calculated separately for normal pedestrians and for tourists. Based on a sample of 210 normal pedestrians walking along a 100-ft course laid out on the White House sidewalk (Table 4), it was found that the average normal pedestrian walks at a rate of 5.1 feet per second (fps). This rate of 5.1 fps is slightly higher than speeds recorded by other pedestrian studies. The Traffic Engineering Handbook (2), for example, gives a rate of 4.2 fps; Hoel (6) gives 4.8 fps; Wheeler and Navin (1) give 4.5 fps; and MacDorman (8) gives 4.6 fps. The higher average speeds measured at the White House no doubt reflect in large part the lack of distractions and window-shoppers otherwise prevalent where many retail stores line the sidewalks.

Similar calculations, based on a sample of 162 tourists walking over a 100-ft course,

revealed an average walking speed of 3.2 fps (Table 5).

The average rate of travel per average pedestrian, therefore, depends on the relative proportions of normal pedestrians and tourists in the total flow. During the 11:00 a.m. to 1:00 p.m. period in the peak summer months, the ratio of normal pedestrians to tourists is 4 to 3. Thus, the rate of travel for the average individual pedestrian is calculated by multiplying the proportion of normal pedestrians by their average rate of speed (4 × 5.1 = 20.4), multiplying the proportion of tourists by their average rate of speed (3 × 3.2 = 9.6), adding the two products together (20.4 + 9.6 = 30.0), and then dividing by 7 to obtain the rate of speed per person (30.0 ÷ 7 = 4.3). Given the proportion of tourists to normal pedestrians present during the peak summer months, the average pedestrian crossing the White House sidewalk travels at an average rate of 4.3 fps.

TABLE 5

OBSERVED TOURIST SPEEDS ON WHITE HOUSE SIDEWALK

Time Required to Walk 100 ft (sec)	No. of Persons Walking at Various Speeds (N)	Speed (fps) (S)	S × N
20	6	5.0	30.0
25	38	4.0	152.0
30	45	3.3	148.5
35	40	2.9	116.0
40	1	2.5	40.0
45	3	2.2	6.6
50	6	2.0	12.0
55	8	1.8	14.4
Total	162		519.5

Sum of persons observed = 162
Sum of S × N = 519.5

$$\text{Average speed} = \frac{\text{Sum of S} \times \text{N}}{\text{Sum of persons observed}} = \frac{519.5}{162} = 3.2 \text{ fps}$$

Number of Pedestrians Per Square Foot

Each moving pedestrian occupies per second an area that is defined by his size and walking speed. When the concentration of pedestrians in a given area increases beyond a certain optimum point, forward movement becomes increasingly limited by the presence of people to the front and side. On the other hand, increases in concentration up to that optimum point increase the quantity of pedestrians that can move past a given point during any period of time. The degree of pedestrian concentration is a function of the number of square feet occupied by each moving pedestrian, and is typically designated as the K factor. Thus, a concentration of 1 pedestrian per 10 sq ft may be expressed in terms of 0.1 pedestrian per sq ft. Mathematically, this figure is conveniently stated as a K factor of 0.1.

Wheeler and Navin (1) in a recent study have described the relationship between pedestrian walking speeds and concentrations. This study, conducted on college campuses, shows that, the faster a pedestrian walks, the more space he needs. Conversely, higher concentrations of pedestrians must move at relatively slower speeds. More significantly, the study shows that pedestrians concentrated at K factors of as much as 0.1 pedestrian per sq ft can move at speeds up to and above 4.3 fps. A K factor of 0.05 pedestrian per sq ft would give a pedestrian 20 sq ft in which to walk and would allow for free and easy movement. A K factor of 0.1 pedestrian per sq ft, which would give a pedestrian 10 sq ft in which to walk, would be somewhat more confined but offers a more efficient concentration at which to move masses of people. In general, therefore, pedestrians moving at 4.3 fps can be efficiently grouped together in concentrations as high as 0.1 pedestrian per sq ft. The results of the Wheeler and Navin study are shown in Figure 2.

Pedestrian Flow

The flow of pedestrian traffic is the number of pedestrians that can pass over a given point during a specific period of time with varying degrees of concentration and at varying rates of speed for each foot of sidewalk width. The flow of traffic may be expressed mathematically by the equation $Q = K \times U \times T$, where Q is the flow of pedestrian traffic, K is the density of pedestrian concentration per square foot of sidewalk space, U is the average speed of the pedestrian movement, and T is the time period involved. Thus, using 0.1 as the optimum pedestrian concentration (K) for efficient movement of pedestrian traffic, 4.3 fps as the average walking speed (U) of the typical White House pedestrian, and 3,600 sec, or 1 hour, as the time period (T) involved, it is apparent that approximately 1,548

pedestrians can walk along the White House sidewalk in an orderly manner for each foot of sidewalk width during an hour:

$$Q = 0.1 \times 4.3 \times 3,600 = 1,548$$

The equivalent figure for a concentration (K) of 0.075 pedestrian per sq ft is 1,161; for a concentration of 0.05 pedestrian per sq ft, the figure is 774.

These figures are based on a one-way traffic flow. The studies of Wheeler and Navin have shown, however, that the sidewalk capacity is reduced by the friction created when two streams of pedestrian traffic move in opposite directions. When the pedestrian flow is split evenly, with 50 percent moving in one direction and 50 percent moving in the other, there is a 4.0 percent loss of sidewalk capacity relative to the one-way flow. This would reduce the White House sidewalk traffic flows to 1,486 pedestrians per hour per foot of sidewalk width for a concentration of 0.1 pedestrian per sq ft, 1,115 for a concentration of 0.075 pedestrian per sq ft, and 743 for a concentration of 0.5 pedestrian per sq ft.

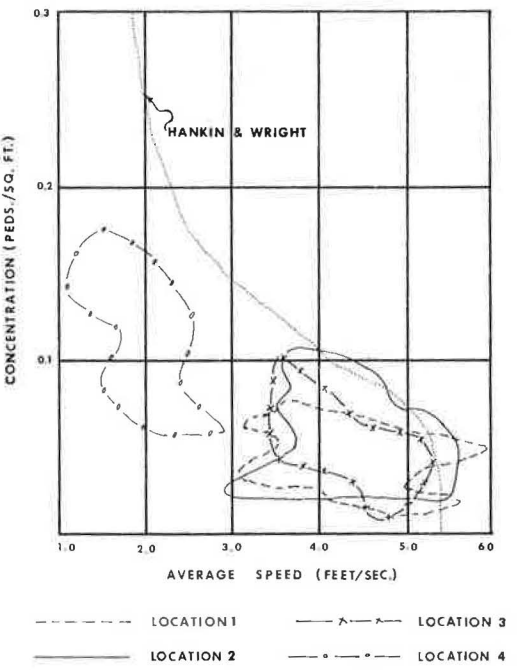

Figure 2.

To determine the width of a traffic lane for the peak pedestrian summer traffic on the White House sidewalk, one need only multiply these flow or Q figures by different sidewalk widths. Table 6 gives the number of pedestrians that can move along the White House sidewalk per hour, in a two-way flow, for sidewalk widths of 5 ft, 7.5 ft, and 10 ft at pedestrian concentrations of 0.05, 0.075, and 0.1 pedestrian per sq ft.

In sum, design flow projection of 3,260 pedestrians per hour for the peak pedestrian traffic over the White House sidewalk during the summer months could be accommodated in a 5-ft wide traffic lane bordering the curb of Pennsylvania Avenue. If 3,715 pedestrians per hour moved along this 5-ft traffic lane, they might comfortably be dispersed at a pedestrian concentration (K factor) of approximately 0.05 pedestrian per sq ft, i.e., a concentration of one pedestrian for every 20 sq ft. Assuming the average pedestrian requires approximately 2 ft of sidewalk width in which to walk, a 5-ft traffic lane could accommodate two 2-ft streams of pedestrian traffic, each moving in the opposite direction, with an extra foot in between for clearance. Each pedestrian would occupy a moving traffic zone of 20 sq ft—an area approximately 2 by 10 ft. At the most efficient concentration of 0.1 pedestrian per sq ft, the 5-ft wide traffic lane could accommodate up to 7,430 pedestrians per hour. At this concentration of 0.1 pedestrian per sq ft, a 5-ft wide traffic lane could handle over 4,000 more pedestrians than the 3,360 pedestrians actually using the White House sidewalk during the peak summer months and could accommodate over 6,000 more pedestrians than the 1,382 persons actually using the sidewalk during the peak summer 5:00 to 6:00 p.m. period.

DETERMINING NUMBER OF DEMONSTRATORS THAT CAN BE ACCOMMODATED

The White House sidewalk has a usable width of approximately 35 ft. A 5-ft wide pedestrian traffic lane would leave 30 ft of width for demonstrators, a traffic lane of 7.5 ft would leave 27.5 ft, and a traffic lane of 10 ft would leave 25 ft. Since the usable length of the White House sidewalk is 730 ft, the three areas available for demonstrations

are 25,075 sq ft, 21,900 sq ft, and 18,250 sq ft respectively.

The remainder of this study is devoted to determining the maximum number of orderly demonstrators that can be accommodated on the available space on the White House sidewalk for three basic types of demonstration—circulating, stationary, and walk-by.

TABLE 6

NUMBER OF PEDESTRIANS PER HOUR THAT CAN MOVE ALONG VARYING WIDTHS OF SIDEWALK AT VARYING CONCENTRATIONS

Sidewalk Width (ft)	Pedestrian Concentrations		
	0.05 per sq ft	0.075 per sq ft	0.1 per sq ft
5	3,715	5,757	7,430
7.5	5,573	8,363	11,145
10	7,430	11,150	14,860

Circulating Demonstrations

A circulating demonstration is one in which a constant number of demonstrators congregate in a specific area and circulate through that area at varying rates of speed. The basic technique used to determine how many demonstrators can occupy a given area of sidewalk space at any instant in time is to multiply the varying degrees of pedestrian concentration (the K factor) by the space (feet) available. However, the degrees of pedestrian concentration vary with the speed at which demonstrators walk; the faster they move, the more space is required.

Wheeler and Navin have determined how many pedestrians actually do move along each foot of sidewalk space per minute at varying rates of speed. Their results were obtained from computations based on actual data, and their optimum flows are recorded flows, not projected flows. From their flow-speed chart, summarized in Table 7, the numbers of pedestrians that can pass a given point for each foot of sidewalk space can be determined for different walking speeds.

The values in Table 6 provide all the necessary information for the standard flow equation ($Q = K \times U \times T$) except for K, the pedestrian concentration per square foot of space, which may be computed by rearranging the flow equation:

$$K = \frac{Q}{U \times T}$$

Using the speed and flow figures in Table 6 and using 60 sec or 1 min for T, the K factors are given in Table 8. These K factors, when multiplied by the total area available, will give the number of orderly pedestrians that the area can accommodate at various rates of speed. The results of this computation for 35 ft of sidewalk width (25,550 sq ft), 30 ft of sidewalk width (21,900 sq ft), 27.5 ft of sidewalk width (20,075 sq ft), and 25 ft of sidewalk width (18,250 sq ft) are given in Table 9.

The densities, speeds, and other pedestrian characteristics in Table 9 are not based on demonstration situations. Because there are no available studies of actual demonstrations, it is not possible within this study to determine whether the speeds, densities, and other characteristics of pedestrians in demonstrations are the same as, or different from, normal pedestrian characteristics. If demonstrators walk more rapidly they would need additional room, and the estimates and figures in Table 9 would have to be decreased. If, on the other hand, demonstrators walk more slowly or at greater densities, these figures might have to be increased.

TABLE 7

NORMAL PEDESTRIAN FLOW FOR VARYING RATES OF SPEED

Walking Speed (fps)	Flow (pedestrians per min per ft of width)
4.0	27
3.0	26
2.0	22
1.0	12

TABLE 8

NORMAL PEDESTRIAN FLOW FOR VARYING RATES OF SPEED AND DEGREES OF CONCENTRATION

Walking Speed (fps)	Flow (pedestrians per min per ft of width)	K
4.0	27	0.11
3.0	26	0.14
2.0	22	0.18
1.0	12	0.20

TABLE 9

NUMBER OF ORDINARY PEDESTRIANS ACCOMMODATED WITH VARYING AMOUNTS OF SIDEWALK SPACE AT VARYING CONCENTRATIONS

Walking Speed (fps)	Degrees of Concentration (K)	Width and Area of Sidewalk			
		25 ft (18,250 sq ft)	27.5 ft (20,075 sq ft)	30 ft (21,900 sq ft)	35 ft (25,550 sq ft)
4.0	0.11	2,008	2,208	2,409	2,811
3.0	0.14	2,555	2,811	3,066	3,577
2.0	0.18	3,285	3,614	3,942	4,599
1.0	0.20	3,650	4,015	4,380	5,110

Stationary Demonstrations

A stationary demonstration is one in which a fixed number of demonstrators remain standing in a certain area with little or no movement or circulation.

In general, a larger number of demonstrators can stand within a given area than can move about or circulate within that same area for the simple reason that a moving person requires more space per second than does one who is stationary. The two variables necessary to calculate the maximum number of demonstrators that can stand in a given area are the amount of space allotted to the demonstration and the level of concentration at which the demonstrators can be grouped together.

The space available for demonstrations on the White House sidewalk has already been determined. The complete absence of a traffic lane would leave 25,550 sq ft for demonstrations; a pedestrian traffic lane 5 ft wide would leave 21,900 sq ft; and a 10-ft traffic lane would leave 18,250 sq ft.

The concentration factor, or number of square feet to be allotted to each demonstrator, is perhaps most accurately determined by reference to studies analyzing the amount of space necessary for passengers waiting for buses in loading zones and sidewalk queues. One survey conducted by the Institute of Traffic Engineers discovered that the space allotted by various city, county, and state traffic planning organizations to queuing pedestrians varied from 2.3 to 6.0 sq ft per person. The Traffic Engineering Handbook (2) estimates that for double queues approximately 2.8 sq ft should be allotted to each standing person. Because the average demonstrator is probably willing and prepared to relinquish some of the room he would otherwise expect as a normal pedestrian, the extent to which demonstrators may be concentrated, for purposes of this study, may be selected from the lower end of this range of estimates. The number of demonstrators that can stand within the four different areas of the White House sidewalk space at varying degrees of concentration are given in Table 10. Allocating 2.5 sq ft to each demonstrator, the entire White House sidewalk can accommodate 10,220 standing demonstrators.

Walk-By Demonstrations

A walk-by demonstration is one in which large numbers of demonstrators walk past the White House at varying rates of speed and at varying levels of concentration. The demonstrators might assemble at some convenient location near the White House, such as Lafayette Park or the grounds surrounding the Washington Monument, and then proceed toward one end of the White House sidewalk where they would walk along its entire length and either disperse or repeat the cycle. The numbers of persons such a demonstration could accommodate are most conveniently expressed in terms of total numbers of demonstrators per hour.

TABLE 10

NUMBER OF STANDING DEMONSTRATORS ACCOMMODATED WITH VARYING AMOUNTS OF SIDEWALK AT VARYING DEGREES OF CONCENTRATION

Number of Square Feet per Demonstrator	Square Feet of Sidewalk Space			
	18,250	20,075	21,900	25,550
2.5	7,300	8,030	8,760	10,220
3.5	5,214	5,736	6,257	7,300
4.5	4,056	4,461	4,867	5,678

In Tables 7 and 8 it was shown that at least the following numbers of ordinary pedestrians could walk across each foot of sidewalk width at varying speeds and concentrations per minute: 27 walking at 4.0 fps, 26 walking at 3.0 fps, 22 walking at 2.0 fps, and 12 walking at 1.0 fps. The numbers of demonstrators that can walk by the White House per hour per foot of sidewalk width are equally large and are simply expressed by multiplying the numbers of pedestrians, stated earlier, by the width of sidewalk feet available and the number 60 to obtain the results in terms of total demonstrators per hour. These results are given in Table 11.

TABLE 11

NUMBER OF WALK-BY DEMONSTRATORS THAT VARYING SIDEWALK WIDTHS COULD ACCOMMODATE PER HOUR AT VARYING SPEEDS

Rate (fps)	Available Sidewalk Width (ft)			
	25	27.5	30	35
4.0	40,500	44,550	48,600	56,700
3.0	39,000	42,900	46,800	54,600
2.0	33,000	36,300	39,600	46,200
1.0	18,000	19,800	21,600	25,200

SUMMARY AND CONCLUSIONS

The dimensions of the sidewalk in front of the White House are approximately 775 ft by 37.5 ft. The sidewalk area available for pedestrians and demonstrators is approximately 730 ft by 35 ft and encompasses a total area of 25,550 sq ft.

A study was undertaken to determine, first, how much sidewalk space was required by the maximum number of pedestrians that now, or in the future, are likely to use the White House sidewalk, and, second, how many orderly demonstrators can reasonably be accommodated in the remaining sidewalk space. Based on actual pedestrian counts conducted at the White House sidewalk and on other relevant traffic engineering studies, it was determined that the maximum projected number of pedestrians that might use the sidewalk during the peak summer periods was 3,260 per hour. It was then determined that 3,260 pedestrians per hour could be accommodated within a traffic lane 5 ft in width in which the pedestrians could group themselves into concentration of 0.0 pedestrian per sq ft, or 1 pedestrian every 20 sq ft.

The remaining sidewalk space was then studied to determine how many circulating, stationary, and walk-by demonstrators could reasonably be accommodated in that space at varying degrees of concentration. It was found that when demonstrators circulated at the rate of 1.0 fps and at a concentration of 0.2 demonstrator per sq ft, the entire 35 ft of sidewalk width could accommodate 5,110 demonstrators, 30 ft of sidewalk width could accommodate 4,380, and 25 ft of sidewalk width could accommodate 3,650.

The number of stationary demonstrators that could stand in various amounts of sidewalk space was even larger. At the optimum concentration of 2.5 sq ft for every demonstrator, 10,220 demonstrators could occupy the entire 35 ft of sidewalk width, 8,760 could occupy 30 ft of sidewalk width, 8,030 could occupy 27.5 ft of sidewalk width, and 7,300 could occupy 25 ft of sidewalk width.

Finally, the number of demonstrators that could walk by the White House at various rates of speed over various widths of sidewalk space was determined. At between 3.7 and 4.3 fps, 56,700 demonstrators per hour could pass by the White House over 35 feet of sidewalk width, 48,600 could pass over 30 ft of sidewalk width, 44,550 could pass over 27.5 ft, and 40,500 could pass over 25 ft.

REFERENCES

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