WIND-ENGINEERING STUDY OF TWIN OFFICE TOWERS, ATLANTA

by

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Symbol	Definition
U	Local mean velocity
D	Characteristic dimension (building height, width, etc.)
ν	Kinematic viscosity of approach flow
$\frac{UD}{\nu}$	Reynolds number
E	Mean voltage
A	Constant
B	Constant
n	Constant
U_{rms}	Root-mean-square of fluctuating velocity
E_{rms}	Root-mean-square of fluctuating voltage
U_{∞}	Reference mean velocity outside the boundary layer
y	Height above surface
δ	Height of boundary layer
T_u	Turbulence intensity U_{rms}/U or U_{rms}/U_{∞}

1. INTRODUCTION

1.1 General

Increased use of pedestrian plaza areas in modern architectural design has brought about a greater need to consider wind and gustiness in the design of these areas. Recognition that tall buildings generate winds in pedestrian areas about the structure has led to increased concern about the effects of a proposed structure on the wind environment in pedestrian areas. Because nearby buildings may also affect local wind characteristics, the architect may want to consider these influences in the placement and design of building entrances or plazas. Techniques have been developed during the past decade for wind-tunnel modeling of atmospheric winds about building complexes which allow the prediction of the wind environment near the buildings. This information permits pedestrian areas to be protected by design changes before the building is constructed or, if construction is complete, permits an evaluation of possible measures under consideration for alleviation of wind problems.

Modeling the atmospheric winds about a structure requires special consideration of flow conditions in order to guarantee similitude between model and prototype. A detailed discussion of the similarity requirements and their wind-tunnel implementation can be found in References [1-3]. In general, the requirements are that the model and prototype be scaled in geometry, that the approach mean velocity at the building site have a vertical profile shape similar to the full-scale flow, that the turbulence characteristics of the flows be similar, and that the Reynolds number for the model and prototype be equal.

These criteria are satisfied by constructing a scale model of the structure and its surroundings and performing the wind tests in a wind tunnel specifically designed to model atmospheric boundary-layer flows. Reynolds number similarity requires that the quantity UD/ν be similar for model and prototype. Since ν, the kinematic viscosity of air, is identical for both, Reynolds numbers cannot be made equal with reasonable wind velocities. Wind velocity in the wind tunnel would have to be the model scale factor times the prototype wind. However, for sufficiently high Reynolds number ($>2 \times 10^4$), the wind flow characteristics about the structure and pressure coefficients on the structure will be essentially constant with Reynolds number. Typical values encountered are $10^7 - 10^8$ for the full scale and $10^5 - 10^6$ for the wind-tunnel model. Thus acceptable flow similarity is achieved without precise Reynolds number equality.

1.2 The Twin Office Towers

A wind-tunnel study was performed for the Twin Office Tower Complex to be located adjacent to the state capitol building in Atlanta. A 1:240 scale model (frontispiece) was used. The objectives of the wind-tunnel study were to obtain wind velocity and gustiness in pedestrian areas about the structure. In addition, a flow-visualization study was performed to define overall flow patterns to determine whether or not a complete study of wind pressures on the structure was warranted and to determine regions of possible pedestrian discomfort.

2. EXPERIMENTAL CONFIGURATION

2.1 Wind Tunnel

The wind-tunnel study was performed in the environmental wind tunnel located in the Fluid Dynamics and Diffusion Laboratory at Colorado State University, Figure 1. The tunnel is an open-circuit facility driven by a 50 h.p. variable-speed propeller. The test section is nominally 12 ft wide, 8 ft high and 57 ft long fed through a 3.35:1 contraction ratio. The roof is adjustable to maintain a zero pressure gradient along the test section. The mean velocity can be adjusted continuously from 1 to 38 fps.

2.2 Model

A 1:240 scale model including local topography was constructed for the wind-tunnel tests. Two configurations of the model were used, Figure 2. Configuration 1 represented the first phase of construction including the two office towers and connecting podium structure. Configuration 2 added two structures to the southwest of the towers.

The model was installed on the 12 ft-diameter turntable located 45 ft from the test-section entrance. An area of 1440 ft radius surrounding the model center was modeled to match existing buildings and topography. The region upstream from the modeled area was covered with a randomized roughness constructed from 1 in. cubes. A spire arrangement at the test-section entrance provided a thicker boundary layer than would otherwise be available. The upstream configuration was designed to provide approximately a 4 ft boundary-layer thickness, a velocity power law appropriate to the Atlanta site, and a logarithmic velocity profile with a realistic roughness length. A photograph of the model installed in the wind tunnel is shown in Figure 3.

Thirty-six locations on the model were selected for quantitative velocity measurements as shown in Figure 4 where a single measurement location is assigned two numbers, the first (locations 1-21) represent configuration 1 without the additional buildings and the second (locations 22-36) represent configuration 2 with the additional buildings. These locations were selected in conjunction with Aeck Associates to provide maximum information regarding pedestrian comfort levels in the primary pedestrian areas. Positions 1 and 2 were located at entrances to the nearby state capitol building to provide a reference location where people are currently experiencing winds.

3. INSTRUMENTATION AND DATA ACQUISITION

3.1 Flow Visualization

Visualization of the flow in the vicinity of the model is helpful in locating regions of high velocity or gustiness. It is also useful in indicating areas of possible high pressures on the surface of the structures. Titanium-tetrachloride smoke was released from sources on and near the model and motion picture records made. Conclusions obtained from these smoke studies are discussed in Section 4.1.

3.2 Velocity

Vertical-velocity and turbulence-intensity profiles were measured upstream of the model to establish the adequacy of the approach velocity profile. In addition, mean velocity and turbulence-intensity measurements were made 0.3 in. (6.0 ft) above the surface at each of the 36 locations indicated in Figure 4 for the two model configurations at 16 to 24 wind directions per location. The surface measurements are indicative of the environment to which a pedestrian would be subjected.

Measurement of velocity at each location was made with a single hot-wire anemometer mounted with its axis vertical. The instrumentation used was a Thermo-Systems constant temperature anemometer (Model 1050) with a 0.001 in. dia. platinum-film sensing element 0.020 in. long. Mean voltage output was read from a digital voltmeter with a time-constant circuit while rms voltage was obtained from a DISA RMS meter (Model 55035) and was read from a digital voltmeter.

Calibration of the hot-wire anemometer was performed using a Thermo-Systems Calibrator (Model 1125). The calibration data was fit to a variable exponent King's-law relationship

$$E^2 = A + BU^n$$

where E is the hot-wire output voltage, U the approach velocity and A, B and n are coefficients selected to fit the calibration data. A typical calibration showing the linear relationship between E^2 and U^n is plotted in Figure 5. The above relationship was used to recover the mean velocity at measurement points from the measured mean voltage. The fluctuating velocity in the form U_{rms} (root-mean-square velocity) was obtained from

$$U_{rms} = \frac{2\ E\ E_{rms}}{B\ n\ U^{n-1}}$$

where E_{rms} is the root-mean-square voltage output from the anemometer. All turbulence velocities were divided by both local mean velocity U and mean velocity outside the boundary layer U_∞. Division by U gives an indication of the relative unsteadiness at the location while division by U_∞ permits easy determination of the actual magnitude of rms velocity fluctuations at a point for various approach velocities.

The mean velocity and turbulence data were combined with climatological data obtained at the Atlanta Municipal Airport to provide an indication of the frequency with which velocities of various magnitudes could be expected at each measurement location. Two sets of data from the airport location were used (both sets were frequency of occurrence of winds as a function of wind direction and wind amplitude): the annual mean representing average conditions and the January to March mean representing the windiest period. These two sets of prototype data were combined with two types of velocities measured in the wind-tunnel test program: the mean velocity representing average conditions and the mean plus three times the rms velocity

representing a peak gust. The data were combined to provide, for each measurement location, the percentage of time during which a given velocity would be exceeded. In addition, the wind gusts at each measurement location were compared to those of two existing reference sites in order to provide an indication of relative wind severity.

4. RESULTS

4.1 Flow Visualization

A 1000 ft film is included as part of this report showing characteristics of flow about the model using smoke to make the flow visible. A listing of the contents of the film is shown in Table 1. Smoke was released at a number of points on the model in pedestrian areas to show high-velocity or high-turbulence regions and at points elevated on the structure to identify possible glass-loading problems. Smoke flow was photographed at 16 wind directions for configuration 1 and 5 wind directions for configuration 2. Several conclusions were evident from the flow visualization.

The overall flow patterns showed the velocities in pedestrian areas to be moderate and, in most cases, without swirling flow. Adjacent structures, while not particularly tall, appeared to provide some protection from high-velocity winds. The strongest surface winds at the office tower entrance located in the station main entrance on Piedmont Avenue occurred for westerly to southwesterly winds. It appeared that the entrance door itself would be in a fairly calm airflow, but that moderately strong winds would occur within 8 to 10 ft of the doorway. A similar situation existed for the building entrance adjacent to the station on Butler Avenue for southerly winds. Moderate or low velocities through the station appeared to occur for almost all wind directions. Winds at the front of the twin towers near the main entrance and loading docks were moderate except for winds approximately parallel to that face when some swirling flows were observed. Addition of the structures in configuration 2 appeared to lower the wind velocities near the front entrance.

Flows about the structure at higher elevations did not show any unusual flow patterns which characteristically are associated with high pressure loadings on the glass. For flows at approximately 45 degrees to the building faces, a vortex was observed adjacent to the upwind tower originating at the corner of the tower and podium structure. The vortex was rather large in diameter and rotated fairly slowly so that unusually large pressures would not be expected in this region. Flow over the roof corners for these wind directions did show a tight vortex rollup on the roof characteristic of flat-roofed buildings. Uplift pressures near these corners may be high and with the low parapet height involved, could result in movement of loose material on the roof surface near the corners.

4.2 Velocity

Approach velocity profiles are shown in Figures 6a and 6b. These profiles were taken upstream from the model representing the characteristics of the boundary layer approaching the model. The boundary-layer thickness, δ, was 48.5 in. corresponding to a prototype value of 970 ft. The boundary-layer thickness is a reasonable value for the field site. In the form

$$\frac{U}{U_\infty} = \left(\frac{y}{\delta}\right)^n$$

the velocity profile has an exponent n of 0.28 for the approach flow which is an acceptable value for city environments such as Atlanta with moderate building heights extending for a distance outward from the building site. If the profile shown in Figure 6a is plotted in semilogarithmic form, the effective roughness height y_o can be obtained from the zero

velocity intercept of the best fit line. This value is approximately 9 ft, which is slightly large but not unreasonable for the site modeled.

The profile of longitudinal turbulence intensity approaching the model is shown in Figure 6b. The turbulence intensities are typical of those found over cities. For the purpose of this report, turbulence intensity is defined as the root-mean-square of the longitudinal velocity fluctuations divided by the reference mean velocity U_∞ at the outer edge of the boundary layer,

$$Tu_1 = \frac{U_{rms}}{U_\infty},$$

or as the rms velocity divided by the local mean velocity,

$$Tu_2 = \frac{U_{rms}}{U}.$$

Mean velocity and turbulence intensity at locations 1-36 shown in Figure 4 for 16 wind directions are listed in Table 2 and are plotted in Figures 7a-7r. Positions 1-21 were measured without the auxiliary buildings in place (Configuration 1) while positions 22-36 were measured with the buildings in place (Configuration 2). Measurements were taken 0.3 in. (6.0 ft prototype) above the surface. A site map is superimposed on the polar plots to aid in visualization of the effects of nearby structures on the results.

The largest mean velocities were measured at point 26 (Configuration 2 with the added buildings) for wind directions from ENE through SE with values up to 66 percent of the reference velocity U_∞. Point 15 (Configuration 1) at the station entrance showed mean velocities up to 53 percent for generally westerly winds. The largest values of rms velocity were found at points 7 and 11 with values of 21.4 and 24.8 percent of U_∞ respectively. The high values at these points may be due to the presence of the adjacent walls used for visual screening. The

largest values of "gustiness" or local turbulence intensity (U_{rms}/U) were in the range of 60 to 73 percent found at locations 13 and 22. Large values of gustiness must be interpreted in terms of the magnitude of mean velocity since a low local wind velocity can lead to large values as effectively as large rms velocities. Both locations experienced generally low mean velocities.

In order to compare the wind magnitudes about the proposed structure with existing locations, two sites (1 and 2) were selected at the entrances to the nearby capitol for reference purposes. Table 3 shows the magnitude of a peak gust--represented by the mean velocity plus three times the rms velocity as a percentage of the mean velocity at the reference height--at both reference locations by wind direction. The largest peak gusts were approximately 77 and 75 percent of U_∞. A value of 76 percent of U_∞ was used as representative of the peak gust found at positions 1 and 2 for comparison with other locations.

Table 4 shows peak gusts as percent of U_∞ and ratios of peak gust for each position to the peak gust (76 percent of U_∞) selected for the reference positions. Only those locations and wind directions where the peak gust was greater than 76 percent of U_∞ are listed. Values of Peak Gust Ratio only slightly above 1.0 cannot be considered to represent a more severe environment than the reference locations although positions with a wide range of wind directions with the ratio above 1 will be as windy as the reference location more often. Locations experiencing the largest gust ratios are positions 11 (1.62), 34 (1.45), and 7 (1.45) These are at the corner of the structure and may be adversely affected by the projecting walls adjacent to the loading areas.

The fact that a particular location exhibits higher wind velocities than the reference location is not necessarily an indication of an unacceptable wind environment. To enable a quantitative assessment of the wind environment, the wind tunnel data were combined with wind freqeuncy and direction information obtained at the Atlanta airport. Table 5 shows the frequency and direction data obtained from summaries published by the National Weather Service for the period 1951-1960. Two sets of frequency data were used: one representing annual averages and one representing the windiest months of January through March. These data, obtained at an elevation of 72 ft, were converted to velocities at the reference height for the wind tunnel measurements (970 ft) and combined with the wind tunnel data to obtain cumulative probability distributions (percent time a given velocity is exceeded) for wind velocity at each site. The percentage times were summed by wind direction to get a percent time exceeded at each site independent of wind direction (but accounting for the fact that the wind blows from different directions with varying frequency). These results are listed in Tables 6 and 7 and plotted in Figures 8 and 9 for annual and winter winds. In the tables, a percentage time exceeded of 0.0 indicates a value below 0.1, the resolution limit of the frequency table.

Interpretation of Figures 8 and 9 is aided by a description of the effects of wind of various magnitudes on people. The earliest quantitative description of wind effects was established by Sir Francis Beaufort in 1806 for use at sea and is still in use today. Several recent investigators have added to the knowledge of wind effects on pedestrians. These investigations along with suggested criteria for acceptance have been summarized by Penwarden and Wise [4]. The Beaufort

scale, based on mean velocity only, is reproduced as Table 8 including qualitative descriptions of wind effects. Table 8 suggests that mean wind speeds below 12 mph are of minor concern and that mean speeds above 24 mph are definitely inconvenient. Locations 15 and 26 reach velocities of 24 mph only 0.1 percent of the time (approximately 9 hours out of a year) for the annual velocity distribution and do not reach it at all for the winter winds. Winter winds, although generally stronger than annual winds, do not reach amplitudes as large as annual winds for very low probability levels due to the directional characteristics of the winter winds and the local velocities at individual measurement locations. Mean winds at the worst measurement locations exceed the 12 mph level no more than 5 to 7 percent of the time for annual winds and 10 to 13 percent of the time for winter winds.

Peak gust values in Figures 8 and 9 require a somewhat different interpretation. The peak gust curves shown are the percent of time during which a several-second gust of the stated magnitude could occur (say less than one of these gusts per hour). Evidence suggests that gusts greater than about 35 to 45 mph in magnitude can cause major impediment to pedestrians, particularly the elderly. For annual winds, all locations except 7 and 11 experienced winds in which gusts of 35 mph or higher could occur less than 0.5 percent of the time (approximately 0.8 percent for those two locations). For winter winds, the largest percentage of time during which 35 mph gusts could occur was 0.7 percent found at location 6. Most sites did not reach 35 mph at the 0.1 percent level. For both annual and winter winds, the percentage of time during which gusts of 24 mph could occur (the limit for agreeable winds on the Beaufort scale) was never larger than 10 percent (location 6) and was much lower for many locations.

5. CONCLUSIONS

A simulated atmospheric boundary-layer flow over a model of the Twin Office Towers, Atlanta, was established to examine the wind characteristics in pedestrian areas about the proposed structure and a possible future addition. Smoke was released at numerous locations about the model for several wind directions to determine qualitatively the wind characteristics in pedestrian areas. Quantitative measurements of wind velocity and turbulence were obtained at 36 selected locations for 16-24 wind directions to determine areas where pedestrian comfort might be a problem. Additional smoke flow observations were made to identify possible glass loading problems.

The results from both smoke flow and quantitative velocity measurements indicated that the proposed structure would, in general, not cause severe adverse pedestrian environments. Several locations, especially those at exposed building corners, for example locations 7, 11 and 26, would experience strong gusts for some wind directions but that these times would be a sufficiently small percentage of the total time that no corrective action need be contemplated at this time. Location 15 at the entrance to the station experienced strong mean velocities for westerly winds. While some discomfort may be experienced by pedestrians for strong westerly winds, these conditions should represent an acceptably small percentage of the total time.

Smoke flow about the upper portions of the Twin Office Towers showed no patterns of flow characteristic of exceptionally high pressures on the structure. Flow visualization of flow over the roof of the structure indicated that high pressures and velocities capable of moving light gravel existed near the corners. These conditions are characteristic of flat-roofed structures with low parapets.

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TABLE 1

MOTION PICTURE SCENE GUIDE
ATLANTA TWIN OFFICE TOWERS

SCENE	APPROACH WIND AZIMUTH	CONFIGURATION
1		Titles & Model
2	000 (N)	1
3	023 (NNE)	1
4	045 (NE)	1
5	068 (ENE)	1
6	090 (E)	1
7	113 (ESE)	1
8	135 (SE)	1
9	158 (SSE)	1
10	180 (S)	1
11	203 (SSW)	1
12	225 (SW)	1
13	248 (WSW)	1
14	270 (W)	1
15	293 (WNW)	1
16	315 (NW)	1
17	338 (NNW)	1
18	135 (SE)	2
19	180 (S)	2
20	225 (SW)	2
21	270 (W)	2
22	315 (NW)	2

Table 2. WIND VELOCITIES--ATLANTA TWIN OFFICE TOWERS

POSITION 1

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	22.7	10.1	44.4
22.50	30.3	13.2	43.4
45.00	19.4	8.7	44.7
67.50	26.7	12.5	46.7
90.00	23.5	12.6	53.5
112.50	14.6	7.6	51.8
135.00	16.0	8.4	52.2
157.50	23.1	10.8	46.5
180.00	27.2	12.1	44.7
202.50	34.7	14.0	40.3
225.00	25.0	9.8	39.3
247.50	17.4	8.2	46.9
270.00	12.4	5.9	48.1
292.50	11.7	5.8	49.8
315.00	16.3	8.3	51.1
337.50	27.8	11.9	42.9

POSITION 2

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	21.7	10.0	46.4
22.50	21.6	10.3	47.5
45.00	18.0	8.8	49.1
67.50	12.1	6.9	56.8
90.00	32.4	14.2	43.8
112.50	23.1	13.7	59.4
135.00	15.5	8.0	52.0
157.50	14.8	6.7	45.0
180.00	17.1	7.7	44.8
202.50	12.3	5.8	47.1
225.00	9.2	4.7	51.0
247.50	10.7	5.7	52.8
270.00	14.3	7.3	51.0
292.50	16.0	8.2	50.9
315.00	18.3	10.4	56.9
337.50	23.2	10.0	42.9

POSITION 3

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	31.7	13.9	44.0
22.50	25.2	11.9	46.9
45.00	18.2	8.7	48.1
67.50	22.4	11.6	51.5
90.00	24.5	12.5	50.9
112.50	42.4	16.0	37.8
135.00	25.9	10.9	41.9
157.50	26.9	10.2	37.9
180.00	21.9	8.5	38.7
202.50	20.5	8.3	40.4
225.00	16.5	7.2	43.4
247.50	13.0	5.7	43.7
270.00	16.7	7.5	44.7
292.50	31.4	11.3	35.9
315.00	30.7	10.6	34.4
337.50	31.7	13.0	41.2

POSITION 4

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	39.4	15.7	39.7
22.50	25.7	11.7	45.5
45.00	12.8	5.5	43.1
67.50	27.6	13.0	47.2
90.00	38.8	17.3	44.5
112.50	48.0	16.7	34.8
135.00	33.4	11.9	35.6
157.50	29.8	9.7	32.7
180.00	24.7	8.1	32.6
202.50	21.3	8.6	40.4
225.00	15.6	7.0	44.7
247.50	17.5	8.4	47.8
270.00	18.5	8.6	46.6
292.50	30.8	11.1	35.9
315.00	44.3	13.1	29.7
337.50	41.8	15.8	37.8

Table 2 (cont'd) WIND VELOCITIES--ATLANTA TWIN OFFICE TOWERS

POSITION 5

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	35.8	13.4	37.4
22.50	25.8	9.6	37.4
45.00	18.3	9.7	52.7
67.50	44.8	13.3	29.8
90.00	48.6	14.2	29.2
112.50	41.6	15.6	37.5
135.00	23.5	9.4	40.0
157.50	24.3	9.2	37.8
180.00	24.5	8.8	35.8
202.50	19.3	8.2	42.4
225.00	17.6	7.3	41.8
247.50	16.8	7.6	44.9
270.00	17.9	7.5	42.1
292.50	22.8	8.1	35.4
315.00	30.5	12.0	39.4
337.50	30.7	14.0	45.5

POSITION 6

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	35.9	17.1	47.6
22.50	24.7	11.2	45.6
45.00	16.0	6.5	40.9
67.50	34.7	14.6	42.0
90.00	43.8	19.4	44.3
112.50	38.3	17.2	44.9
135.00	34.0	12.5	36.8
157.50	32.9	10.4	31.7
180.00	27.3	9.3	33.9
202.50	21.4	8.8	41.1
225.00	17.5	8.1	46.5
247.50	19.0	9.2	48.4
270.00	31.5	12.7	40.2
292.50	31.0	12.2	39.4
315.00	41.4	17.0	41.0
337.50	38.3	18.7	48.7

POSITION 7

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	47.2	10.8	23.0
22.50	38.9	10.7	27.4
45.00	15.2	7.1	46.8
67.50	28.1	9.0	32.1
90.00	14.2	6.2	43.9
112.50	11.6	5.2	44.6
135.00	30.4	9.0	29.7
157.50	43.1	13.4	31.0
180.00	43.8	17.0	38.9
202.50	44.8	21.4	47.7
225.00	46.0	21.3	46.3
247.50	15.5	6.9	44.3
270.00	31.8	10.1	31.8
292.50	37.7	11.5	30.6
315.00	43.3	11.8	27.3
337.50	48.7	10.2	20.8

POSITION 8

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	12.9	6.6	51.2
22.50	9.9	4.2	43.0
45.00	12.6	5.9	46.7
67.50	8.7	3.6	41.5
90.00	11.7	4.7	40.1
112.50	13.1	5.6	42.6
135.00	10.2	4.0	39.4
157.50	13.1	5.5	42.4
180.00	15.7	6.5	41.5
202.50	16.0	6.4	39.9
225.00	17.1	7.4	43.2
247.50	13.6	6.1	44.8
270.00	18.5	8.5	46.1
292.50	23.9	12.0	50.4
315.00	25.4	13.1	51.6
337.50	17.2	9.8	56.8

Table 2 (cont'd) WIND VELOCITIES--ATLANTA TWIN OFFICE TOWERS

POSITION 9

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	19.6	9.6	49.0
22.50	15.8	7.1	45.0
45.00	8.8	3.8	42.9
67.50	10.9	5.1	47.1
90.00	21.8	10.5	48.3
112.50	23.6	12.0	51.0
135.00	29.3	12.2	41.7
157.50	28.3	12.7	44.8
180.00	34.3	12.2	35.5
202.50	28.7	13.9	48.4
225.00	29.2	13.6	46.5
247.50	29.3	12.8	43.6
270.00	37.6	13.3	35.3
292.50	24.9	12.1	48.3
315.00	21.0	11.7	55.6
337.50	24.5	11.4	46.6

POSITION 10

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	9.1	3.9	43.4
22.50	11.2	5.1	46.0
45.00	11.9	4.8	40.9
67.50	14.2	6.3	44.6
90.00	15.9	8.0	50.1
112.50	18.5	9.8	53.2
135.00	18.9	9.3	49.3
157.50	15.7	7.8	49.9
180.00	16.3	6.9	42.5
202.50	11.6	5.0	42.8
225.00	12.7	5.3	42.1
247.50	12.0	5.3	43.8
270.00	14.1	6.3	44.9
292.50	11.5	4.9	42.5
315.00	12.8	5.7	44.4
337.50	10.8	4.8	44.2

POSITION 11

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	15.8	8.2	52.0
22.50	16.3	7.5	46.0
45.00	11.8	5.7	48.5
67.50	41.5	10.1	24.3
90.00	48.0	9.5	19.8
112.50	43.1	9.6	22.3
135.00	37.9	12.2	32.3
157.50	22.9	9.7	42.3
180.00	19.0	9.0	47.2
202.50	32.2	16.4	50.9
225.00	48.7	24.8	50.9
247.50	41.7	20.7	49.7
270.00	23.7	12.6	53.2
292.50	13.0	7.0	53.6
315.00	13.4	6.8	50.9
337.50	11.4	5.5	48.0

POSITION 12

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	14.8	6.9	46.4
22.50	16.3	7.2	44.4
45.00	19.8	9.4	47.5
67.50	22.2	10.9	48.9
90.00	14.9	6.6	44.5
112.50	12.0	5.8	48.6
135.00	12.5	6.0	48.1
157.50	19.9	7.8	39.3
180.00	21.4	9.0	42.2
202.50	29.6	14.0	47.2
225.00	36.2	17.6	48.7
247.50	21.0	8.8	41.9
270.00	20.2	8.2	40.6
292.50	14.9	7.0	46.7
315.00	13.0	5.9	45.8
337.50	13.8	6.4	46.3

Table 2 (cont'd) WIND VELOCITIES--ATLANTA TWIN OFFICE TOWERS

POSITION 13

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	14.1	7.6	54.1
22.50	8.0	5.0	61.7
45.00	12.5	8.4	67.3
67.50	7.0	5.1	73.4
90.00	5.5	3.4	62.0
112.50	6.6	3.6	54.5
135.00	3.8	2.0	53.8
157.50	7.2	4.2	57.9
180.00	8.2	4.8	59.3
202.50	8.3	5.1	61.5
225.00	11.1	6.9	61.7
247.50	15.4	6.5	42.1
270.00	25.1	7.6	30.1
292.50	16.7	6.6	39.9
315.00	17.8	6.7	37.9
337.50	20.0	8.1	40.7

POSITION 14

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	11.9	6.2	51.9
22.50	7.8	4.3	54.4
45.00	5.5	2.8	51.7
67.50	7.1	3.1	43.8
90.00	11.8	5.0	42.1
112.50	10.7	4.7	43.8
135.00	4.9	2.1	43.9
157.50	4.0	1.7	42.4
180.00	3.1	1.0	34.0
202.50	4.0	1.6	40.9
225.00	4.5	2.1	45.5
247.50	9.3	4.5	48.0
270.00	15.2	7.0	46.2
292.50	19.3	8.6	44.6
315.00	21.9	9.6	43.6
337.50	17.8	9.4	52.8

POSITION 15

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	15.5	7.4	47.6
22.50	20.6	9.5	46.2
45.00	33.7	11.4	33.8
67.50	30.3	6.2	20.6
90.00	32.1	8.7	26.9
112.50	29.4	8.8	30.0
135.00	10.0	3.9	39.1
157.50	8.9	3.3	36.5
180.00	7.8	2.9	36.9
202.50	15.7	5.7	36.1
225.00	22.1	11.6	52.4
247.50	37.4	10.5	28.0
270.00	53.1	8.4	15.8
292.50	47.1	8.8	18.7
315.00	47.2	8.6	18.2
337.50	31.0	11.7	37.7

POSITION 16

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	13.6	5.6	41.4
22.50	9.7	4.2	42.8
45.00	10.4	3.9	37.7
67.50	17.5	4.5	25.6
90.00	22.6	6.5	29.0
112.50	22.0	6.0	27.2
135.00	20.5	6.0	29.2
157.50	19.4	6.0	31.0
180.00	18.3	5.5	30.0
202.50	14.6	4.6	31.3
225.00	11.0	5.5	49.7
247.50	31.7	11.1	35.2
270.00	43.3	15.2	35.2
292.50	30.1	11.5	38.1
315.00	29.9	11.7	39.1
337.50	18.6	7.2	38.8

Table 2 (cont'd) WIND VELOCITIES--ATLANTA TWIN OFFICE TOWERS

POSITION 17

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	17.9	8.0	44.3
22.50	15.6	7.4	47.5
45.00	18.7	8.5	45.4
67.50	19.8	8.6	43.7
90.00	14.0	6.6	47.2
112.50	8.8	3.3	37.9
135.00	11.1	4.6	41.2
157.50	11.9	5.0	42.5
180.00	12.3	5.1	41.6
202.50	27.0	12.4	45.9
225.00	40.1	12.7	31.8
247.50	40.1	13.0	32.4
270.00	49.6	17.5	35.2
292.50	20.9	9.0	43.0
315.00	22.1	9.8	44.1
337.50	16.4	7.4	45.1

POSITION 18

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	9.1	4.1	45.2
22.50	9.8	4.5	45.4
45.00	9.7	4.4	45.2
67.50	10.5	5.2	49.2
90.00	8.9	3.6	40.7
112.50	9.4	3.8	40.5
135.00	15.2	5.5	36.3
157.50	22.1	6.4	29.2
180.00	21.1	7.2	34.2
202.50	20.9	8.9	42.8
225.00	25.4	11.4	44.9
247.50	15.7	7.5	47.8
270.00	7.0	2.9	41.4
292.50	5.2	1.7	33.2
315.00	8.0	3.7	46.5
337.50	9.4	4.2	45.0

POSITION 19

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	11.1	4.1	37.3
22.50	11.2	3.8	33.7
45.00	8.2	3.4	41.9
67.50	12.0	5.8	48.8
90.00	17.3	10.1	58.2
112.50	30.3	13.8	45.6
135.00	20.6	11.6	56.3
157.50	15.3	7.6	49.6
180.00	11.4	4.3	38.1
202.50	9.3	3.4	36.6
225.00	8.3	3.3	39.5
247.50	6.6	2.4	35.8
270.00	5.5	1.8	33.6
292.50	4.6	1.2	26.0
315.00	5.0	1.4	27.4
337.50	8.8	3.3	37.1

POSITION 20

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	35.5	7.4	20.9
22.50	36.9	11.2	30.3
45.00	27.2	11.0	40.5
67.50	16.7	7.9	47.5
90.00	14.7	5.9	40.1
112.50	19.6	6.9	35.2
135.00	30.3	8.8	29.0
157.50	36.8	8.5	23.1
180.00	37.9	8.7	23.1
202.50	38.9	11.7	30.0
225.00	31.2	13.9	44.6
247.50	19.4	8.8	45.4
270.00	11.3	4.7	41.2
292.50	7.9	3.0	38.2
315.00	12.2	4.7	38.3
337.50	28.3	7.0	24.9

Table 2 (cont'd) WIND VELOCITIES--ATLANTA TWIN OFFICE TOWERS

POSITION 21

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	23.5	4.6	19.6
22.50	15.5	4.7	30.2
45.00	9.3	4.1	43.9
67.50	13.4	6.6	49.3
90.00	15.3	5.8	38.0
112.50	12.6	5.5	43.7
135.00	18.6	8.9	47.9
157.50	24.3	10.1	41.6
180.00	27.7	10.9	39.5
202.50	25.5	8.5	33.3
225.00	11.2	5.6	50.4
247.50	19.6	4.1	21.1
270.00	28.4	5.1	18.0
292.50	26.6	4.9	18.3
315.00	23.7	4.2	17.6
337.50	29.0	5.2	17.9

POSITION 22

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	42.6	9.9	23.3
22.50	40.4	9.6	23.8
45.00	20.4	10.0	49.3
67.50	20.1	11.7	58.1
90.00	15.0	9.9	65.8
112.50	10.7	6.8	63.5
135.00	7.3	3.3	45.3
157.50	7.3	2.8	38.2
180.00	7.5	2.8	37.5
202.50	9.0	3.8	42.4
225.00	10.2	6.0	58.7
247.50	11.7	5.2	44.8
270.00	27.4	10.1	37.0
292.50	39.0	10.5	26.8
315.00	43.2	9.9	23.0
337.50	43.2	9.9	23.0

POSITION 23

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	17.1	8.0	46.9
22.50	12.9	5.6	43.5
45.00	13.4	6.1	45.1
67.50	34.1	16.1	47.3
90.00	29.6	15.0	50.8
112.50	32.0	14.7	45.9
135.00	16.1	7.3	45.5
157.50	18.9	9.6	50.8
180.00	18.5	8.8	47.7
202.50	20.4	9.3	45.4
225.00	21.3	9.9	46.4
247.50	14.1	6.8	47.9
270.00	17.5	8.1	46.4
292.50	14.0	6.3	45.4
315.00	17.3	7.7	44.2
337.50	20.3	9.9	48.5

POSITION 24

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	20.0	9.9	49.9
22.50	20.3	10.2	50.2
45.00	15.6	6.7	42.8
67.50	25.1	14.0	55.8
90.00	29.6	13.6	45.9
112.50	30.4	12.8	42.1
135.00	28.1	12.3	44.0
157.50	37.2	13.2	35.5
180.00	41.9	12.1	28.7
202.50	26.4	10.7	40.7
225.00	23.9	10.5	44.0
247.50	25.6	10.6	41.5
270.00	23.6	9.5	40.3
292.50	28.2	10.5	37.1
315.00	32.7	12.0	36.8
337.50	24.9	13.1	52.7

Table 2 (cont'd) WIND VELOCITIES--ATLANTA TWIN OFFICE TOWERS

POSITION 25

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	47.4	19.4	40.9
22.50	33.1	14.2	42.9
45.00	12.3	5.9	47.9
67.50	14.5	6.8	46.9
90.00	20.1	9.0	44.5
112.50	19.9	9.2	46.1
135.00	25.7	13.3	51.7
157.50	40.3	11.7	29.0
180.00	44.6	8.9	20.0
202.50	45.4	9.6	21.1
225.00	33.3	12.5	37.6
247.50	26.3	12.1	46.0
270.00	19.2	8.8	45.8
292.50	17.0	7.7	45.5
315.00	21.8	11.1	51.0
337.50	46.7	17.5	37.4

POSITION 26

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	16.7	7.2	42.8
22.50	19.6	7.6	38.9
45.00	23.4	9.4	40.2
67.50	59.1	11.3	19.2
90.00	66.3	11.2	16.9
112.50	57.9	13.4	23.1
135.00	51.4	12.6	24.5
157.50	32.7	13.2	40.2
180.00	16.3	7.7	47.3
202.50	26.0	10.8	41.5
225.00	42.2	10.5	25.0
247.50	53.9	11.7	21.8
270.00	30.5	8.4	27.6
292.50	34.8	8.6	24.8
315.00	15.7	7.3	46.9
337.50	14.0	6.4	45.6

POSITION 27

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	30.7	12.5	40.8
22.50	24.6	11.3	46.1
45.00	30.1	13.4	44.5
67.50	19.5	10.4	53.1
90.00	28.5	14.7	51.5
112.50	29.9	14.1	47.1
135.00	13.1	6.6	50.1
157.50	25.5	12.2	47.7
180.00	26.2	12.9	49.1
202.50	23.5	13.2	56.0
225.00	45.1	14.9	33.1
247.50	21.0	8.9	42.6
270.00	27.6	13.0	47.1
292.50	44.0	14.6	33.2
315.00	32.2	14.4	44.6
337.50	36.4	13.4	36.8

POSITION 28

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	26.2	13.9	53.3
22.50	19.3	9.9	51.0
45.00	13.7	6.3	46.0
67.50	19.9	10.3	51.7
90.00	22.9	11.0	48.0
112.50	27.9	13.0	46.6
135.00	21.7	9.6	44.2
157.50	20.7	9.5	45.8
180.00	26.9	12.7	47.0
202.50	34.6	12.2	35.2
225.00	34.8	12.3	35.4
247.50	34.3	13.2	38.3
270.00	30.8	11.8	38.2
292.50	37.5	11.5	30.6
315.00	26.5	11.7	44.2
337.50	30.9	14.9	48.2

Table 2 (cont'd) WIND VELOCITIES--ATLANTA TWIN OFFICE TOWERS

POSITION 29

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	27.6	15.4	55.8
22.50	16.0	8.5	53.1
45.00	15.1	7.0	46.5
67.50	28.8	13.2	45.8
90.00	34.9	15.8	45.1
112.50	24.4	10.6	43.5
135.00	42.1	13.8	32.7
157.50	47.9	11.9	24.8
180.00	43.9	10.2	23.3
202.50	21.3	8.9	41.6
225.00	23.3	11.3	48.4
247.50	25.0	12.6	50.5
270.00	19.5	9.2	47.3
292.50	11.4	5.2	45.6
315.00	14.7	8.2	56.2
337.50	30.4	16.9	55.7

POSITION 30

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	46.9	10.5	22.4
22.50	30.7	11.5	37.3
45.00	16.1	7.6	47.2
67.50	23.3	9.8	42.0
90.00	15.5	7.2	46.8
112.50	13.6	6.3	46.2
135.00	13.9	6.3	45.4
157.50	17.5	8.7	49.7
180.00	19.5	9.3	47.7
202.50	53.6	17.0	31.8
225.00	33.5	16.5	49.3
247.50	17.1	8.8	51.8
270.00	35.1	12.4	35.3
292.50	37.6	10.4	27.6
315.00	45.9	10.3	22.4
337.50	47.1	10.4	22.2

POSITION 31

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	22.1	10.8	49.1
22.50	14.4	7.0	48.6
45.00	16.2	6.8	41.9
67.50	16.3	6.4	39.2
90.00	17.9	8.8	49.1
112.50	15.8	7.7	48.7
135.00	21.8	10.8	49.6
157.50	22.7	11.5	50.9
180.00	19.0	10.0	52.4
202.50	20.4	8.8	42.9
225.00	20.9	9.2	44.0
247.50	12.9	6.1	47.3
270.00	15.4	7.1	46.1
292.50	23.0	11.7	50.7
315.00	29.0	15.0	51.6
337.50	28.6	15.0	52.5

POSITION 32

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	21.7	10.5	48.5
22.50	21.0	8.2	39.3
45.00	9.4	4.2	44.0
67.50	20.9	10.6	50.4
90.00	20.9	11.3	53.9
112.50	28.3	15.2	53.7
135.00	20.1	11.0	54.6
157.50	20.8	10.8	51.8
180.00	23.8	12.2	51.5
202.50	23.7	12.0	50.8
225.00	13.7	6.1	44.9
247.50	23.5	11.8	50.2
270.00	31.6	12.6	39.9
292.50	20.5	10.9	53.0
315.00	34.0	15.2	44.7
337.50	25.7	13.0	50.7

Table 2 (cont'd) WIND VELOCITIES--ATLANTA TWIN OFFICE TOWERS

POSITION 33

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	20.4	8.3	40.7
22.50	17.2	6.5	37.5
45.00	14.6	5.7	39.2
67.50	16.0	7.4	46.4
90.00	24.0	11.0	45.9
112.50	29.6	14.1	47.8
135.00	21.5	9.3	43.1
157.50	20.4	9.4	46.2
180.00	30.4	12.2	40.2
202.50	21.5	9.4	43.7
225.00	19.4	8.1	41.8
247.50	19.9	8.8	44.6
270.00	20.6	10.3	49.7
292.50	14.0	6.9	49.2
315.00	15.1	5.8	38.1
337.50	19.7	8.4	42.6

POSITION 34

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	16.3	8.1	49.4
22.50	19.3	7.9	41.0
45.00	13.1	6.0	45.7
67.50	45.6	9.9	21.6
90.00	51.9	9.5	18.3
112.50	45.9	10.4	22.7
135.00	36.3	11.3	31.0
157.50	31.9	13.6	42.5
180.00	27.4	13.1	47.9
202.50	22.0	11.4	51.6
225.00	33.2	19.5	58.6
247.50	47.9	20.4	42.6
270.00	26.8	12.6	47.1
292.50	12.0	5.5	45.6
315.00	10.3	4.2	41.1
337.50	13.1	6.0	45.8

POSITION 35

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	19.7	7.8	39.6
22.50	16.4	6.8	41.5
45.00	19.5	8.9	45.9
67.50	21.3	8.8	41.2
90.00	12.5	5.7	45.4
112.50	8.7	3.6	41.6
135.00	11.4	4.4	38.7
157.50	8.8	3.5	39.8
180.00	11.2	4.9	43.7
202.50	42.6	19.7	46.4
225.00	26.7	13.2	49.6
247.50	20.6	8.0	38.9
270.00	20.9	8.8	41.9
292.50	16.0	6.7	42.0
315.00	14.7	5.9	40.6
337.50	17.8	7.2	40.7

POSITION 36

WIND AZIMUTH	U/UINF (PERCENT)	URMS/UINF (PERCENT)	URMS/U (PERCENT)
0.00	14.7	6.6	45.1
22.50	18.7	8.0	42.9
45.00	32.7	10.2	31.1
67.50	34.8	7.9	22.7
90.00	32.4	12.1	37.5
112.50	21.9	9.2	42.2
135.00	8.5	3.3	38.4
157.50	7.8	3.0	38.1
180.00	11.4	4.4	38.4
202.50	22.2	11.3	50.8
225.00	28.6	9.2	32.3
247.50	40.6	7.6	18.6
270.00	44.9	8.7	19.4
292.50	41.4	8.1	19.7
315.00	41.6	8.7	20.9
337.50	27.5	10.2	37.1

TABLE 3

PEAK GUSTS AT REFERENCE LOCATIONS

$$\text{Value of Peak Gust} = \left[\frac{U + 3U_{rms}}{U_{\infty}}(100)\right] \quad \text{for Positions 1 and 2}$$

Wind Azimuth		Position 1	Position 2
0	(N)	53.0	51.7
22.5	(NNE)	69.9	52.5
45	(E)	45.5	44.4
67.5	(ENE)	64.2	32.8
90	(E)	61.3	75.0*
112.5	(ESE)	37.4	64.2
135	(SE)	41.2	39.5
157.5	(SSE)	55.5	34.9
180	(S)	63.5	40.2
202.5	(SSW)	76.7*	29.7
225	(SW)	54.4	23.3
247.5	(WSW)	42.0	27.8
270	(W)	30.1	36.2
292.5	(WNW)	29.1	40.6
315	(NW)	41.2	49.5
337.5	(NNW)	63.5	53.2

* Largest values of gust.

Note: The largest gusts at positions 1 and 2 were represented by the value 76 in computations for Table 4.

TABLE 4

COMPARISON OF PEAK GUSTS WITH REFERENCE LOCATIONS

$$\text{Maximum Effective Speed Ratio} = \left[\frac{\text{Max. Eff. Speed}}{\text{Max. Eff. Speed for 1 \& 2}}\right]$$

Position	Peak Gust (% of U_∞)	Peak Gust Ratio	Wind Azimuth
3	90.4	1.19	112.5 (ESE)
4	86.5	1.14	0.0 (N)
	90.7	1.19	90.0 (E)
	98.1	1.29	112.5 (ESE)
	83.3	1.10	315.0 (NW)
	89.2	1.17	337.5 (NNW)
5	76.0	1.00	0.0 (N)
	84.7	1.11	67.5 (ENE)
	91.2	1.20	90.0 (E)
	88.4	1.16	112.5 (ESE)
6	87.2	1.15	0.0 (N)
	78.5	1.03	67.5 (ENE)
	102.0	1.34	90.0 (E)
	89.9	1.18	112.5 (ESE)
	92.4	1.22	315.0 (NW)
	94.4	1.24	337.5 (NNW)
7	79.6	1.05	0 (N)
	83.3	1.10	157.5 (SSE)
	94.8	1.25	180.0 (S)
	109.0	1.43	202.5 (SSW)
	109.9	1.45	225.0 (SW)
	78.7	1.04	315.0 (NW)
	79.3	1.04	337.5 (NNW)
9	77.5	1.02	270 (W)
11	76.5	1.01	90.0 (E)
	81.4	1.07	202.5 (SSW)
	123.1	1.62	225.0 (SW)
	103.8	1.37	247.5 (WSW)
12	89.0	1.17	225.0 (SW)
15	78.3	1.03	270.0 (W)
16	88.9	1.17	270.0 (W)

(cont'd)

TABLE 4 (cont'd)

Position	Peak Gust (% of U_∞)	Peak Gust Ratio	Wind Azimuth
17	78.2	1.03	225.0 (SW)
	79.0	1.04	247.5 (WSW)
	102.1	1.34	270.0 (W)
23	82.3	1.08	67.5 (ENE)
	76.1	1.00	112.5 (ESE)
24	76.8	1.01	157.5 (SSE)
	78.2	1.03	180.0 (S)
25	105.6	1.39	0.0 (N)
	99.2	1.31	337.5 (NNW)
26	93.0	1.22	67.5 (ENE)
	99.9	1.31	90.0 (E)
	98.1	1.29	112.5 (ESE)
	89.2	1.17	135.0 (SE)
	89.0	1.17	247.5 (WSW)
27	89.8	1.18	225.0 (SW)
	87.8	1.16	292.5 (WNW)
	76.6	1.01	337.5 (NNW)
29	82.3	1.08	90.0 (E)
	83.5	1.10	135.0 (SE)
	83.6	1.10	157.5 (SSE)
30	78.4	1.03	0.0 (N)
	104.6	1.38	202.5 (SSW)
	83.0	1.09	225.0 (SW)
	76.8	1.01	315.0 (NW)
	78.3	1.03	337.5 (NNW)
32	79.6	1.05	315.0 (NW)
34	91.7	1.21	225.0 (SW)
	110.0	1.45	247.5 (WSW)
35	101.7	1.34	202.5 (SSW)

TABLE 5

ATLANTA WIND DATA
Percentage Frequencies of Wind Direction and Speed

Annual Hourly Observations of Wind Speed - Miles Per Hour

Direction	0-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	Total
N	.5	1.3	.9	.2					3.0
NNE	.4	.7	.4	.1					1.6
NE	.8	2.1	2.2	.9	.2				6.2
ENE	.6	1.9	3.2	2.1	.3				8.1
E	.7	2.0	3.3	1.5	.2				7.9
ESE	.5	1.4	1.9	.9	.1				4.7
SE	.7	1.9	2.2	.8	.1				5.7
SSE	.5	1.1	1.1	.5	.1				3.3
S	.7	1.6	1.5	.8	.2				4.8
SSW	.4	.8	1.2	.8	.2				3.5
SW	.6	1.6	2.4	1.4	.5	.1			6.6
WSW	.4	1.0	2.0	1.2	.3				4.9
W	.5	1.4	3.2	1.5	.4	.1			7.2
WNW	.4	1.2	3.0	2.6	.9	.2			8.4
NW	.8	2.5	5.4	4.1	1.6	.2			14.7
NNW	.4	1.2	2.0	1.4	.4				5.4
CALM	4.1								4.1
Total	12.9	23.9	35.9	20.7	5.6	.8	.1		100.

Jan - Mar Hourly Observations of Wind Speed - Miles Per Hour

Direction	0-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	Total
N	.2	.7	.5	.2					1.7
NNE	.1	.5	.3	.1					1.0
NE	.5	1.1	1.3	.6	.2				3.7
ENE	.3	1.3	2.5	2.1	.4				6.6
E	.5	1.6	3.2	2.1	.4				7.9
ESE	.4	1.0	1.8	1.1	.2				4.5
SE	.5	1.3	1.9	.7	.1				4.6
SSE	.4	.9	1.0	.6	.2	.1			3.2
S	.6	1.3	1.4	1.0	.5	.1	.1		5.0
SSW	.3	.7	1.2	1.2	.5	.1			4.0
SW	.6	1.1	2.2	2.1	1.1	.2			7.2
WSW	.3	.7	1.5	1.5	.5	.1			4.6
W	.4	.9	2.8	1.8	.8	.1			6.8
WNW	.4	.9	3.0	4.2	2.0	.5	.1		11.1
NW	.7	2.3	5.7	6.6	3.7	.7	.1		19.8
NNW	.2	1.0	1.9	2.1	.8	.1			6.2
CALM	2.7								2.7
Total	9.0	17.3	32.5	27.9	11.2	1.9	.4	.1	100.

Table 6 ATLANTA -- ANNUAL EXPECTED VELOCITIES

POSITION 1

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	65.2	3.0	82.7
4.0	25.5	5.0	64.0
7.0	4.4	8.0	36.2
11.0	.3	14.0	9.0
14.0	.1	21.0	1.2
17.0	.0	29.0	.1
20.0	.0	36.0	.0

POSITION 2

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	57.2	3.0	78.5
4.0	18.4	5.0	57.8
7.0	2.2	8.0	30.5
11.0	.1	14.0	6.2
14.0	.0	21.0	.6
17.0	.0	29.0	.1
20.0	.0	36.0	.0

POSITION 3

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	73.4	3.0	85.0
4.0	39.2	5.0	70.0
7.0	11.6	8.0	46.6
11.0	1.5	14.0	15.4
14.0	.3	21.0	2.9
17.0	.1	29.0	.3
20.0	.0	36.0	.1

POSITION 4

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	77.0	3.0	85.6
4.0	48.5	5.0	73.4
7.0	20.7	8.0	53.0
11.0	5.5	14.0	23.6
14.0	1.7	21.0	7.5
17.0	.3	29.0	1.3
20.0	.1	36.0	.2

Table 6 (cont'd) ATLANTA -- ANNUAL EXPECTED VELOCITIES

POSITION 5

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	76.7	3.0	85.8
4.0	44.8	5.0	72.7
7.0	16.5	8.0	49.4
11.0	3.2	14.0	18.3
14.0	.6	21.0	4.6
17.0	.1	29.0	.5
20.0	.0	36.0	.1

POSITION 6

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	80.0	3.0	87.6
4.0	53.7	5.0	77.2
7.0	22.4	8.0	59.2
11.0	4.9	14.0	28.8
14.0	1.3	21.0	10.0
17.0	.3	29.0	2.2
20.0	.1	36.0	.4

POSITION 7

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	76.7	3.0	85.3
4.0	52.0	5.0	71.7
7.0	26.5	8.0	52.6
11.0	8.5	14.0	24.9
14.0	2.8	21.0	8.7
17.0	.7	29.0	2.1
20.0	.2	36.0	.7

POSITION 8

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	51.5	3.0	70.8
4.0	18.8	5.0	47.9
7.0	3.4	8.0	26.5
11.0	.2	14.0	8.3
14.0	.0	21.0	1.6
17.0	.0	29.0	.1
20.0	.0	36.0	.0

Table 6 (cont'd) ATLANTA -- ANNUAL EXPECTED VELOCITIES

POSITION 9

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	69.1	3.0	82.5
4.0	37.4	5.0	57.5
7.0	9.3	8.0	46.1
11.0	1.0	14.0	16.9
14.0	.3	21.0	2.9
17.0	.1	29.0	.4
20.0	.0	36.0	.1

POSITION 10

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	46.7	3.0	70.6
4.0	6.5	5.0	42.2
7.0	.2	8.0	13.4
11.0	.0	14.0	.6
14.0	.0	21.0	.1
17.0	.0	29.0	.0
20.0	.0	36.0	.0

POSITION 11

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	68.3	3.0	82.5
4.0	37.6	5.0	56.2
7.0	16.5	8.0	44.0
11.0	4.5	14.0	17.2
14.0	1.2	21.0	5.6
17.0	.4	29.0	1.9
20.0	.1	36.0	.7

POSITION 12

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	59.8	3.0	78.3
4.0	19.3	5.0	56.9
7.0	3.5	8.0	28.7
11.0	.6	14.0	6.5
14.0	.1	21.0	1.7
17.0	.0	29.0	.4
20.0	.0	36.0	.1

Table 6 (cont'd) ATLANTA -- ANNUAL EXPECTED VELOCITIES

POSITION 13

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	38.1	3.0	60.5
4.0	12.7	5.0	38.7
7.0	1.0	8.0	16.5
11.0	.1	14.0	1.4
14.0	.0	21.0	.1
17.0	.0	29.0	.0
20.0	.0	36.0	.0

POSITION 14

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	33.6	3.0	49.5
4.0	12.0	5.0	31.8
7.0	1.5	8.0	16.7
11.0	.0	14.0	3.3
14.0	.0	21.0	.2
17.0	.0	29.0	.0
20.0	.0	36.0	.0

POSITION 15

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	71.9	3.0	79.3
4.0	51.1	5.0	65.5
7.0	26.3	8.0	48.6
11.0	8.9	14.0	18.7
14.0	3.4	21.0	4.4
17.0	1.2	29.0	.6
20.0	.4	36.0	.1

POSITION 16

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	65.3	3.0	75.9
4.0	34.0	5.0	56.6
7.0	11.2	8.0	34.2
11.0	1.7	14.0	12.8
14.0	.5	21.0	3.3
17.0	.1	29.0	.5
20.0	.1	36.0	.1

Table 6 (cont'd) ATLANTA -- ANNUAL EXPECTED VELOCITIES

POSITION 17

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	62.7	3.0	77.1
4.0	31.3	5.0	54.1
7.0	10.9	8.0	37.4
11.0	2.7	14.0	13.1
14.0	.9	21.0	3.5
17.0	.4	29.0	.7
20.0	.1	36.0	.3

POSITION 18

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	29.9	3.0	52.9
4.0	7.0	5.0	25.7
7.0	1.1	8.0	9.2
11.0	.1	14.0	1.8
14.0	.0	21.0	.3
17.0	.0	29.0	.0
20.0	.0	36.0	.0

POSITION 19

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	24.0	3.0	40.3
4.0	5.0	5.0	21.4
7.0	.7	8.0	9.3
11.0	.0	14.0	1.6
14.0	.0	21.0	.2
17.0	.0	29.0	.0
20.0	.0	36.0	.0

POSITION 20

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	62.0	3.0	77.2
4.0	25.9	5.0	53.0
7.0	7.0	8.0	27.5
11.0	1.0	14.0	6.6
14.0	.2	21.0	1.3
17.0	.1	29.0	.2
20.0	.0	36.0	.1

Table 6 (cont'd) ATLANTA -- ANNUAL EXPECTED VELOCITIES

POSITION 21

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	62.5	3.0	74.7
4.0	28.3	5.0	52.0
7.0	6.4	8.0	22.8
11.0	.4	14.0	2.3
14.0	.1	21.0	.2
17.0	.0	29.0	.0
20.0	.0	36.0	.0

POSITION 22

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	57.7	3.0	73.6
4.0	33.6	5.0	56.6
7.0	16.6	8.0	38.0
11.0	5.2	14.0	14.1
14.0	1.7	21.0	3.4
17.0	.3	29.0	.4
20.0	.1	36.0	.1

POSITION 23

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	65.5	3.0	81.0
4.0	26.0	5.0	63.3
7.0	4.8	8.0	36.2
11.0	.3	14.0	9.1
14.0	.0	21.0	1.6
17.0	.0	29.0	.2
20.0	.0	36.0	.0

POSITION 24

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	77.4	3.0	87.0
4.0	47.0	5.0	74.8
7.0	13.7	8.0	55.1
11.0	1.8	14.0	19.7
14.0	.4	21.0	3.5
17.0	.1	29.0	.4
20.0	.0	36.0	.1

Table 6 (cont'd). ATLANTA -- ANNUAL EXPECTED VELOCITIES

POSITION 25

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	73.1	3.0	84.7
4.0	36.7	5.0	70.3
7.0	11.9	8.0	45.6
11.0	3.1	14.0	14.9
14.0	.9	21.0	3.5
17.0	.2	29.0	.7
20.0	.1	36.0	.2

POSITION 26

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	77.5	3.0	85.8
4.0	51.5	5.0	72.8
7.0	27.8	8.0	51.8
11.0	10.4	14.0	22.0
14.0	4.6	21.0	6.7
17.0	1.5	29.0	1.0
20.0	.5	36.0	.2

POSITION 27

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	77.8	3.0	87.6
4.0	49.0	5.0	76.5
7.0	18.8	8.0	58.2
11.0	4.6	14.0	24.7
14.0	1.4	21.0	7.5
17.0	.4	29.0	1.5
20.0	.1	36.0	.3

POSITION 28

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	75.7	3.0	86.4
4.0	45.0	5.0	73.6
7.0	14.6	8.0	53.8
11.0	2.3	14.0	19.3
14.0	.5	21.0	4.1
17.0	.2	29.0	.5
20.0	.1	36.0	.1

Table 6 (cont'd) ATLANTA -- ANNUAL EXPECTED VELOCITIES

POSITION 29

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	71.4	3.0	85.0
4.0	35.4	5.0	70.0
7.0	9.9	8.0	45.5
11.0	1.6	14.0	14.8
14.0	.4	21.0	3.1
17.0	.1	29.0	.4
20.0	.0	36.0	.1

POSITION 30

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	72.7	3.0	83.9
4.0	45.0	5.0	69.3
7.0	22.2	8.0	48.4
11.0	7.7	14.0	20.3
14.0	2.6	21.0	6.4
17.0	.6	29.0	1.0
20.0	.2	36.0	.3

POSITION 31

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	66.4	3.0	82.0
4.0	27.7	5.0	64.6
7.0	6.3	8.0	39.0
11.0	.3	14.0	12.2
14.0	.0	21.0	2.7
17.0	.0	29.0	.3
20.0	.0	36.0	.0

POSITION 32

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	69.6	3.0	83.4
4.0	35.8	5.0	69.2
7.0	9.4	8.0	49.0
11.0	1.5	14.0	17.1
14.0	.3	21.0	3.9
17.0	.0	29.0	.6
20.0	.0	36.0	.1

Table 6 (cont'd) ATLANTA -- ANNUAL EXPECTED VELOCITIES

POSITION 33

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	65.8	3.0	80.8
4.0	22.2	5.0	61.5
7.0	2.5	8.0	32.4
11.0	.2	14.0	5.2
14.0	.1	21.0	.5
17.0	.0	29.0	.1
20.0	.0	36.0	.0

POSITION 34

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	67.0	3.0	81.2
4.0	37.7	5.0	62.8
7.0	17.3	8.0	41.2
11.0	4.8	14.0	17.1
14.0	1.2	21.0	4.8
17.0	.3	29.0	1.2
20.0	.1	36.0	.4

POSITION 35

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	56.5	3.0	73.5
4.0	18.9	5.0	51.3
7.0	3.2	8.0	25.6
11.0	.6	14.0	5.2
14.0	.2	21.0	1.4
17.0	.0	29.0	.3
20.0	.0	36.0	.1

POSITION 36

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	72.4	3.0	79.6
4.0	51.3	5.0	66.0
7.0	24.1	8.0	49.2
11.0	6.3	14.0	17.7
14.0	2.0	21.0	3.3
17.0	.5	29.0	.4
20.0	.1	36.0	.1

Table 7 ATLANTA -- JANUARY THRU MARCH EXPECTED VELOCITIES

POSITION 1

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	73.9	3.0	87.8
4.0	34.1	5.0	73.1
6.0	11.5	13.0	17.0
9.0	1.3	20.0	1.8
12.0	.0	26.0	.0
15.0	.0	32.0	.0
19.0	.0	38.0	.0

POSITION 2

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	67.8	3.0	84.9
4.0	27.8	5.0	68.3
6.0	7.1	13.0	14.2
9.0	.0	20.0	.5
12.0	.0	26.0	.0
15.0	.0	32.0	.0
19.0	.0	38.0	.0

POSITION 3

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	81.4	3.0	89.7
4.0	51.6	5.0	78.6
6.0	28.0	13.0	29.2
9.0	7.9	20.0	6.6
12.0	.4	26.0	.2
15.0	.0	32.0	.0
19.0	.0	38.0	.0

POSITION 4

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	84.3	3.0	90.3
4.0	60.4	5.0	81.6
6.0	39.5	13.0	38.5
9.0	18.8	20.0	15.4
12.0	6.6	26.0	4.3
15.0	1.4	32.0	.1
19.0	.0	38.0	.0

Table 7 (cont'd) ATLANTA -- JANUARY THRU MARCH EXPECTED VELOCITIES

POSITION 5

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	83.9	3.0	90.2
4.0	56.3	5.0	80.7
6.0	32.7	13.0	31.6
9.0	10.4	20.0	8.4
12.0	1.8	26.0	.7
15.0	.0	32.0	.0
19.0	.0	38.0	.0

POSITION 6

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	86.5	3.0	91.5
4.0	65.4	5.0	84.4
6.0	42.7	13.0	45.0
9.0	19.2	20.0	19.8
12.0	5.6	26.0	6.7
15.0	.4	32.0	1.6
19.0	.0	38.0	.0

POSITION 7

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	83.3	3.0	89.9
4.0	62.5	5.0	79.5
6.0	45.9	13.0	41.0
9.0	25.7	20.0	18.0
12.0	10.8	26.0	7.1
15.0	3.3	32.0	1.8
19.0	.0	38.0	.0

POSITION 8

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	63.9	3.0	79.4
4.0	29.6	5.0	60.6
6.0	12.2	13.0	17.5
9.0	1.0	20.0	3.8
12.0	.0	26.0	.0
15.0	.0	32.0	.0
19.0	.0	38.0	.0

Table 7 (cont'd) ATLANTA -- JANUARY THRU MARCH EXPECTED VELOCITIES

POSITION 9

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	78.4	3.0	88.4
4.0	50.2	5.0	77.3
6.0	24.8	13.0	32.3
9.0	5.7	20.0	7.7
12.0	.2	26.0	.6
15.0	.0	32.0	.0
19.0	.0	38.0	.0

POSITION 10

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	58.8	3.0	79.2
4.0	11.3	5.0	54.6
6.0	.3	13.0	1.7
9.0	.0	20.0	.0
12.0	.0	26.0	.0
15.0	.0	32.0	.0
19.0	.0	38.0	.0

POSITION 11

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	75.9	3.0	87.9
4.0	43.0	5.0	74.4
6.0	26.1	13.0	24.7
9.0	11.8	20.0	9.6
12.0	4.0	26.0	3.7
15.0	.4	32.0	1.1
19.0	.0	38.0	.0

POSITION 12

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	69.0	3.0	84.4
4.0	26.6	5.0	66.5
6.0	8.2	13.0	10.9
9.0	1.6	20.0	2.3
12.0	.0	26.0	.1
15.0	.0	32.0	.0
19.0	.0	38.0	.0

Table 7 (cont'd) ATLANTA -- JANUARY THRU MARCH EXPECTED VELOCITIES

POSITION 13

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	48.3	3.0	69.4
4.0	19.9	5.0	48.9
6.0	4.5	13.0	4.0
9.0	.0	20.0	.0
12.0	.0	26.0	.0
15.0	.0	32.0	.0
19.0	.0	38.0	.0

POSITION 14

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	43.7	3.0	59.6
4.0	20.1	5.0	42.0
6.0	6.3	13.0	8.7
9.0	.0	20.0	.0
12.0	.0	26.0	.0
15.0	.0	32.0	.0
19.0	.0	38.0	.0

POSITION 15

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	78.8	3.0	84.8
4.0	60.3	5.0	73.6
6.0	43.6	13.0	33.2
9.0	23.4	20.0	10.2
12.0	11.6	26.0	2.0
15.0	4.6	32.0	.0
19.0	.2	38.0	.0

POSITION 16

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	75.3	3.0	83.5
4.0	45.8	5.0	68.2
6.0	25.6	13.0	23.4
9.0	7.7	20.0	6.7
12.0	1.0	26.0	.8
15.0	.0	32.0	.0
19.0	.0	38.0	.0

Table 7 (cont'd) ATLANTA -- JANUARY THRU MARCH EXPECTED VELOCITIES

POSITION 17

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	71.6	3.0	83.4
4.0	41.2	5.0	68.5
6.0	21.2	13.0	22.7
9.0	7.1	20.0	5.8
12.0	2.2	26.0	1.5
15.0	.0	32.0	.0
19.0	.0	38.0	.0

POSITION 18

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	37.2	3.0	60.9
4.0	9.9	5.0	32.4
6.0	2.7	13.0	3.2
9.0	.0	20.0	.0
12.0	.0	26.0	.0
15.0	.0	32.0	.0
19.0	.0	38.0	.0

POSITION 19

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	27.5	3.0	43.8
4.0	5.8	5.0	23.3
6.0	1.2	13.0	2.5
9.0	.0	20.0	.0
12.0	.0	26.0	.0
15.0	.0	32.0	.0
19.0	.0	38.0	.0

POSITION 20

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	68.3	3.0	82.6
4.0	30.3	5.0	59.8
6.0	14.0	13.0	11.4
9.0	4.6	20.0	2.1
12.0	.1	26.0	.0
15.0	.0	32.0	.0
19.0	.0	38.0	.0

Table 7 (cont'd) ATLANTA -- JANUARY THRU MARCH EXPECTED VELOCITIES

POSITION 21

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	72.9	3.0	82.5
4.0	40.2	5.0	64.1
6.0	19.5	13.0	7.7
9.0	2.9	20.0	.0
12.0	.0	26.0	.0
15.0	.0	32.0	.0
19.0	.0	38.0	.0

POSITION 22

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	66.5	3.0	80.1
4.0	41.8	5.0	65.7
6.0	29.8	13.0	25.7
9.0	16.8	20.0	7.8
12.0	6.6	26.0	1.2
15.0	1.5	32.0	.0
19.0	.0	38.0	.0

POSITION 23

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	75.2	3.0	86.8
4.0	36.0	5.0	73.2
6.0	11.2	13.0	16.6
9.0	.5	20.0	1.8
12.0	.0	26.0	.0
15.0	.0	32.0	0
19.0	.0	38.0	

POSITION 24

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	84.7	3.0	91.3
4.0	60.1	5.0	82.7
6.0	34.2	13.0	36.4
9.0	9.6	20.0	9.0
12.0	1.1	26.0	.7
15.0	.0	32.0	.0
19.0	.0	38.0	.0

Table 7 (cont'd) ATLANTA -- JANUARY THRU MARCH EXPECTED VELOCITIES

POSITION 25

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	81.1	3.0	89.6
4.0	48.2	5.0	79.0
6.0	24.6	13.0	27.2
9.0	8.5	20.0	7.3
12.0	2.4	26.0	1.3
15.0	.2	32.0	.0
19.0	.0	38.0	.0

POSITION 26

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	83.2	3.0	89.9
4.0	58.5	5.0	79.8
6.0	39.2	13.0	32.8
9.0	22.0	20.0	11.2
12.0	10.7	26.0	3.1
15.0	4.4	32.0	.0
19.0	.0	38.0	.0

POSITION 27

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	94.3	3.0	91.5
4.0	61.0	5.0	83.4
6.0	37.6	13.0	41.6
9.0	16.0	20.0	16.2
12.0	4.9	26.0	5.0
15.0	1.1	32.0	.6
19.0	.0	38.0	.0

POSITION 28

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	83.2	3.0	90.9
4.0	58.0	5.0	81.6
6.0	34.0	13.0	36.6
9.0	11.1	20.0	9.7
12.0	2.1	26.0	1.4
15.0	.0	32.0	.0
19.0	.0	38.0	.0

Table 7 (cont'd) ATLANTA -- JANUARY THRU MARCH EXPECTED VELOCITIES

POSITION 29

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	78.6	3.0	89.5
4.0	42.9	5.0	77.6
6.0	20.1	13.0	24.6
9.0	5.3	20.0	6.1
12.0	1.4	26.0	1.1
15.0	.0	32.0	.0
19.0	.0	38.0	.0

POSITION 30

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	80.4	3.0	88.8
4.0	56.8	5.0	77.8
6.0	39.7	13.0	35.4
9.0	22.4	20.0	13.9
12.0	10.2	26.0	4.2
15.0	3.3	32.0	.3
19.0	.0	38.0	.0

POSITION 31

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	76.2	3.0	87.7
4.0	40.9	5.0	74.9
6.0	18.9	13.0	25.5
9.0	3.6	20.0	6.9
12.0	.0	26.0	1.1
15.0	.0	32.0	.0
19.0	.0	38.0	.0

POSITION 32

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	78.9	3.0	89.0
4.0	48.9	5.0	78.5
6.0	24.0	13.0	32.5
9.0	6.5	20.0	9.0
12.0	.7	26.0	2.1
15.0	.0	32.0	.0
19.0	.0	38.0	.0

Table 7 (cont'd) ATLANTA -- JANUARY THRU MARCH EXPECTED VELOCITIES

POSITION 33

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	74.9	3.0	86.5
4.0	32.2	5.0	71.3
6.0	8.6	13.0	11.4
9.0	.0	20.0	.2
12.0	.0	26.0	.0
15.0	.0	32.0	.0
19.0	.0	38.0	.0

POSITION 34

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	73.7	3.0	86.2
4.0	41.2	5.0	69.7
6.0	26.1	13.0	24.2
9.0	11.7	20.0	8.9
12.0	3.8	26.0	2.2
15.0	.0	32.0	.0
19.0	.0	38.0	.0

POSITION 35

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	66.0	3.0	80.4
4.0	26.8	5.0	61.2
6.0	7.5	13.0	9.2
9.0	1.1	20.0	1.7
12.0	.0	26.0	.0
15.0	.0	32.0	.0
19.0	.0	38.0	.0

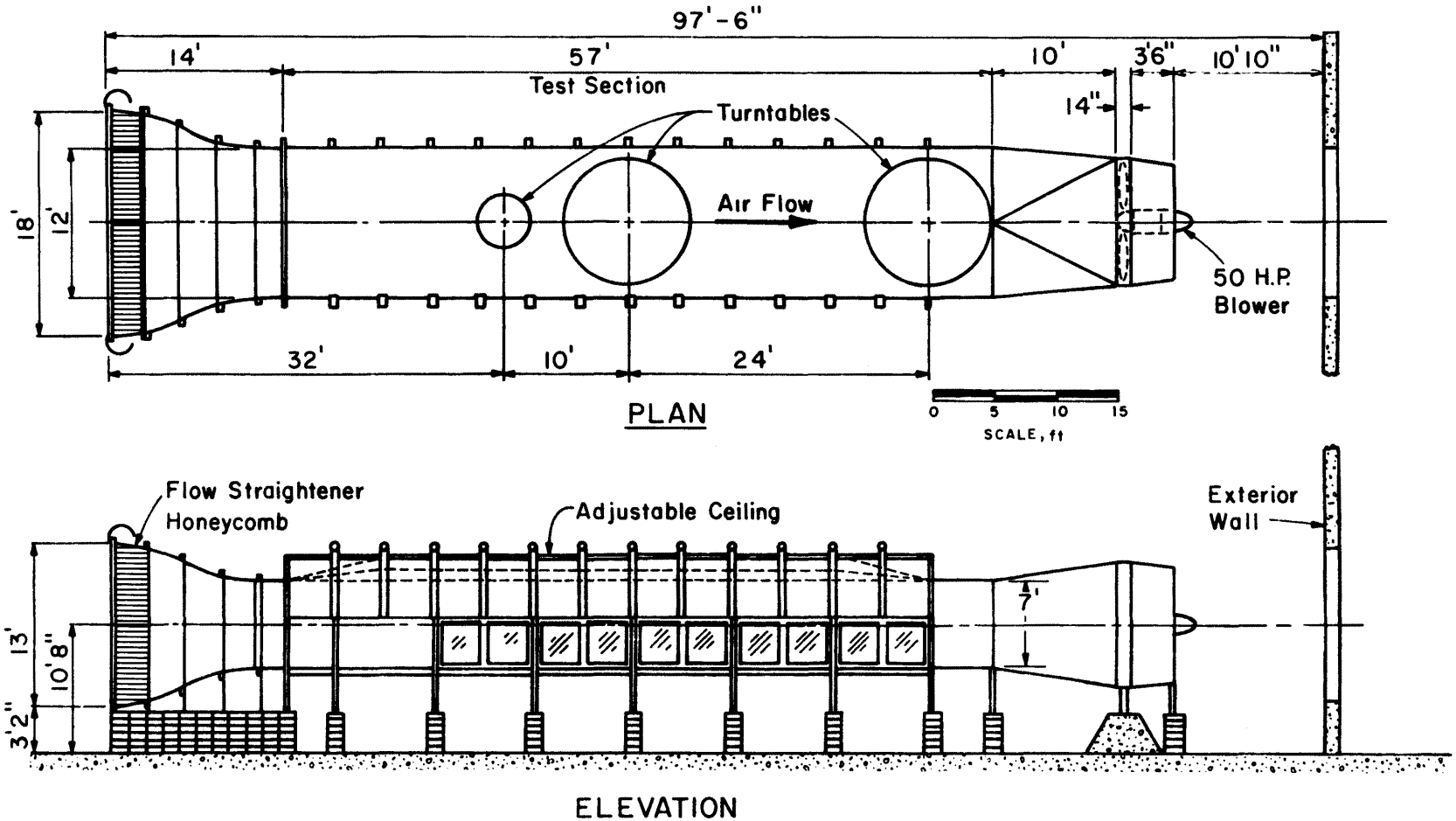
POSITION 36

VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN) EXCEEDS VELOCITY LEVEL	VELOCITY LEVEL --MPH	PERCENT TIME (UMEAN + 3 URMS) EXCEEDS VELOCITY LEVEL
2.0	79.5	3.0	85.2
4.0	60.9	5.0	74.6
6.0	42.5	13.0	32.2
9.0	20.7	20.0	7.7
12.0	7.4	26.0	.5
15.0	1.5	32.0	.0
19.0	.0	38.0	.0

TABLE 8. SUMMARY OF WIND EFFECTS ON PEOPLE.

	Beaufort Number	Speed (mph)	Effects
Calm, light air	0,1	0- 3	Calm, no noticeable wind
Light breeze	2	4- 7	Wind felt on face
Gentle breeze	3	8-12	Wind extends light flag Hair is disturbed Clothing flaps
Moderate breeze	4	13-18	Raises dust, dry soil and loose paper Hair disarranged
Fresh breeze	5	19-24	Force of wind felt on body Drifting snow becomes airborne Limit of agreeable wind on land
Strong breeze	6	25-31	Umbrellas used with difficulty Hair blown straight Difficult to walk steadily Wind noise on ears unpleasant Windborne snow above head height (blizzard)
Near gale	7	32-38	Inconvenience felt when walking
Gale	8	39-46	Generally impedes progress Great difficulty with balance in gusts
Strong gale	9	47-54	People blown over by gusts

Note: Table from Reference 4, pg. 40.

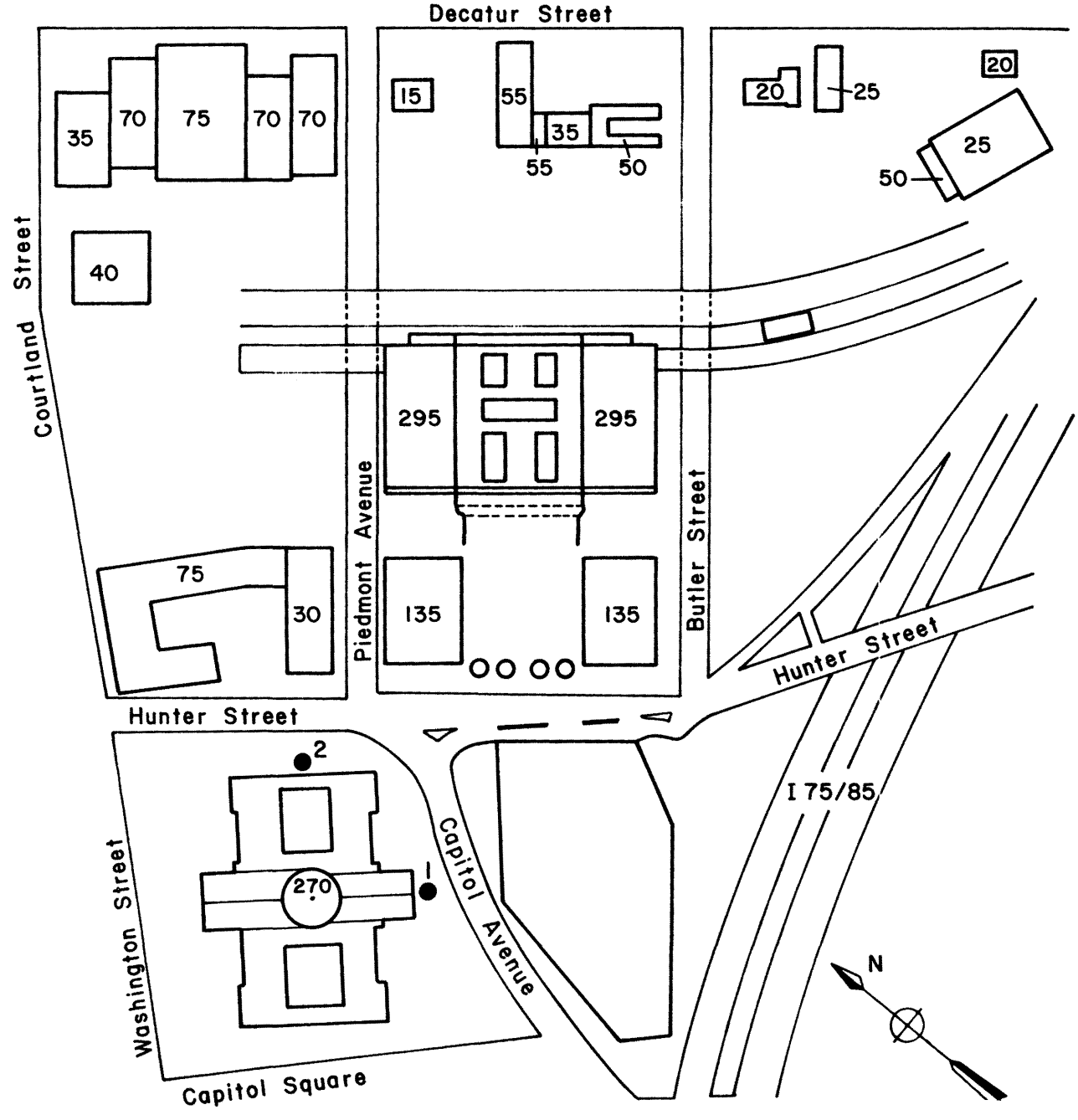


ENVIRONMENTAL WIND TUNNEL
FLUID DYNAMICS & DIFFUSION LABORATORY
COLORADO STATE UNIVERSITY

FIGURE 1. Environmental Wind Tunnel.

FIGURE 2. Two Views of Model Showing Two Configurations.

FIGURE 3. Wind Tunnel View.



8-Numbers Indicate Heights in feet

●-Measurement Locations

FIGURE 4a. Velocity Measurement Locations.

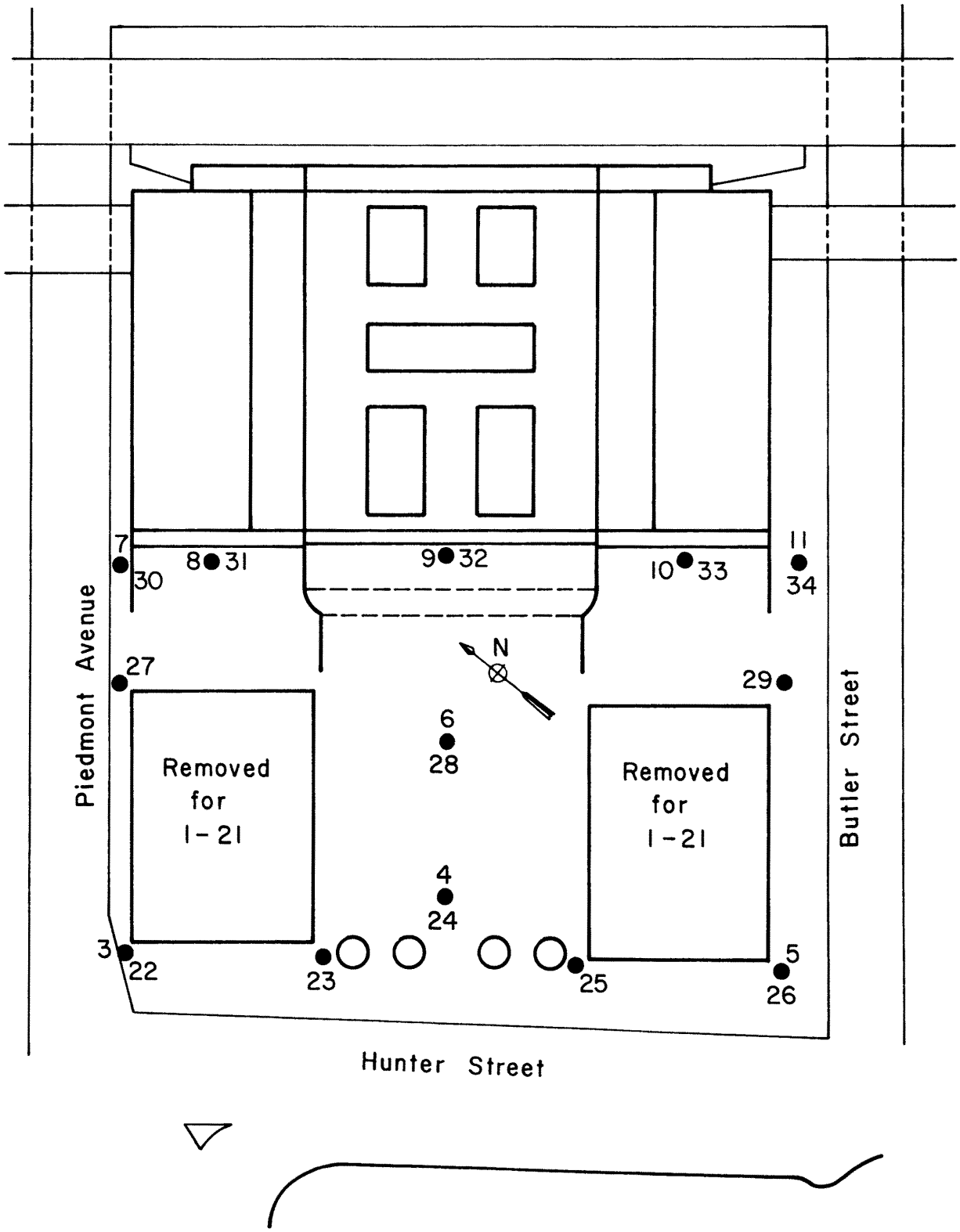


FIGURE 4b. Velocity Measurement Locations.

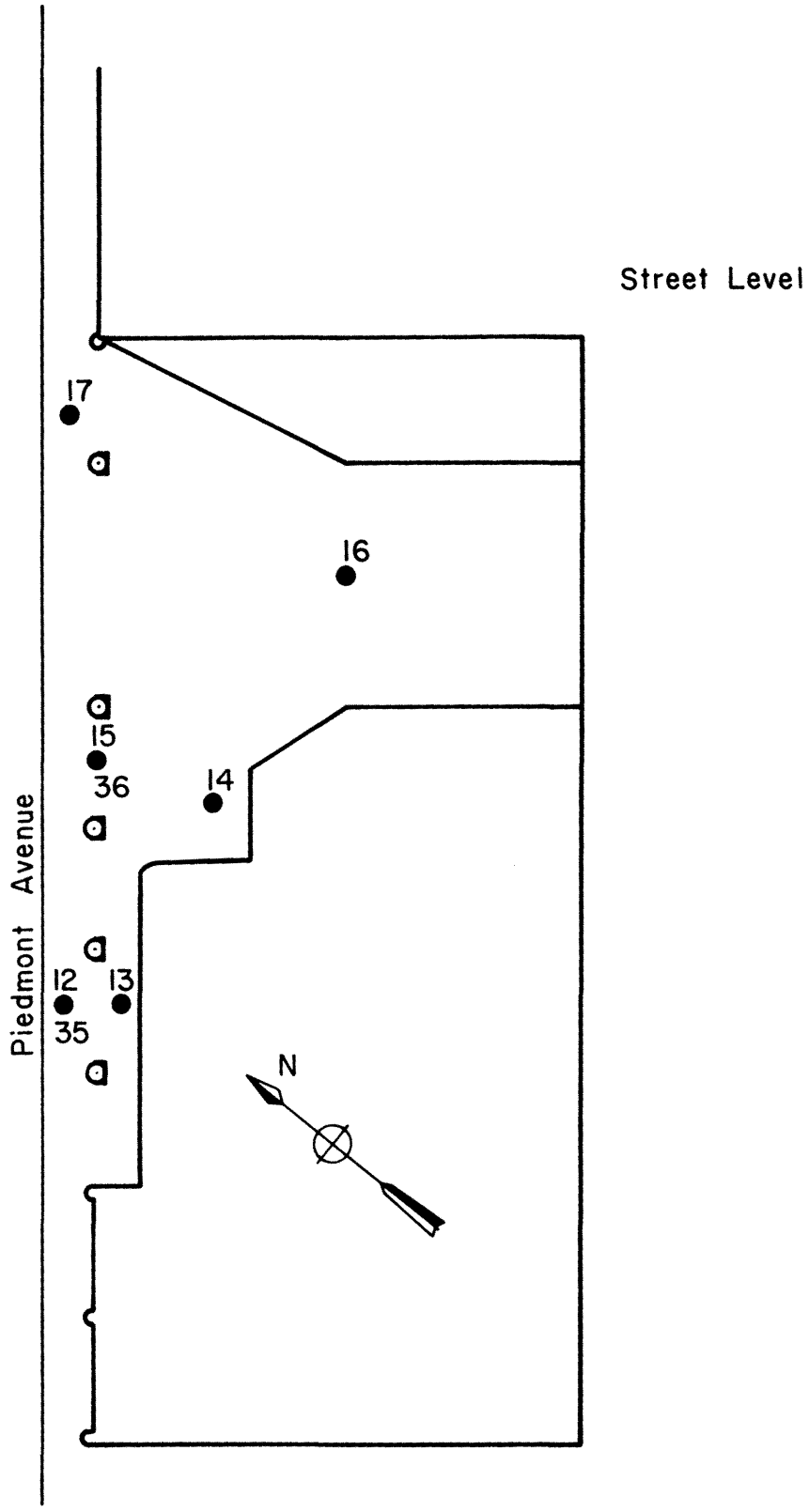


FIGURE 4c. Velocity Measurement Locations.

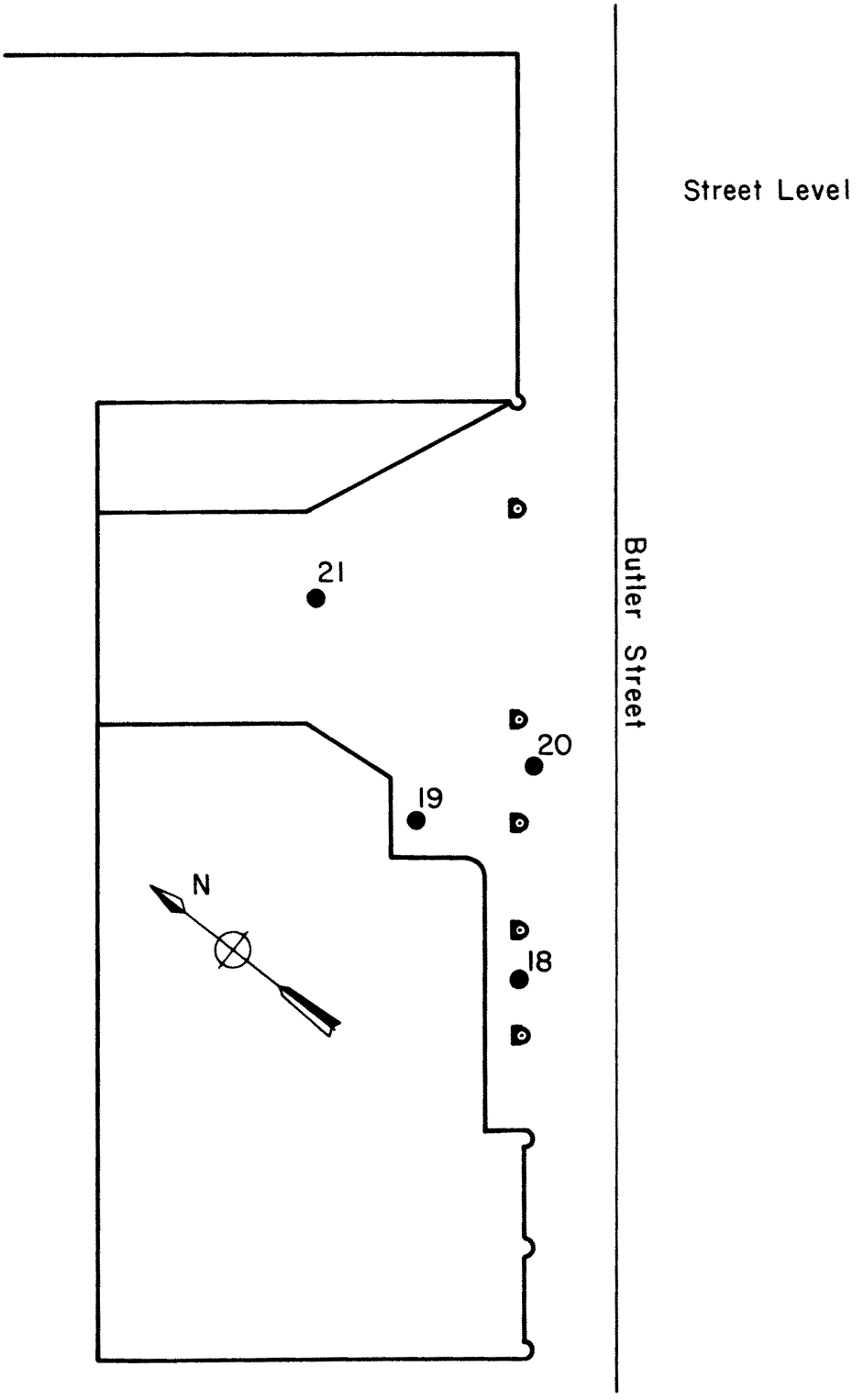


FIGURE 4d. Velocity Measurement Locations.

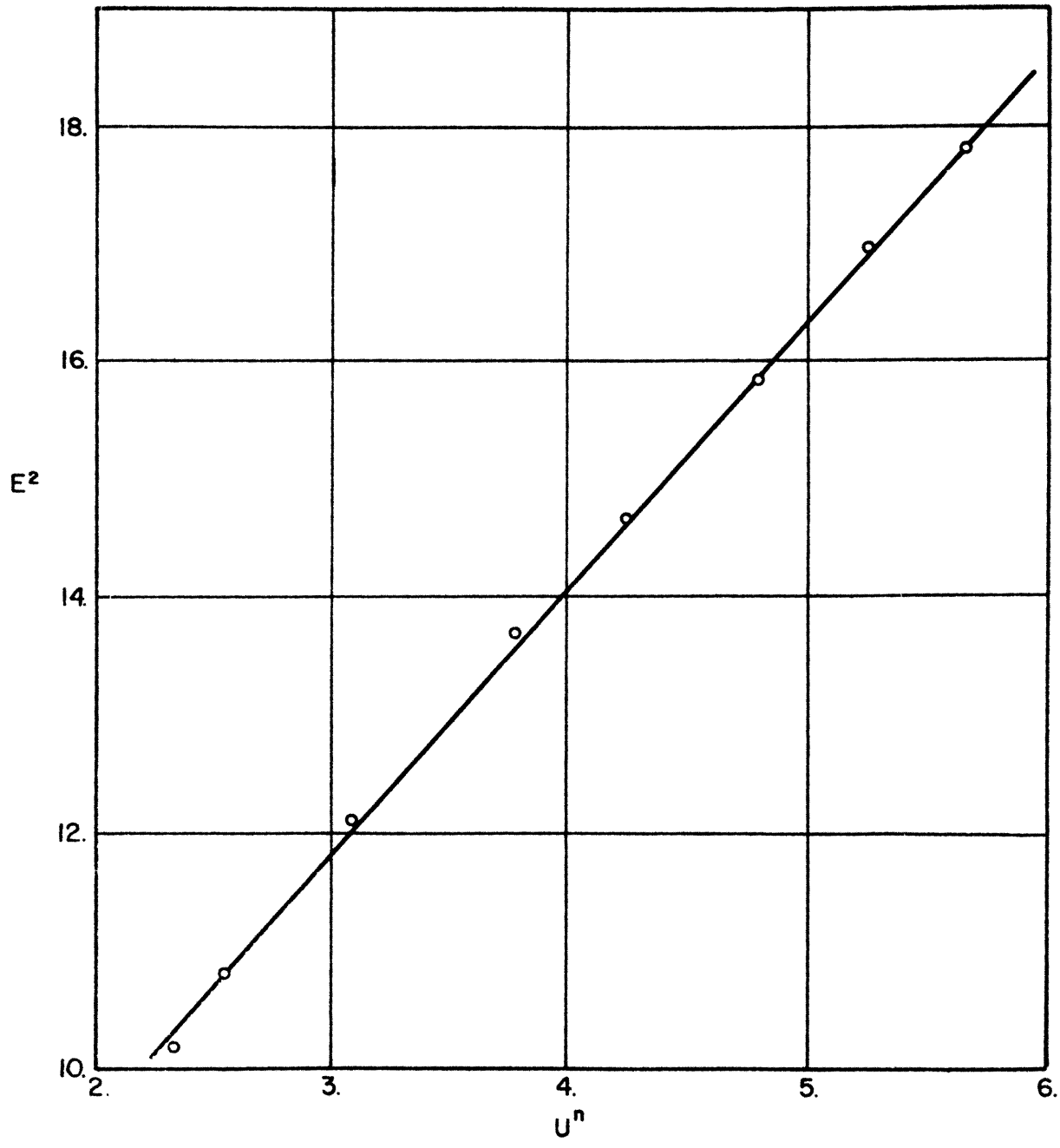


FIGURE 5. Typical Hot-Wire Calibration.

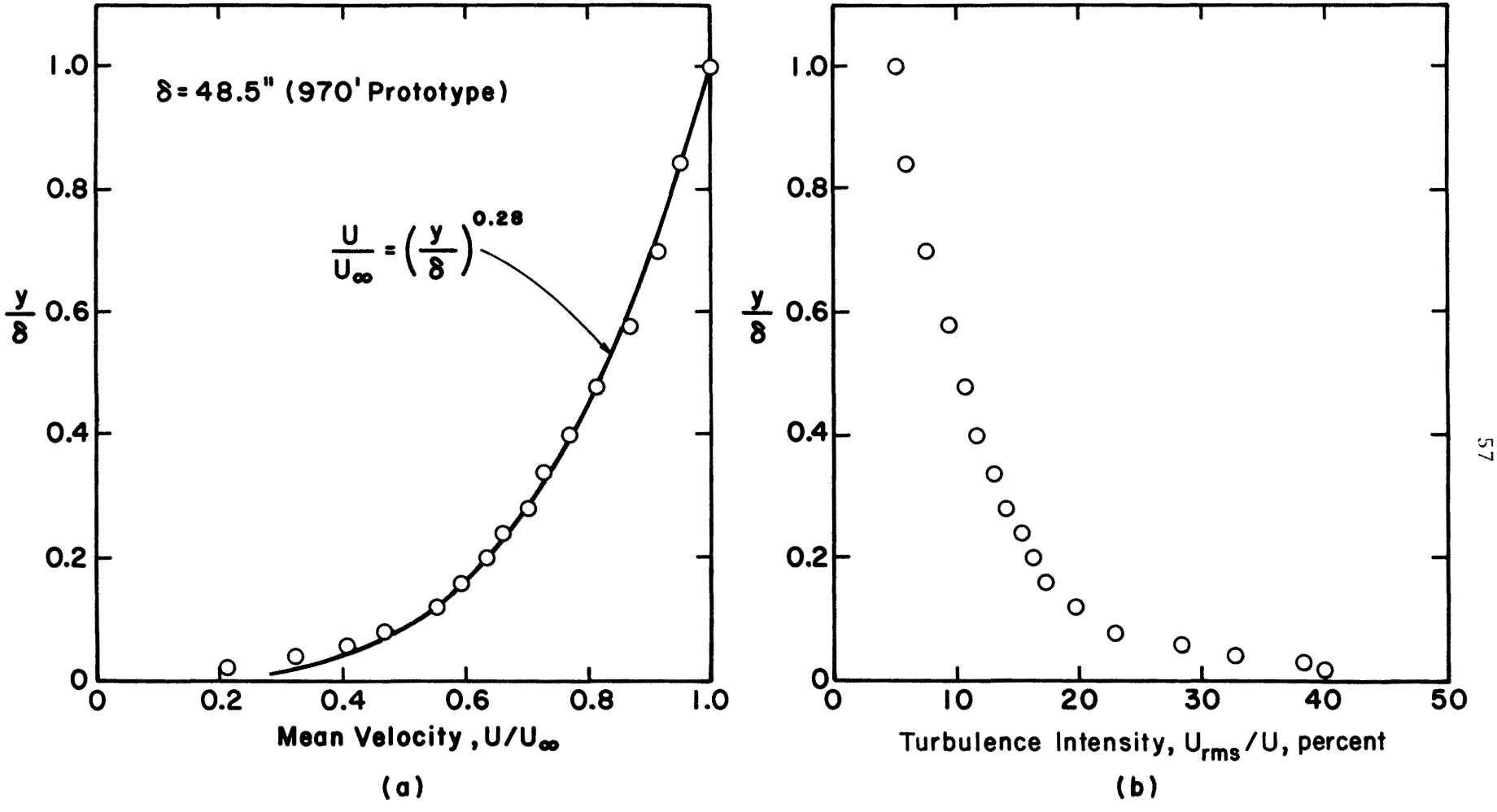


FIGURE 6. Mean Velocity and Turbulence Intensity Profiles Approaching the Model.

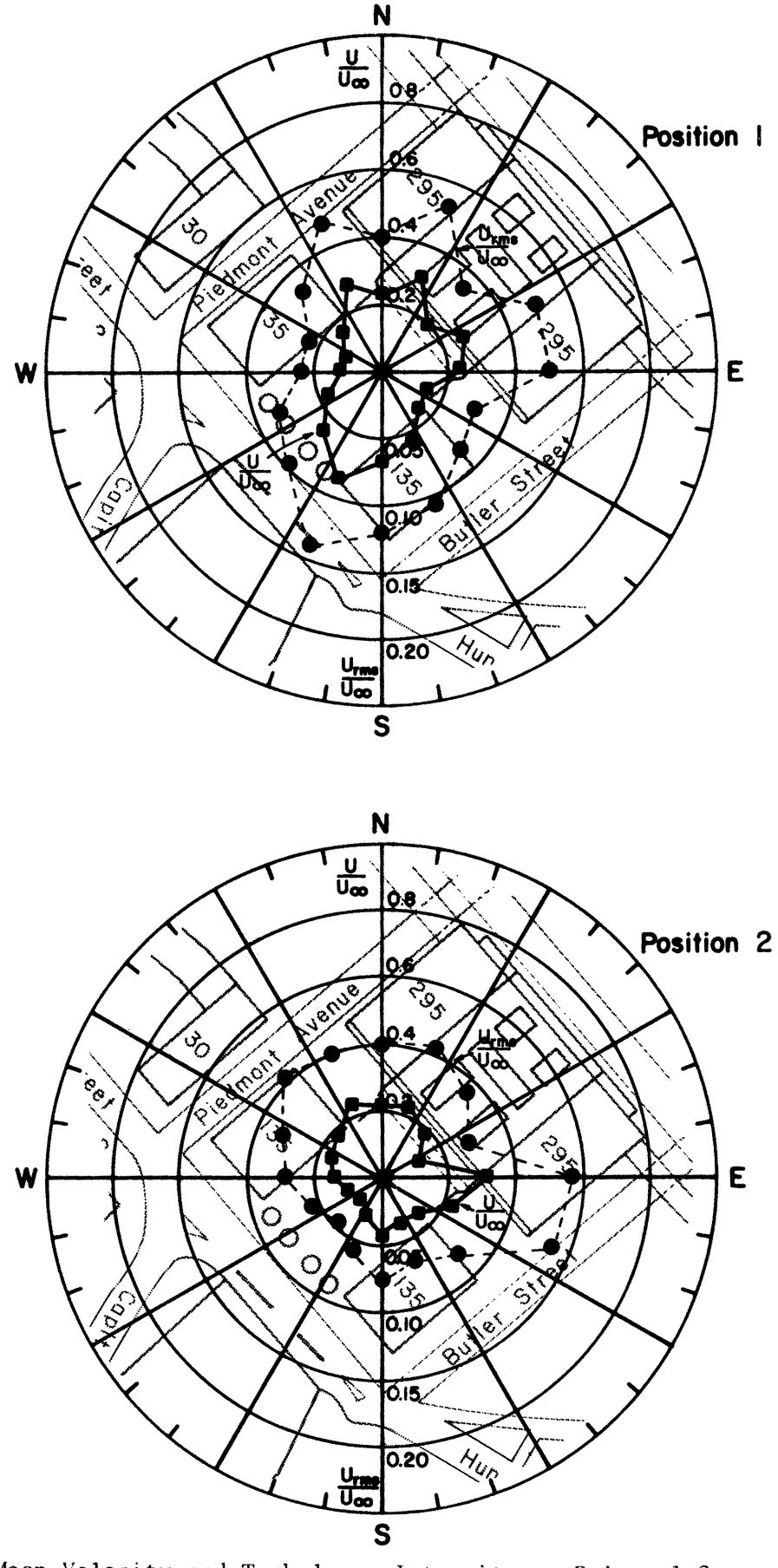


FIGURE 7a. Mean Velocity and Turbulence Intensity at Points 1-2.

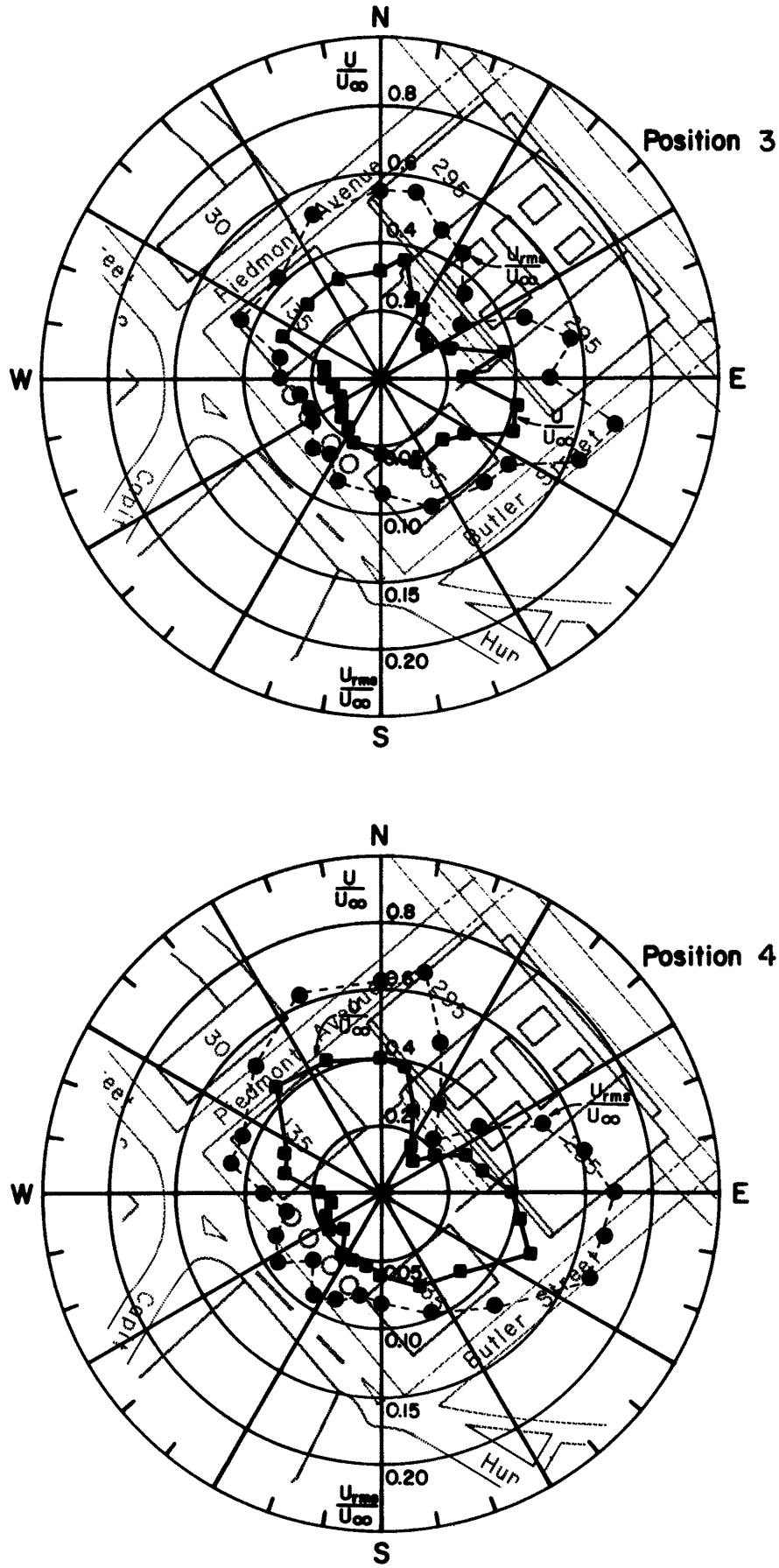


FIGURE 7b. Mean Velocity and Turbulence Intensity at Points 3-4.

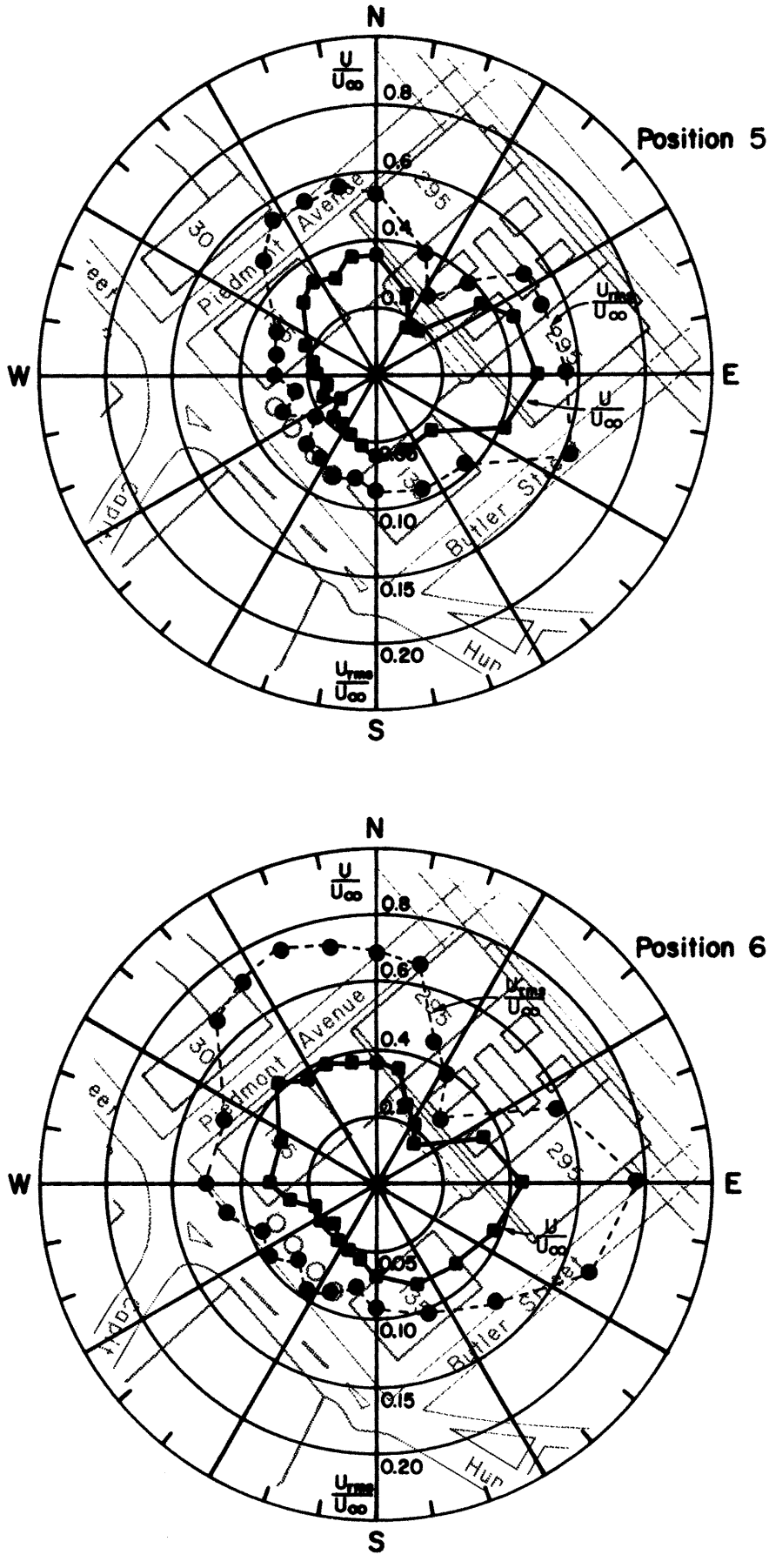


FIGURE 7c. Mean Velocity and Turbulence Intensity at Points 5-6.

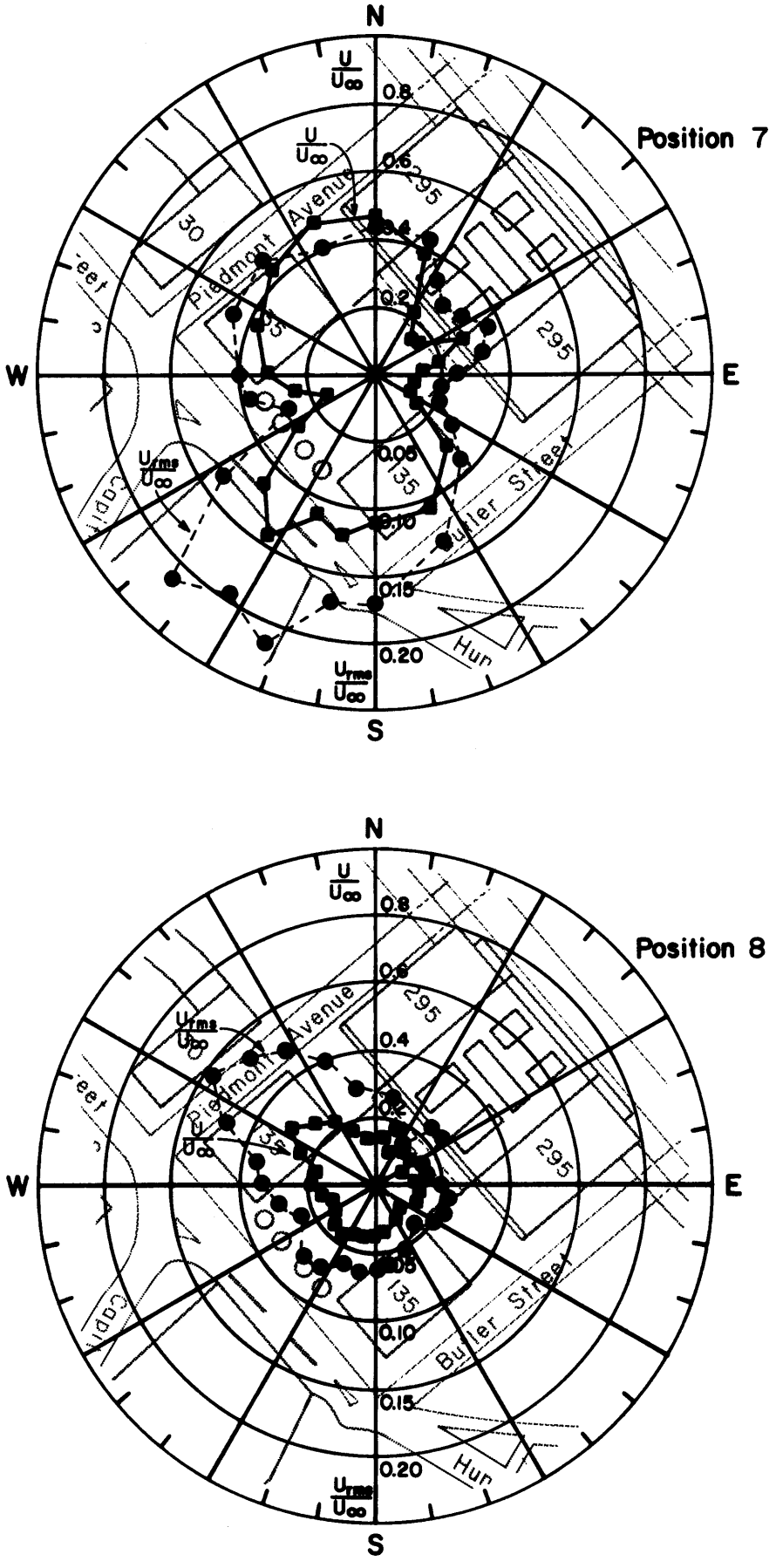


FIGURE 7d. Mean Velocity and Turbulence Intensity at Points 7-8.

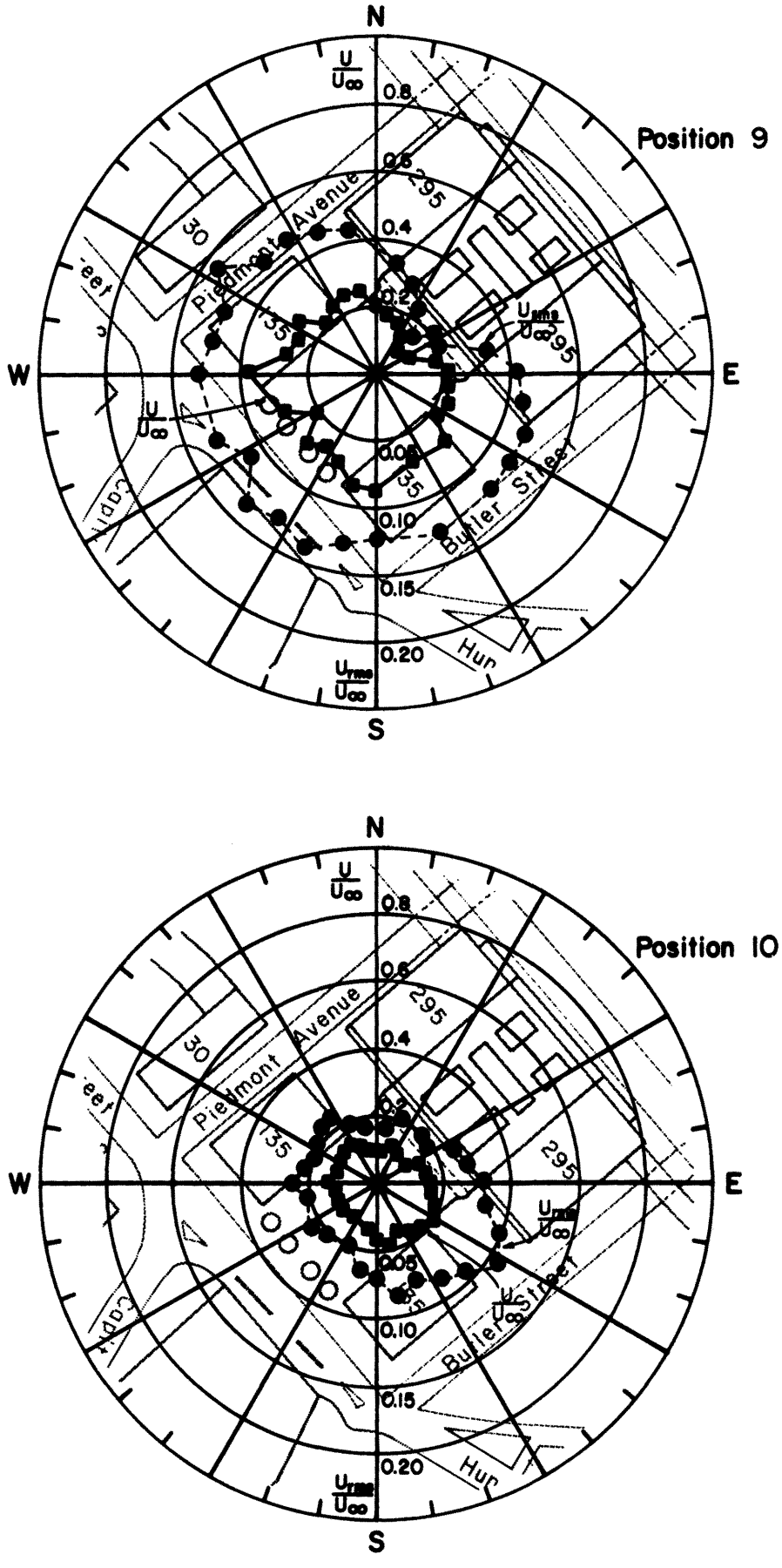


FIGURE 7e. Mean Velocity and Turbulence Intensity at Points 9-10.

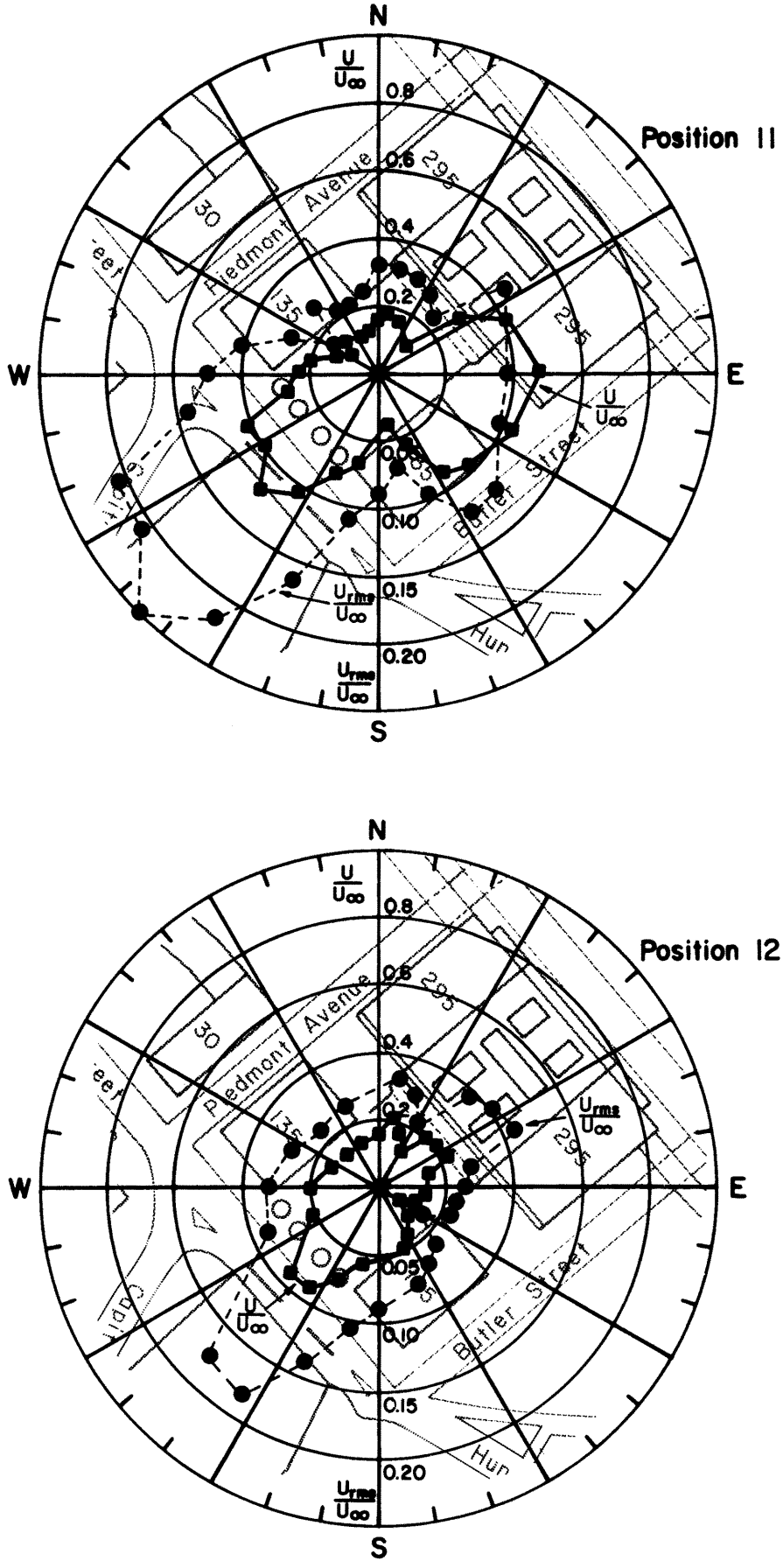
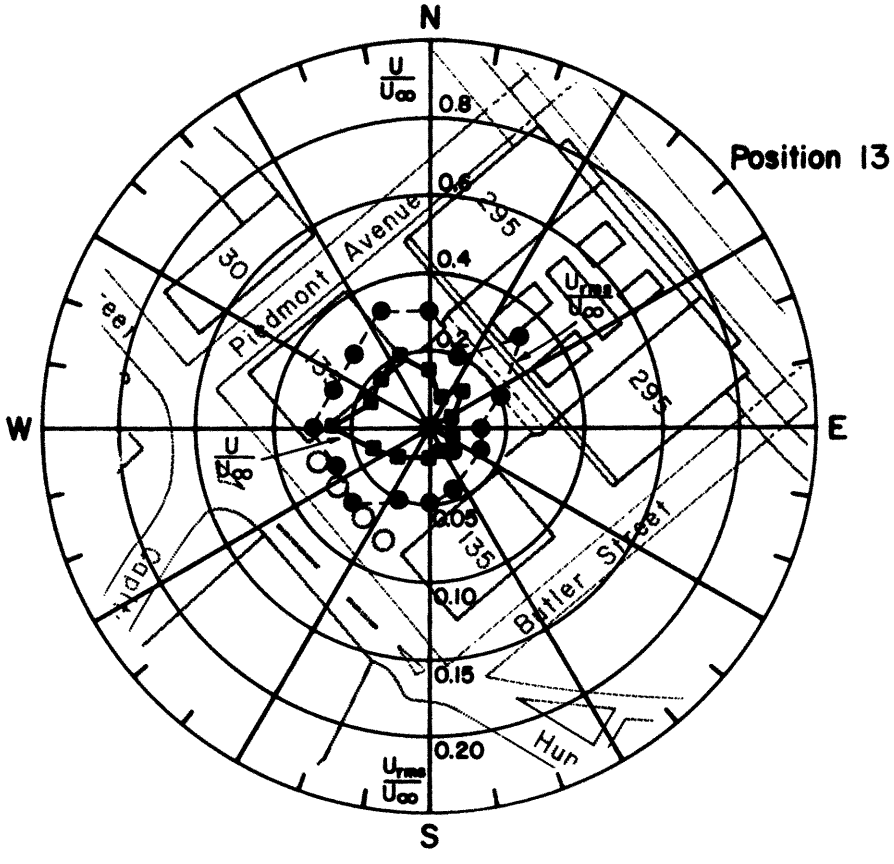


FIGURE 7f. Mean Velocity and Turbulence Intensity at Points 11-12.



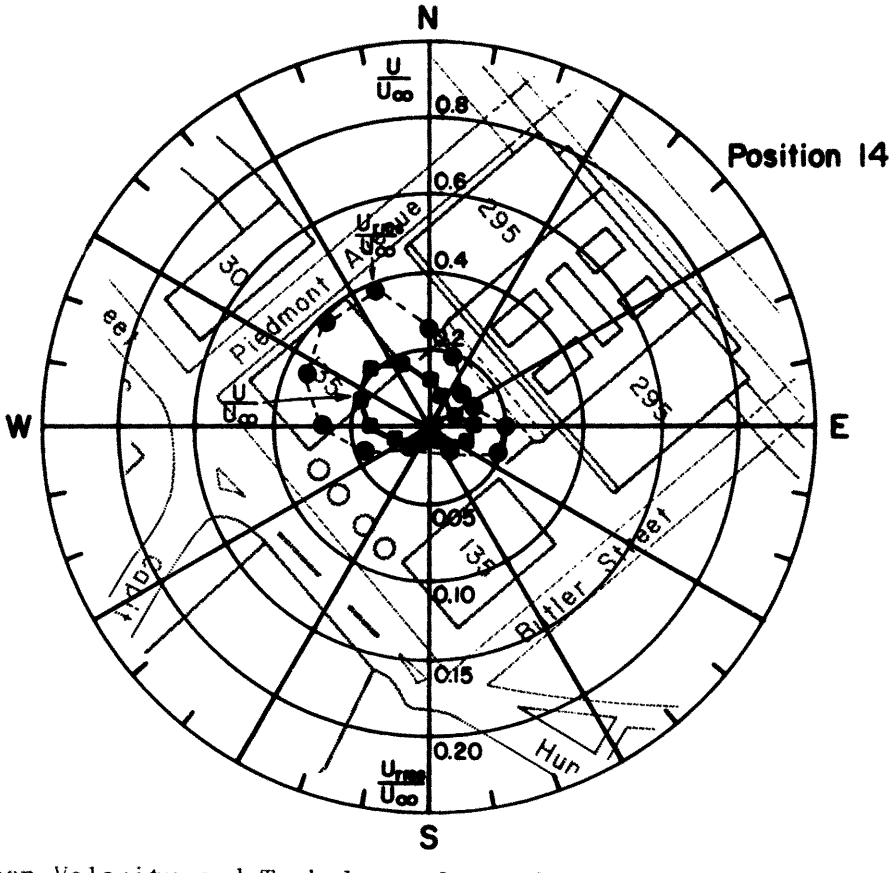


FIGURE 7g. Mean Velocity and Turbulence Intensity at Points 13-14.

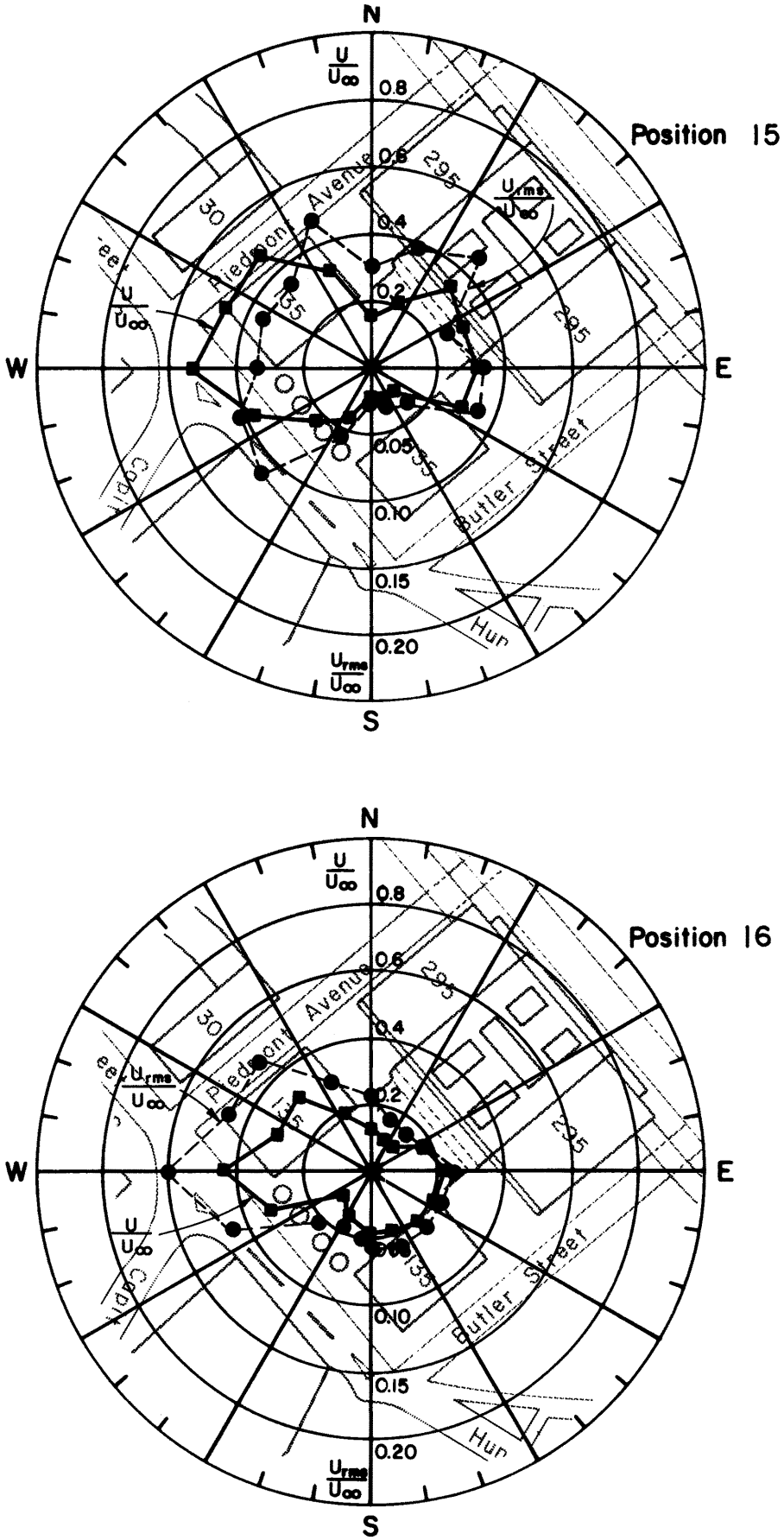


FIGURE 7h. Mean Velocity and Turbulence Intensity at Points 15-16.

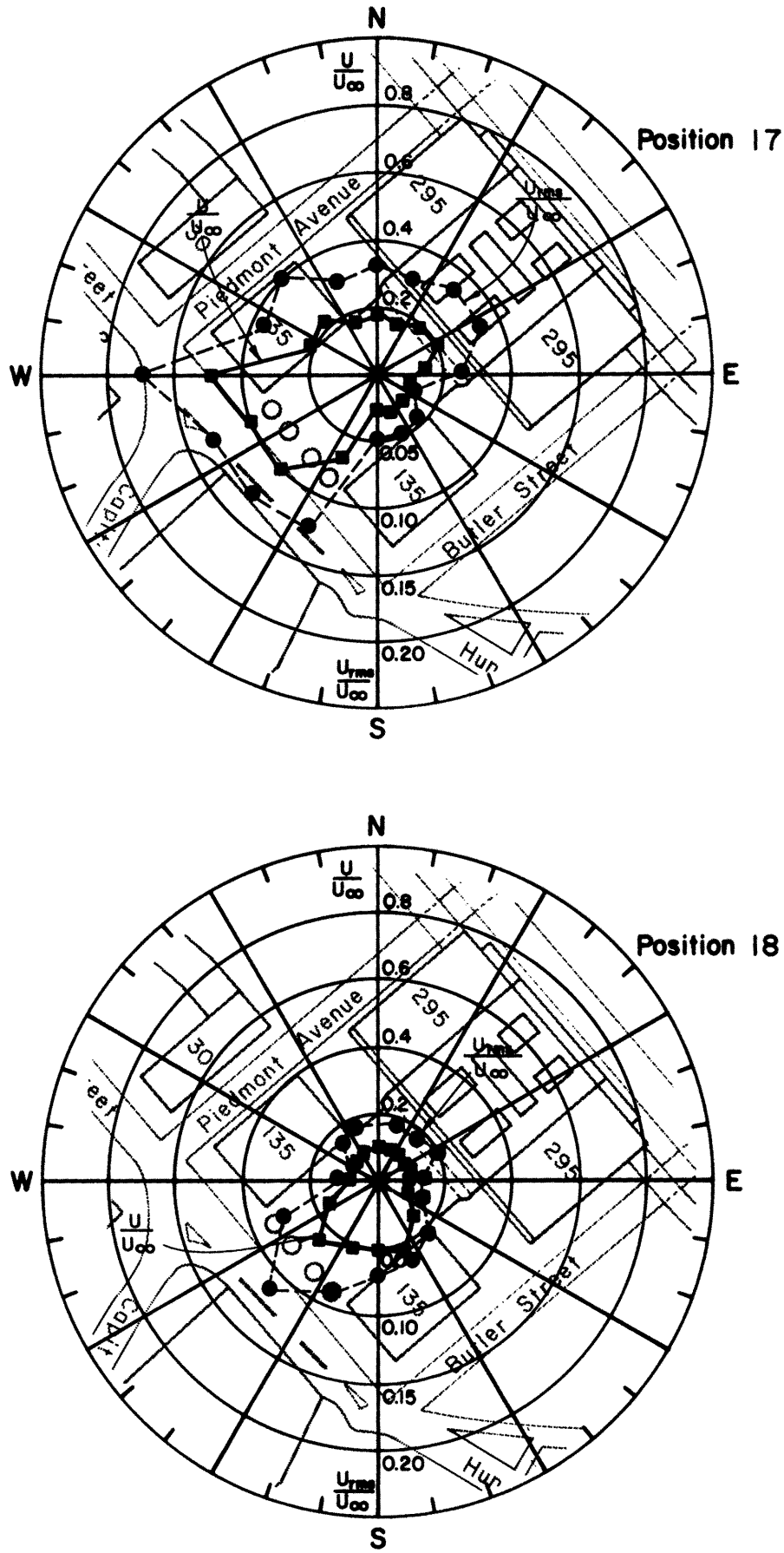


FIGURE 7i. Mean Velocity and Turbulence Intensity at Points 17-18.

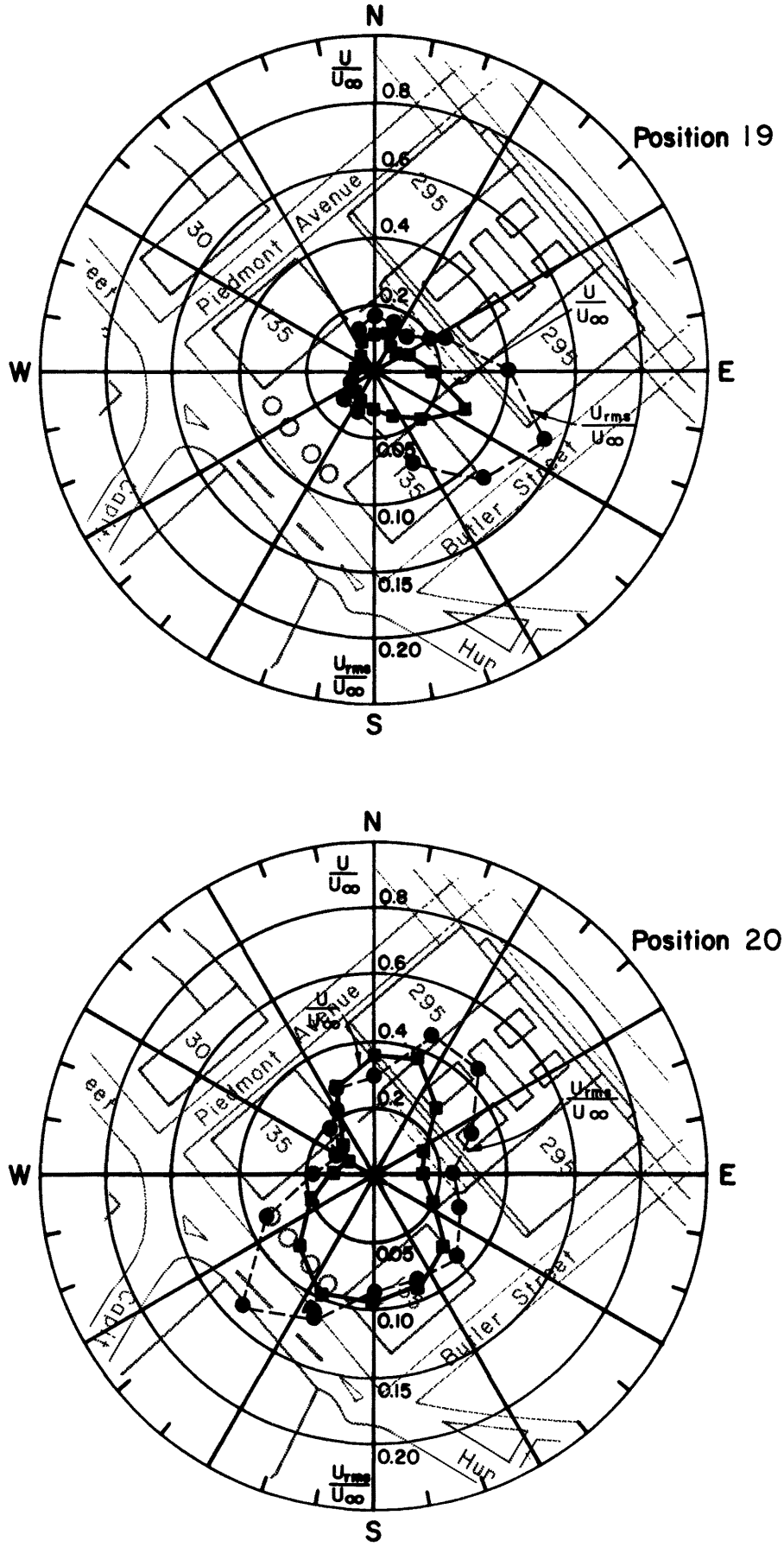


FIGURE 7j. Mean velocity and Turbulence Intensity at Points 19-20.

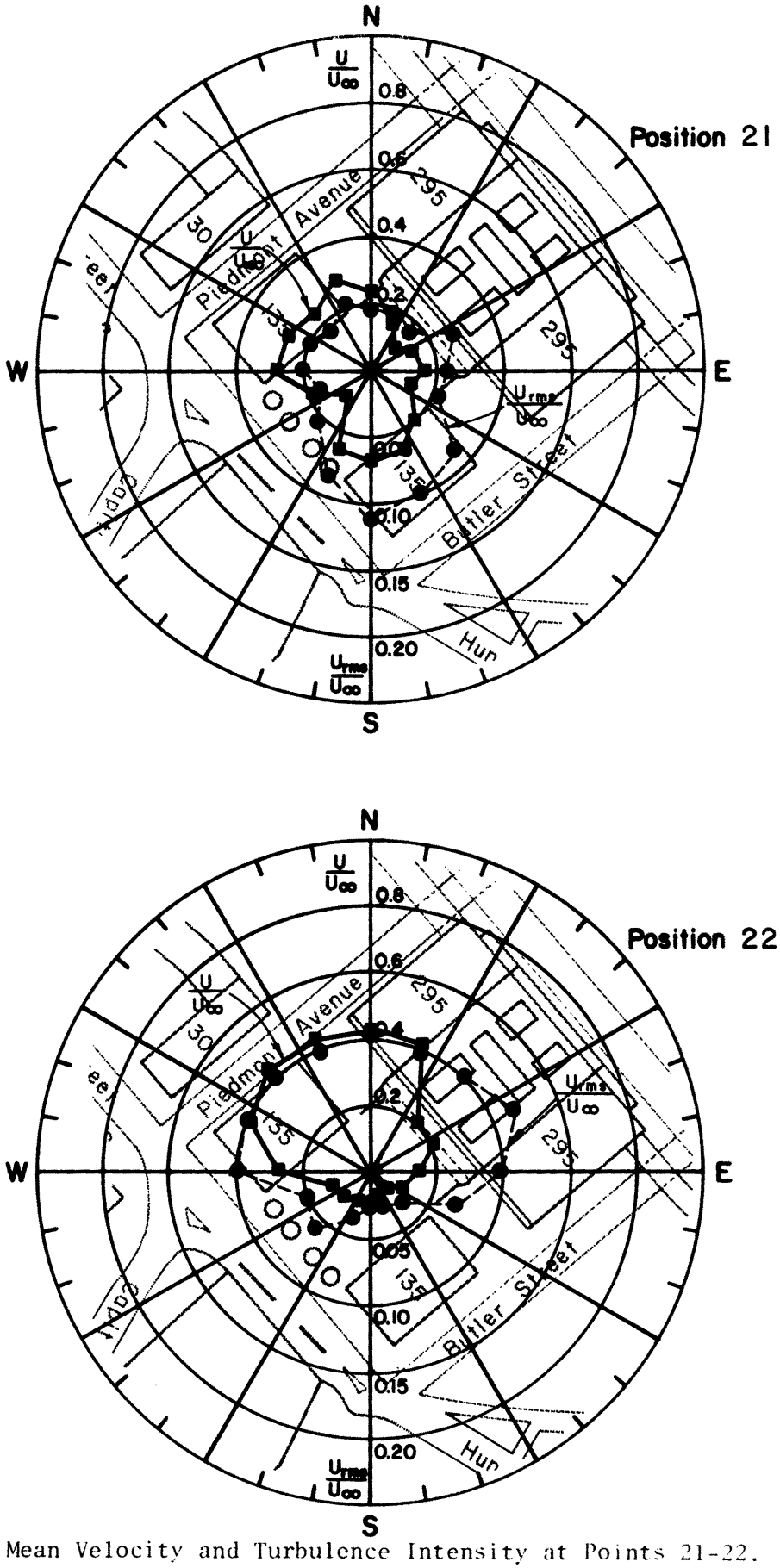
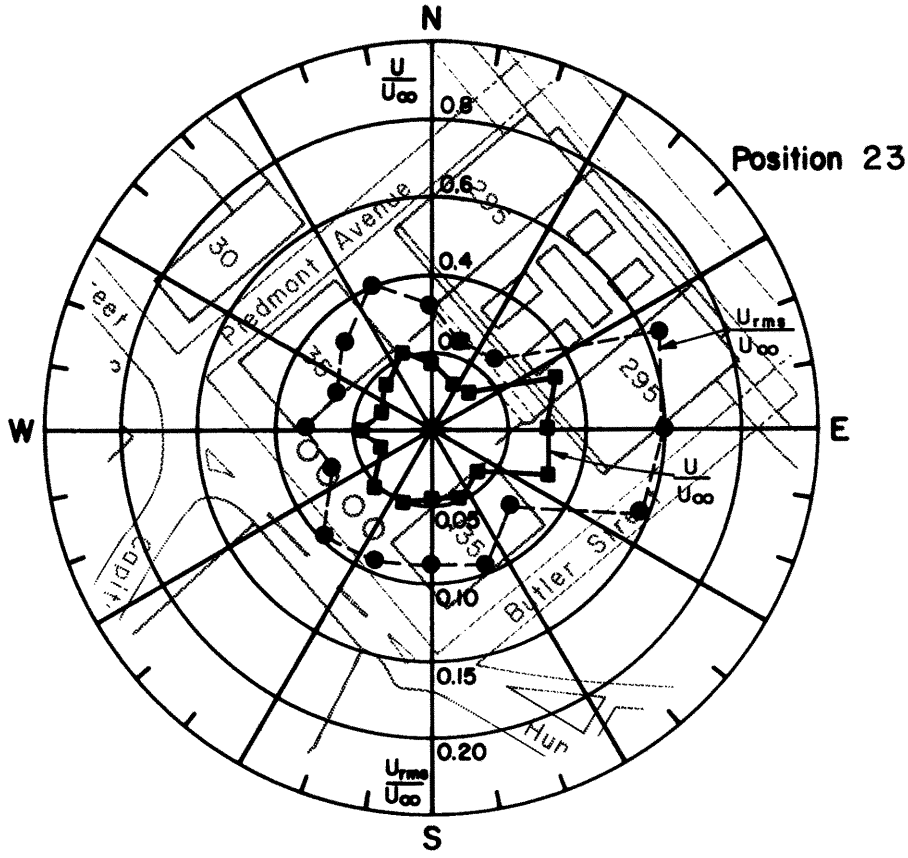


FIGURE 7k. Mean Velocity and Turbulence Intensity at Points 21-22.



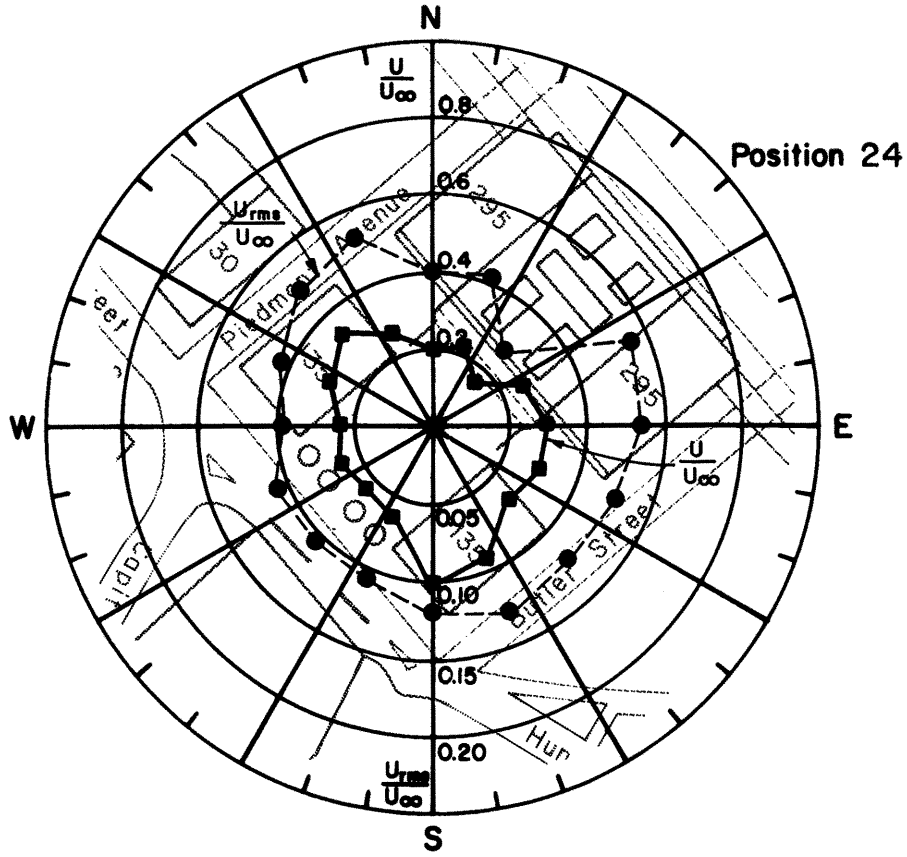


FIGURE 71. Mean Velocity and Turbulence Intensity at Points 23-24.

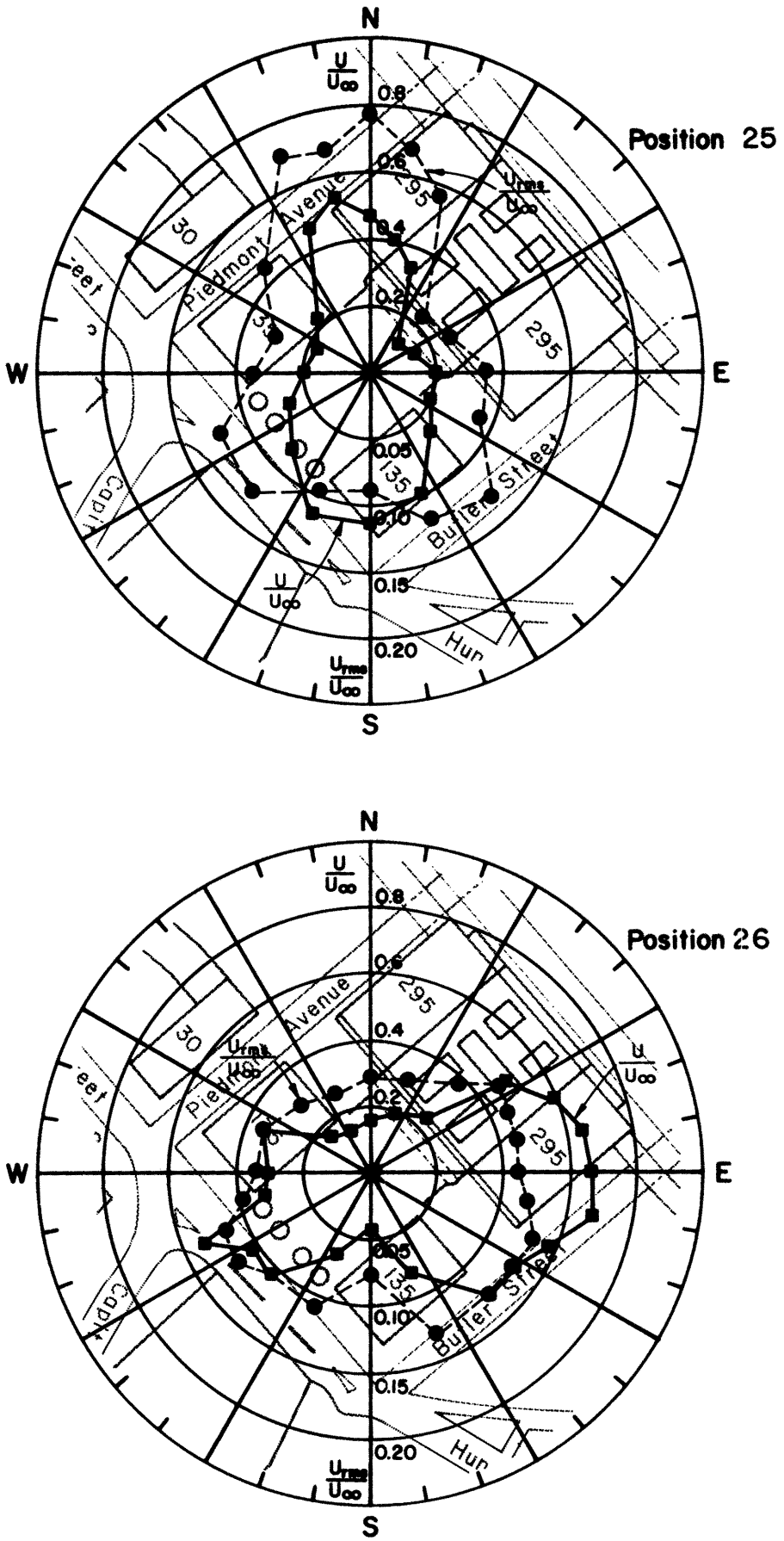
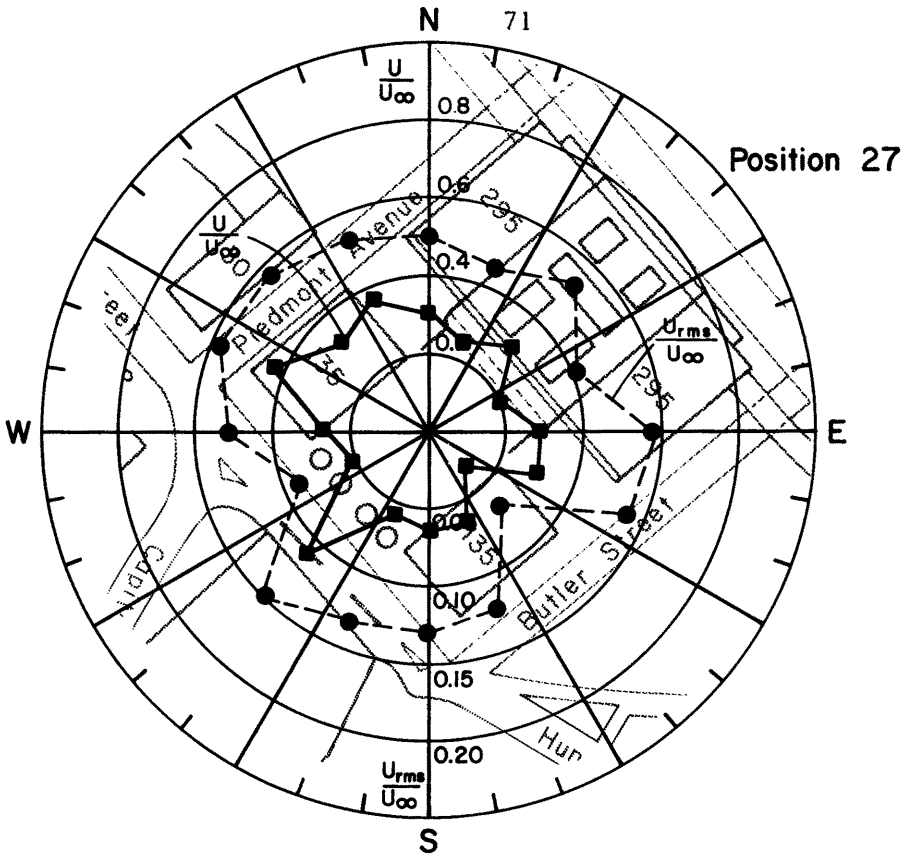


FIGURE 7m. Mean Velocity and Turbulence Intensity at Points 25-26.



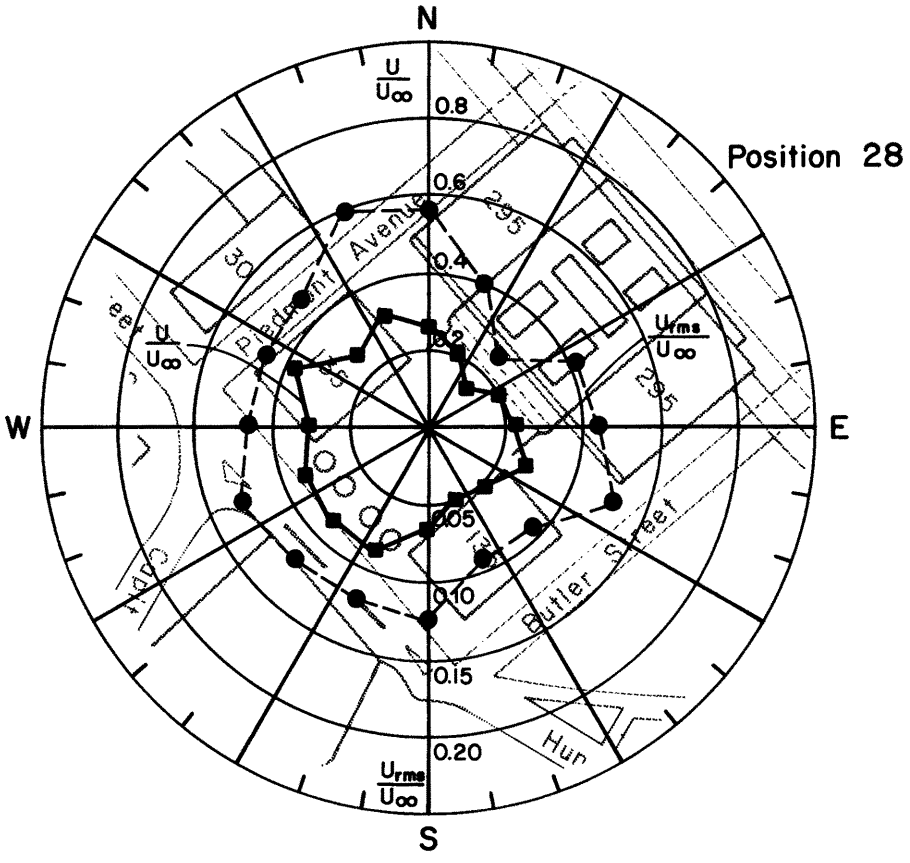


FIGURE 7n. Mean Velocity and Turbulence Intensity at Points 27-28.

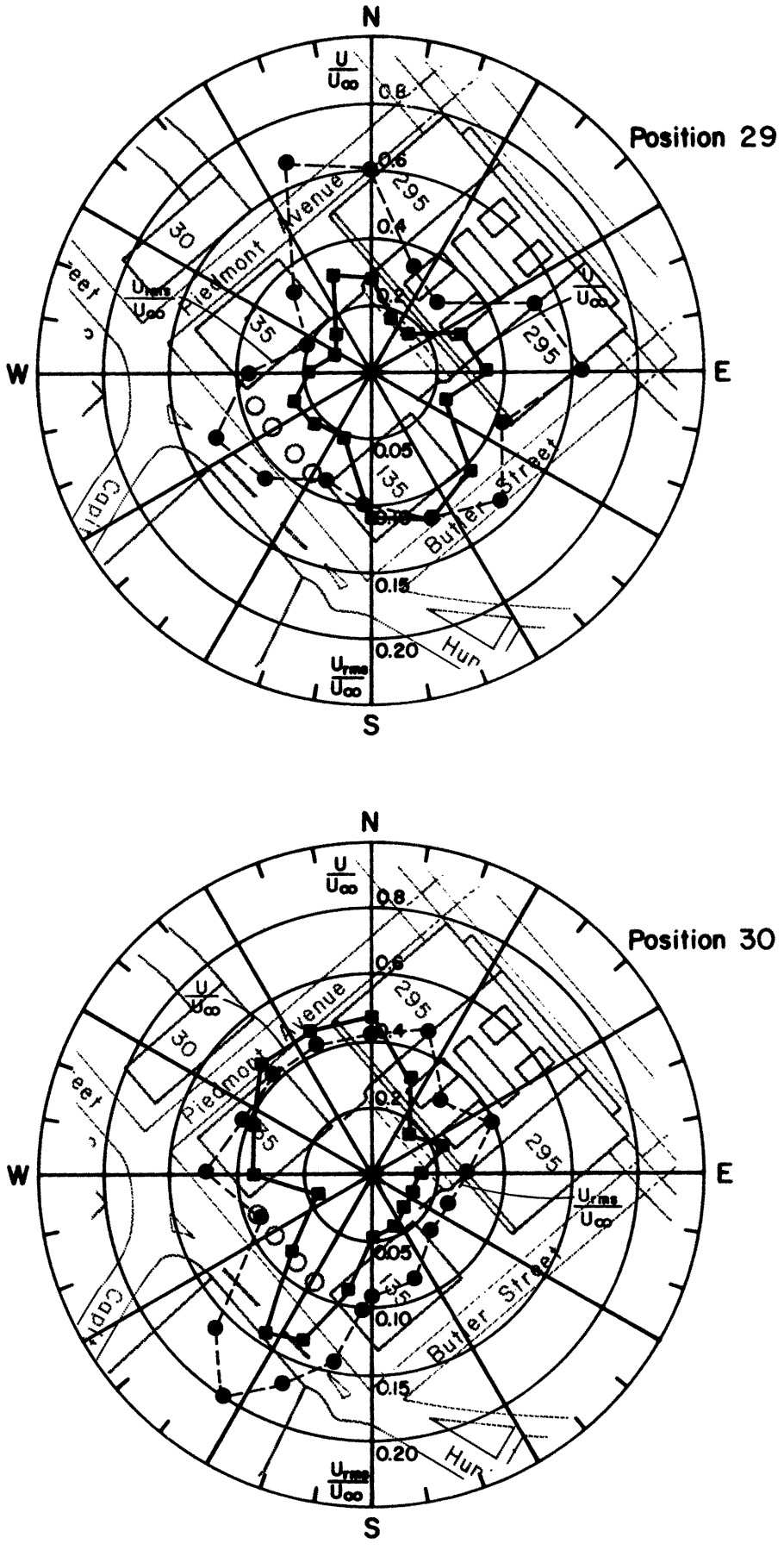


FIGURE 7o. Mean Velocity and Turbulence Intensity at Points 29-30.

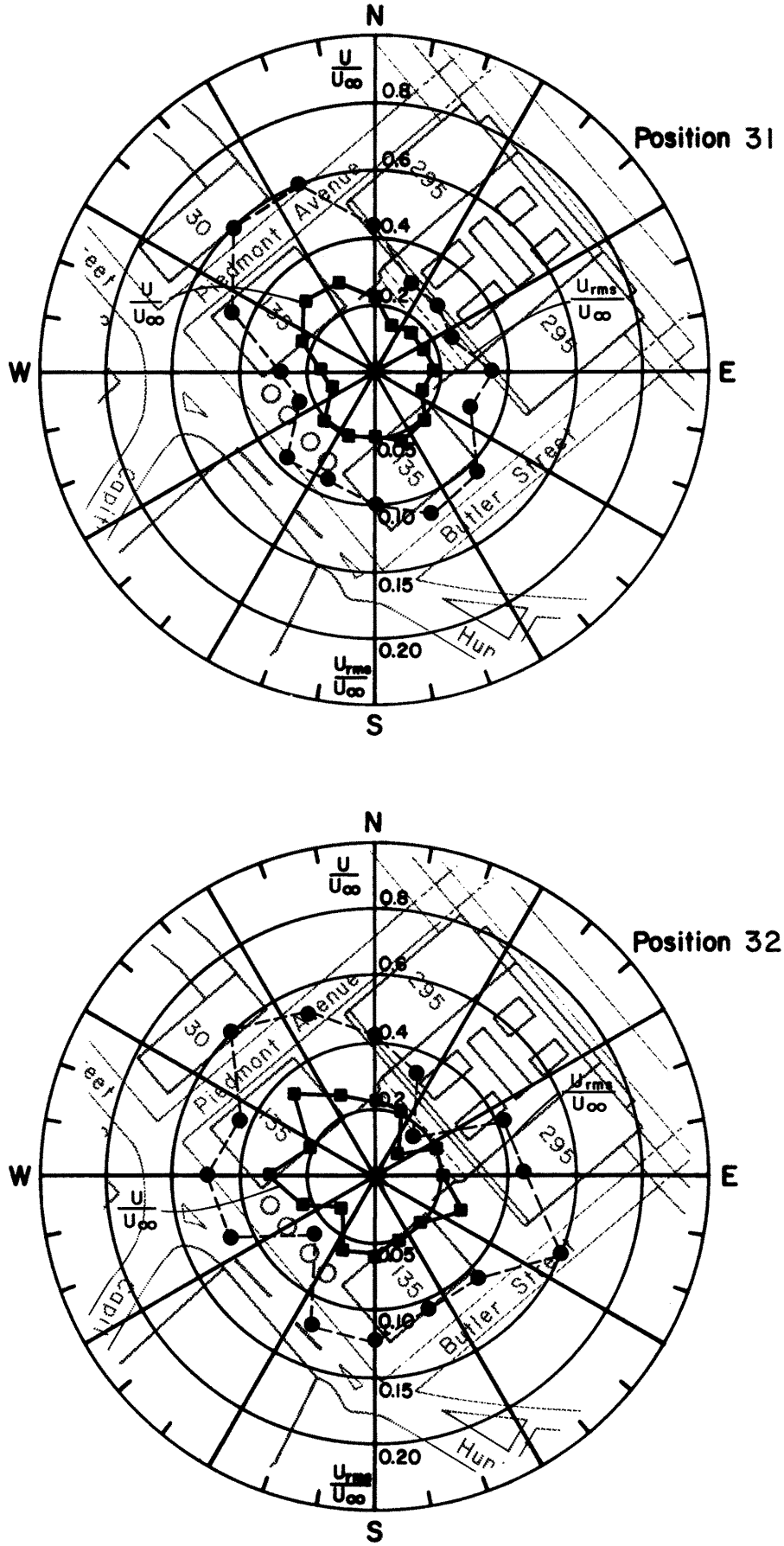


FIGURE 7p. Mean Velocity and Turbulence Intensity at Points 31-32.

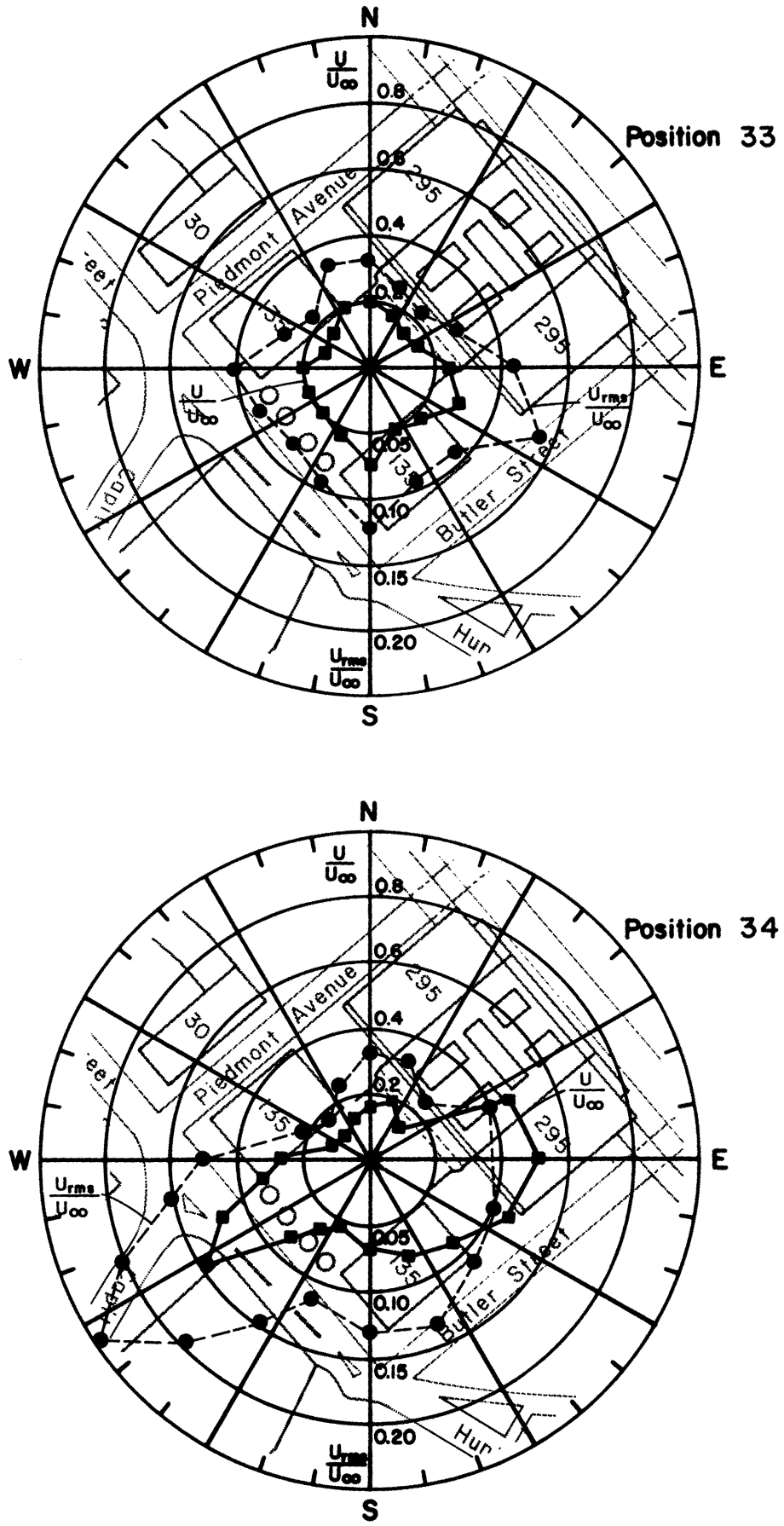


FIGURE 7q. Mean Velocity and Turbulence Intensity at Points 33-34.

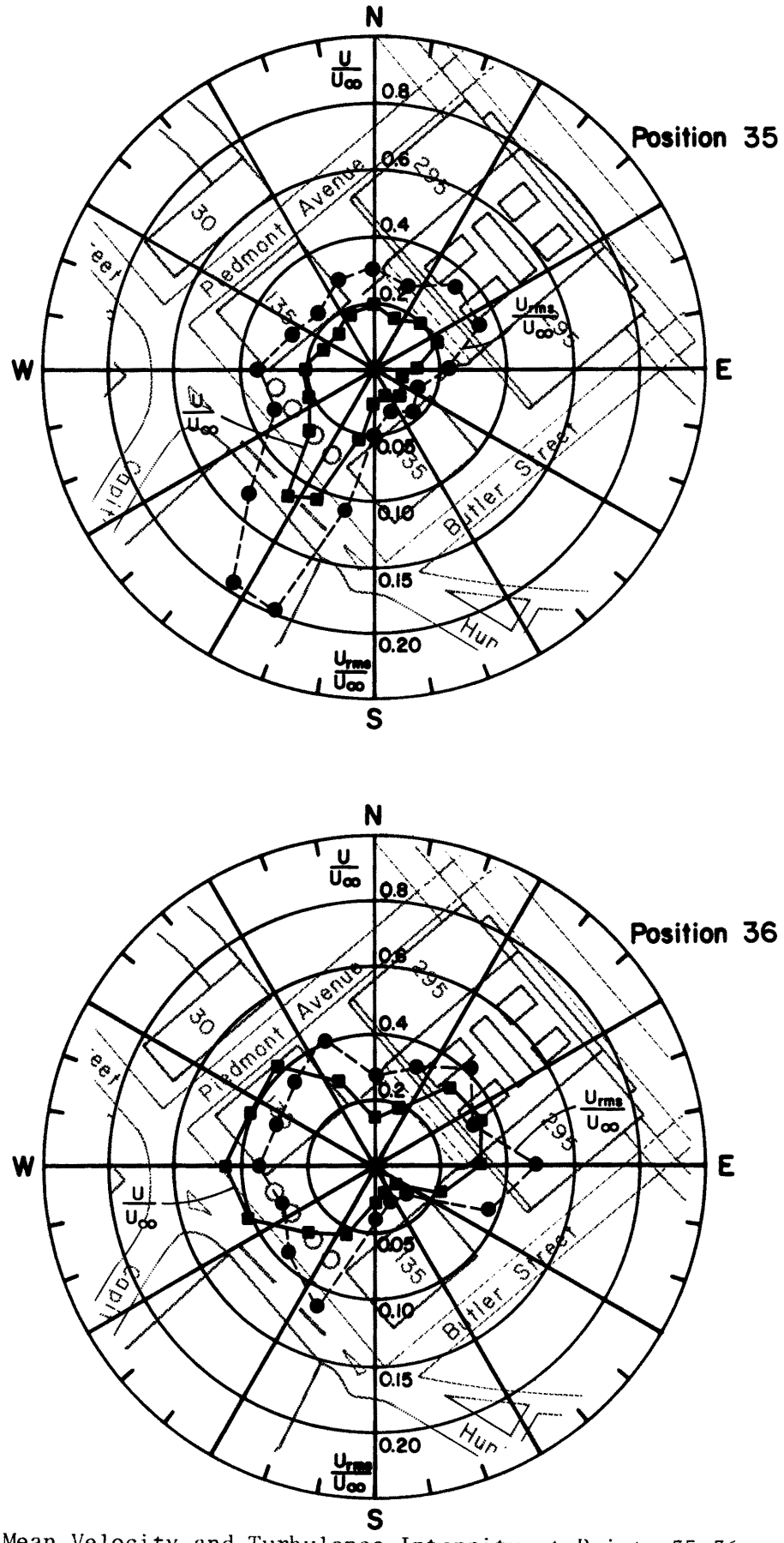


FIGURE 7r. Mean Velocity and Turbulence Intensity at Points 35-36.

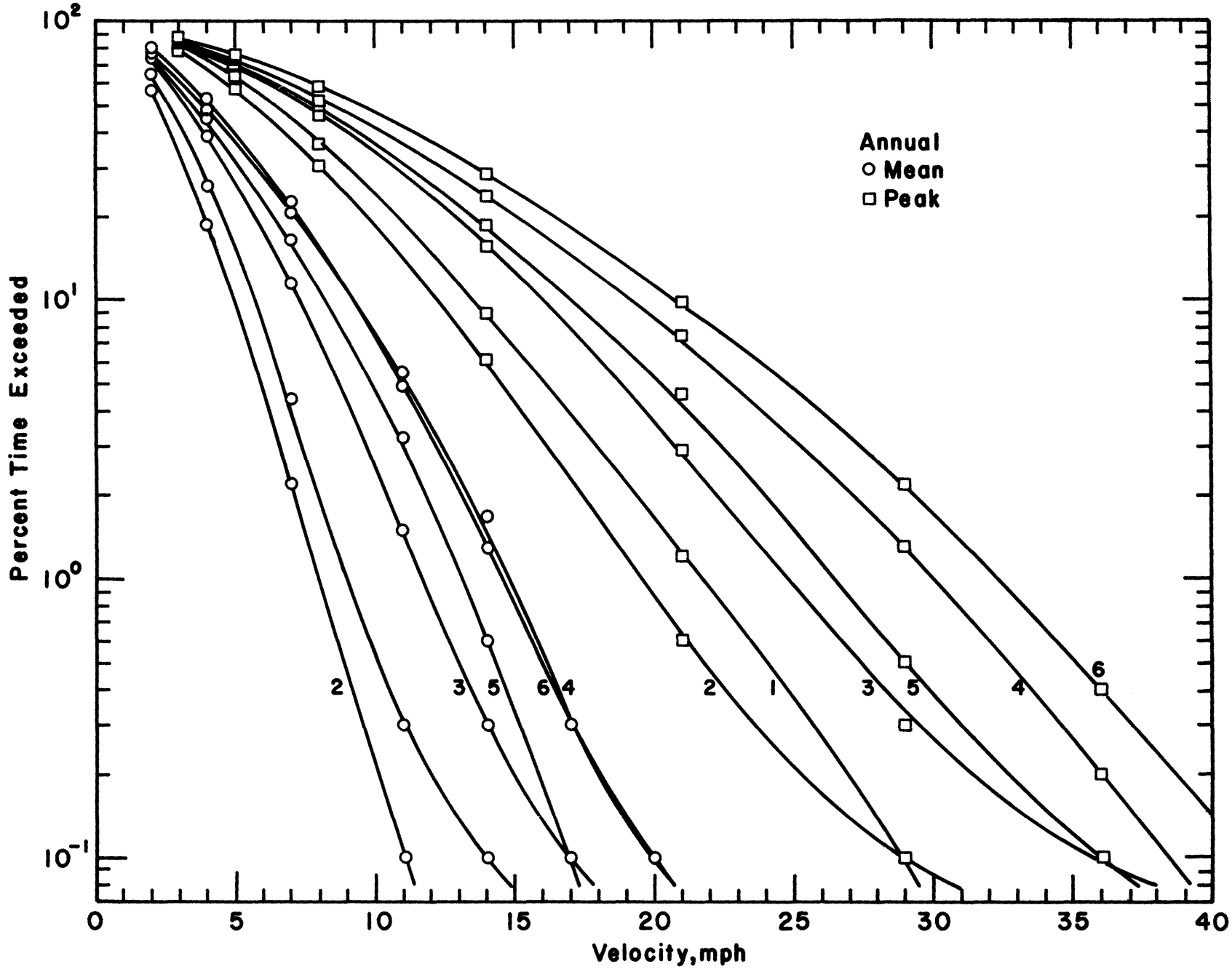


FIGURE 8a. Annual Expected Velocities at Locations 1-6.

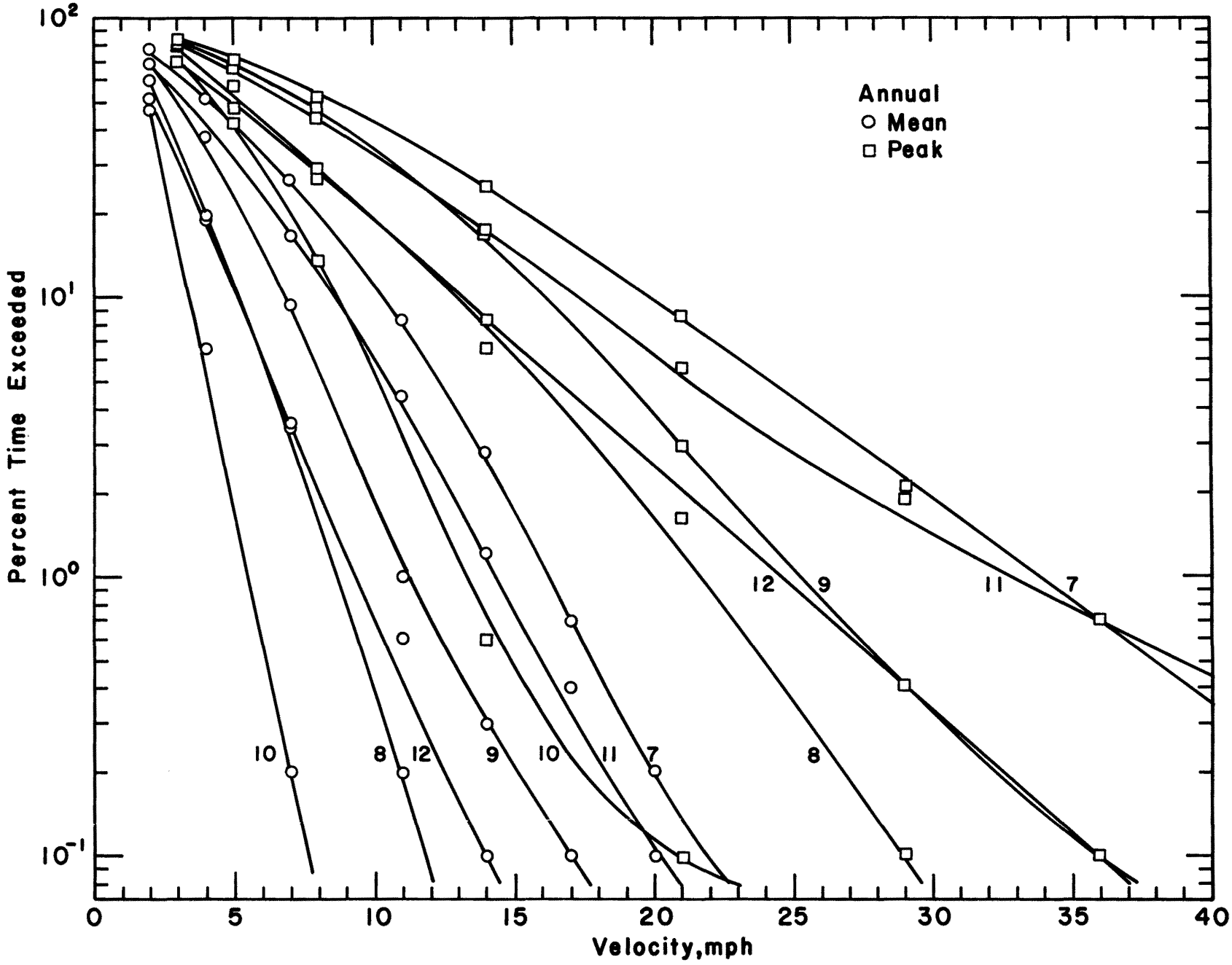


FIGURE 8b. Annual Expected Velocities at Locations 7-12.

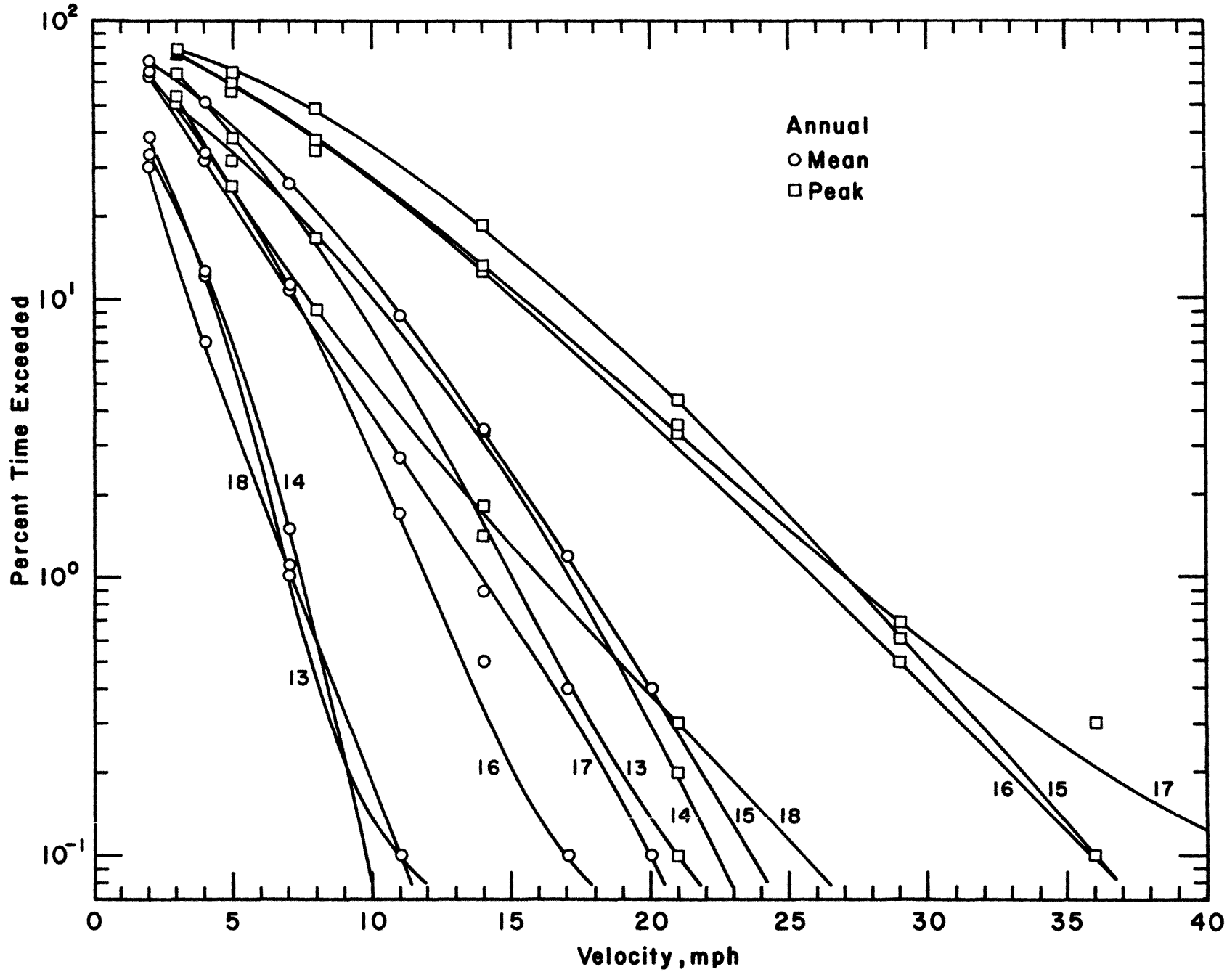


FIGURE 8c. Annual Expected Velocities at Locations 13-18.

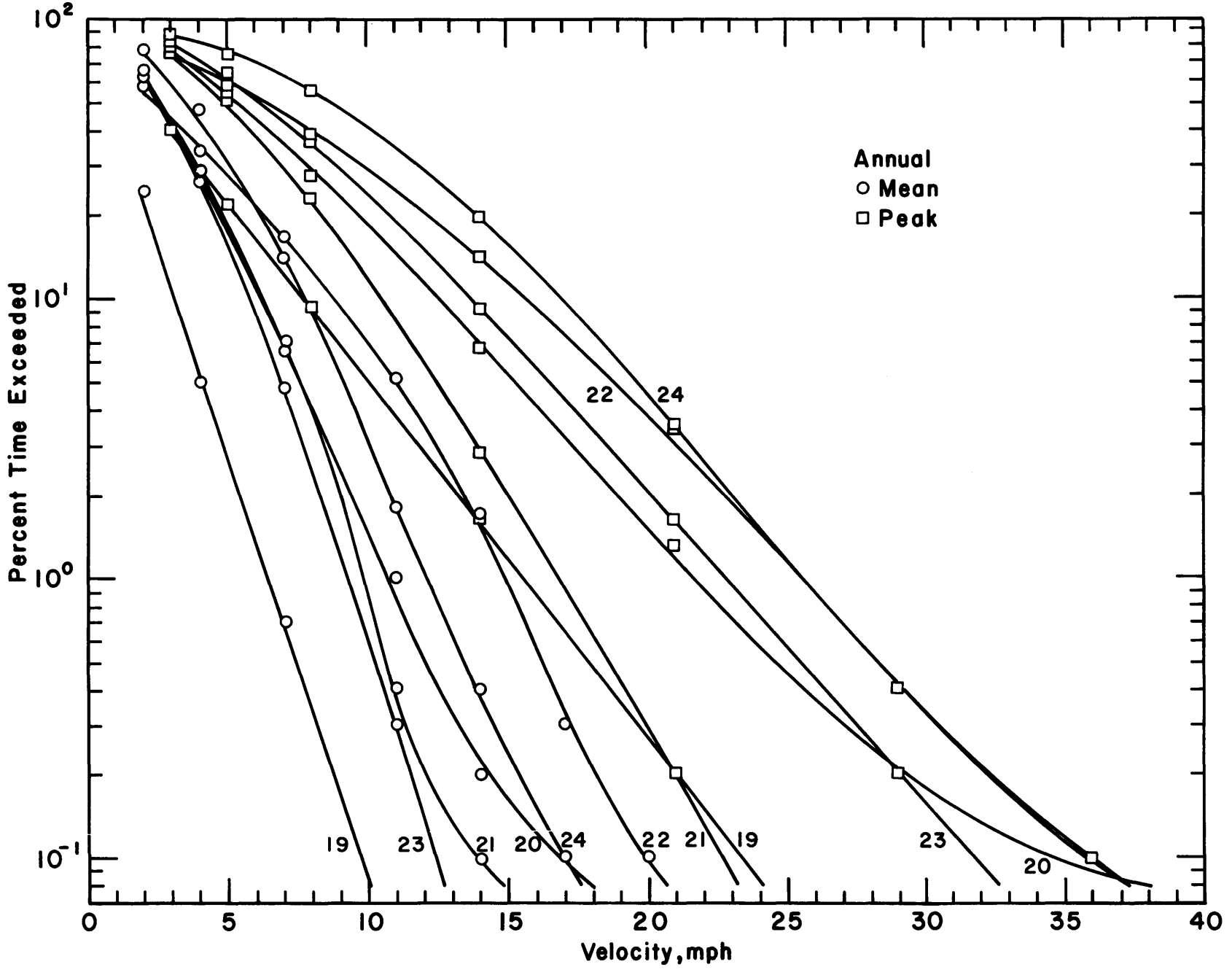


FIGURE 8d. Annual Expected Velocities at Locations 19-24.

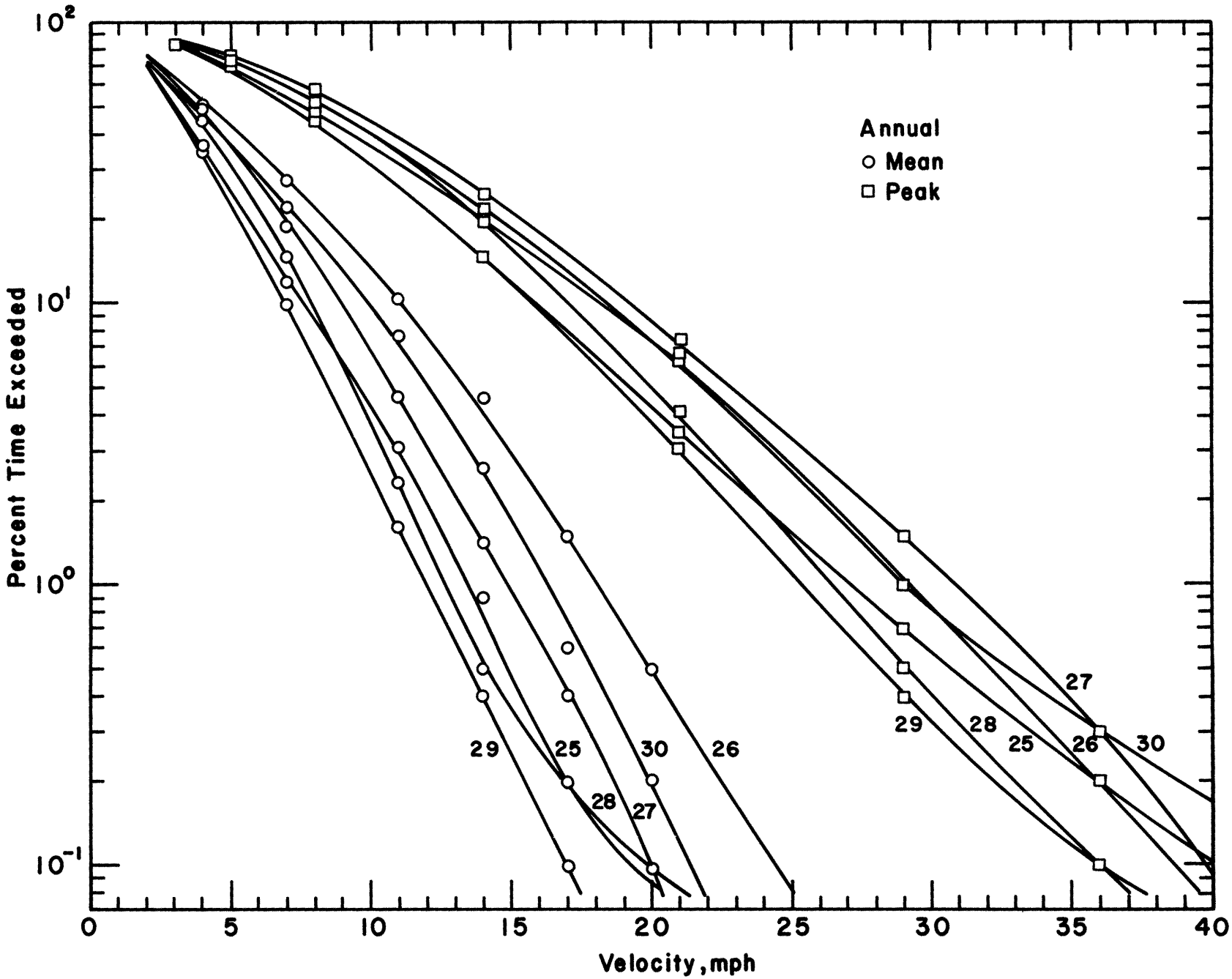


FIGURE 8e. Annual Expected Velocities at Locations 25-30.

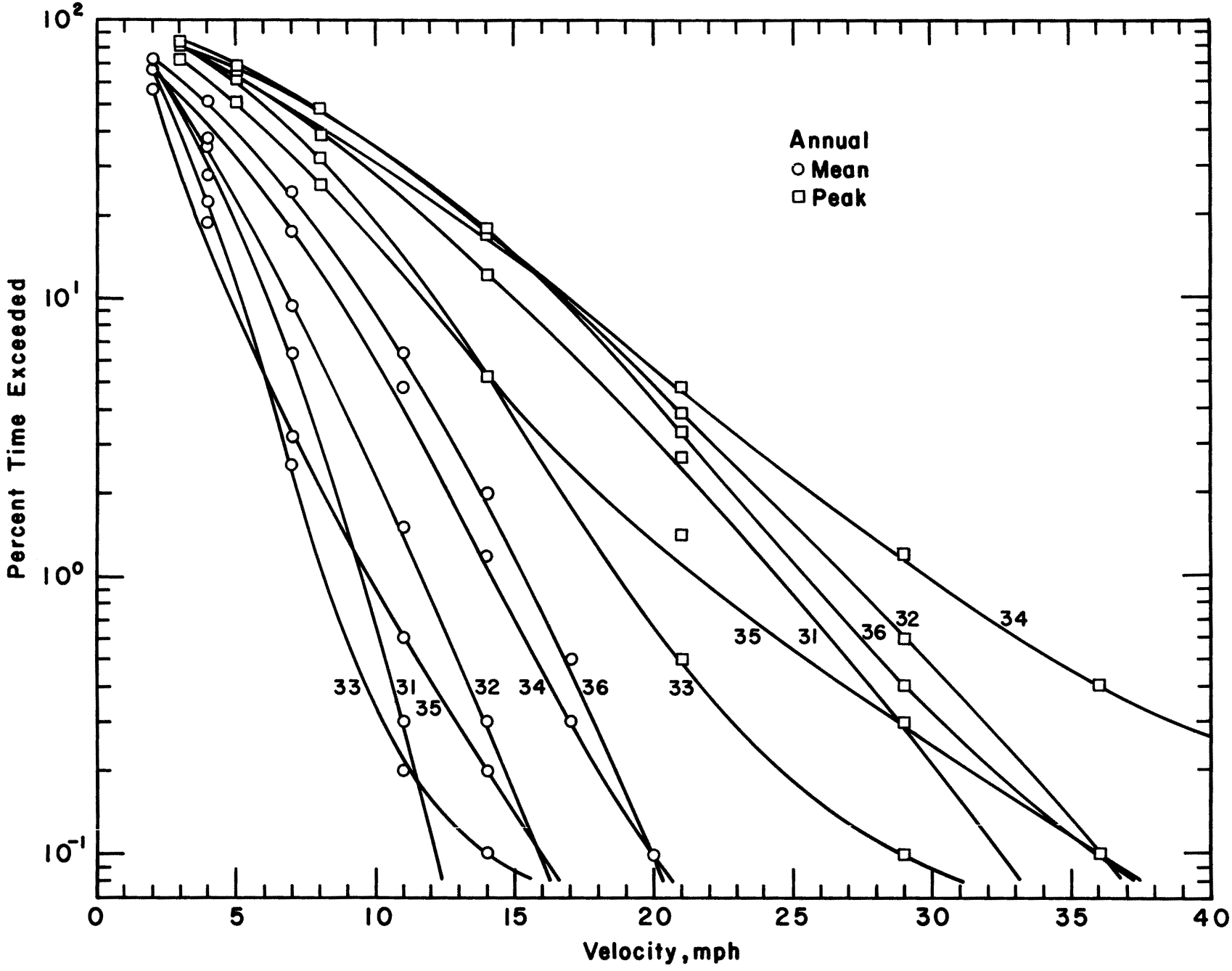


FIGURE 8f. Annual Expected Velocities at Locations 31-36.

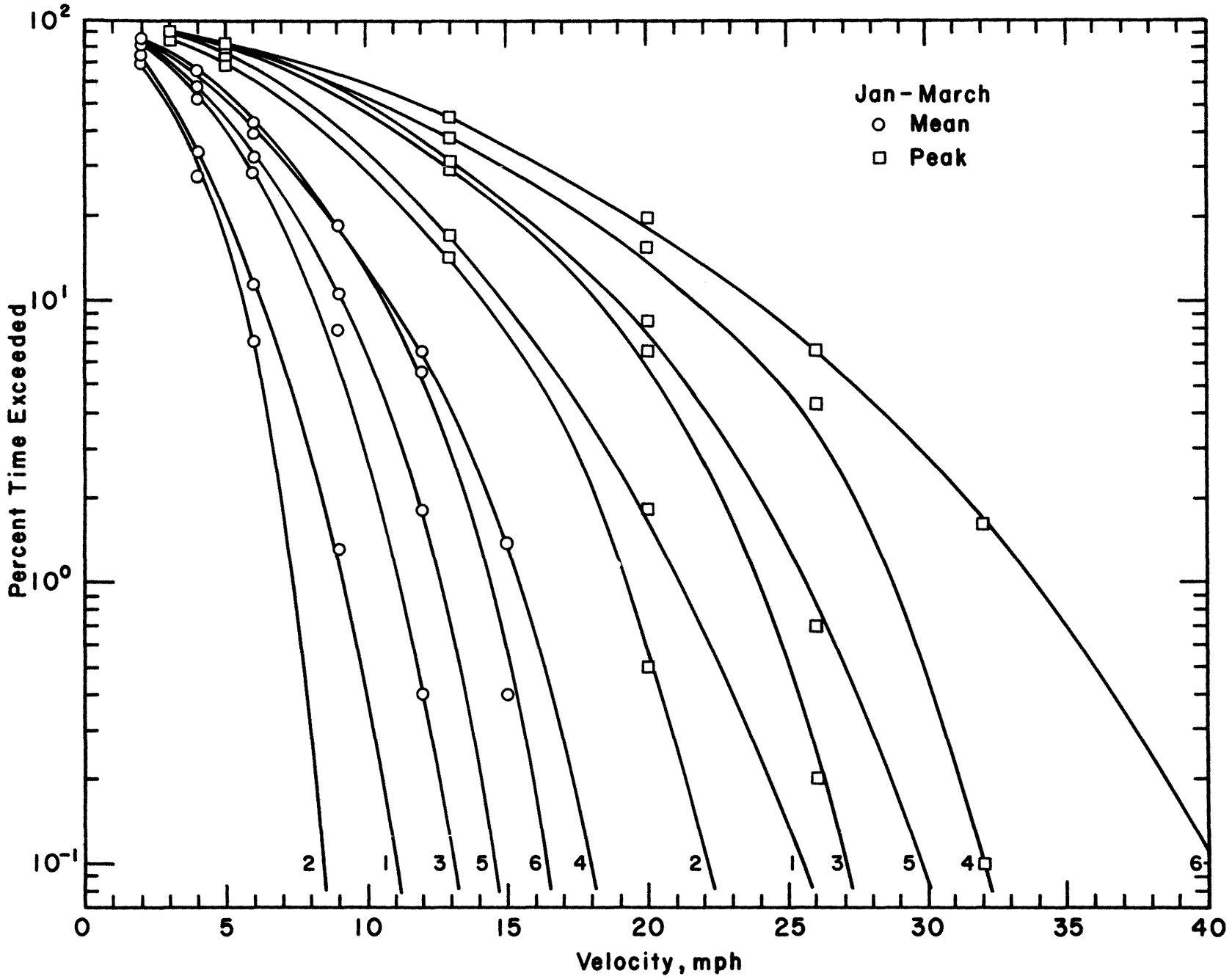


FIGURE 9a. Winter Expected Velocities at Locations 1-6.

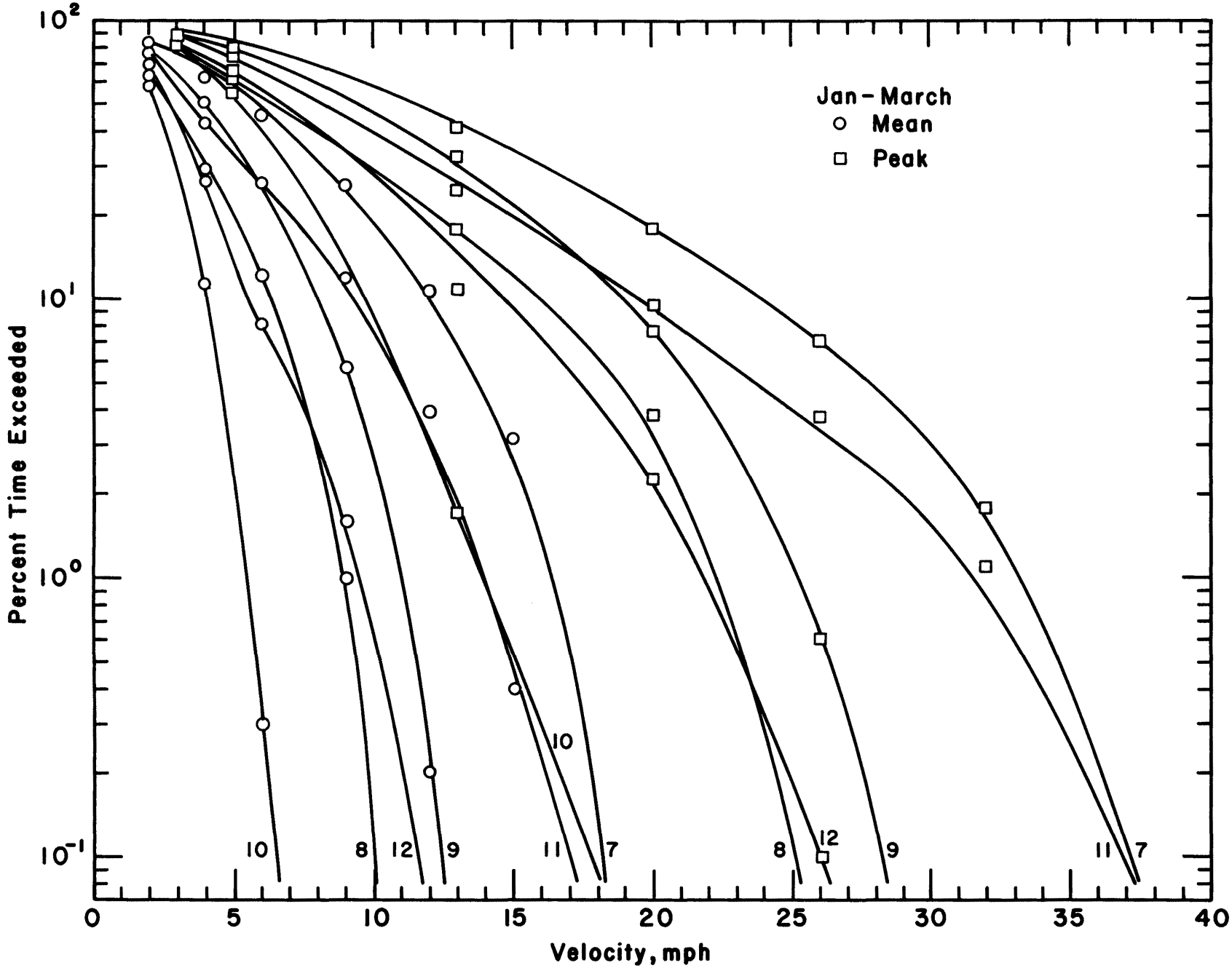


FIGURE 9b. Winter Expected Velocities at Locations 7-12.

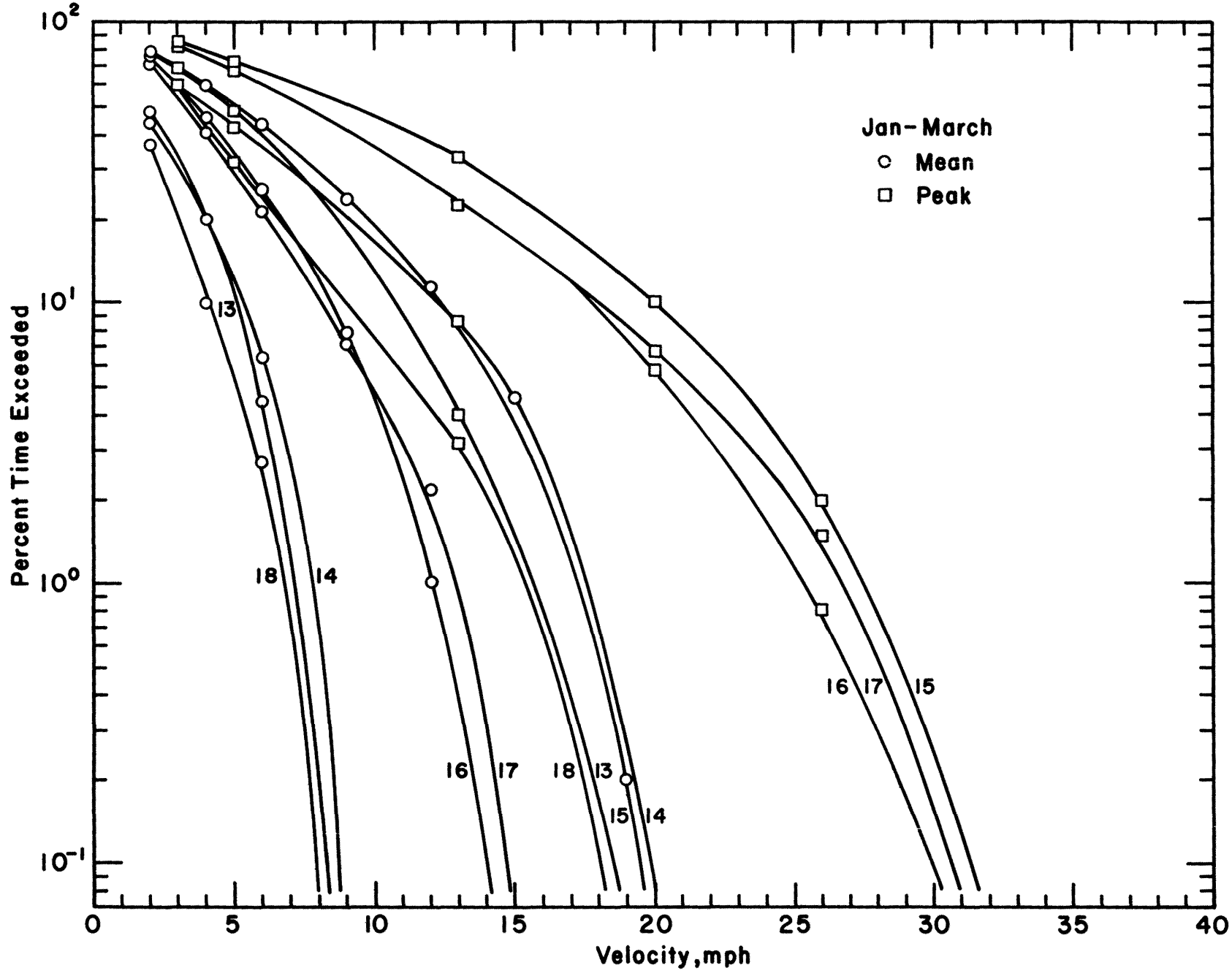


FIGURE 9c. Winter Expected Velocities at Locations 13-18.

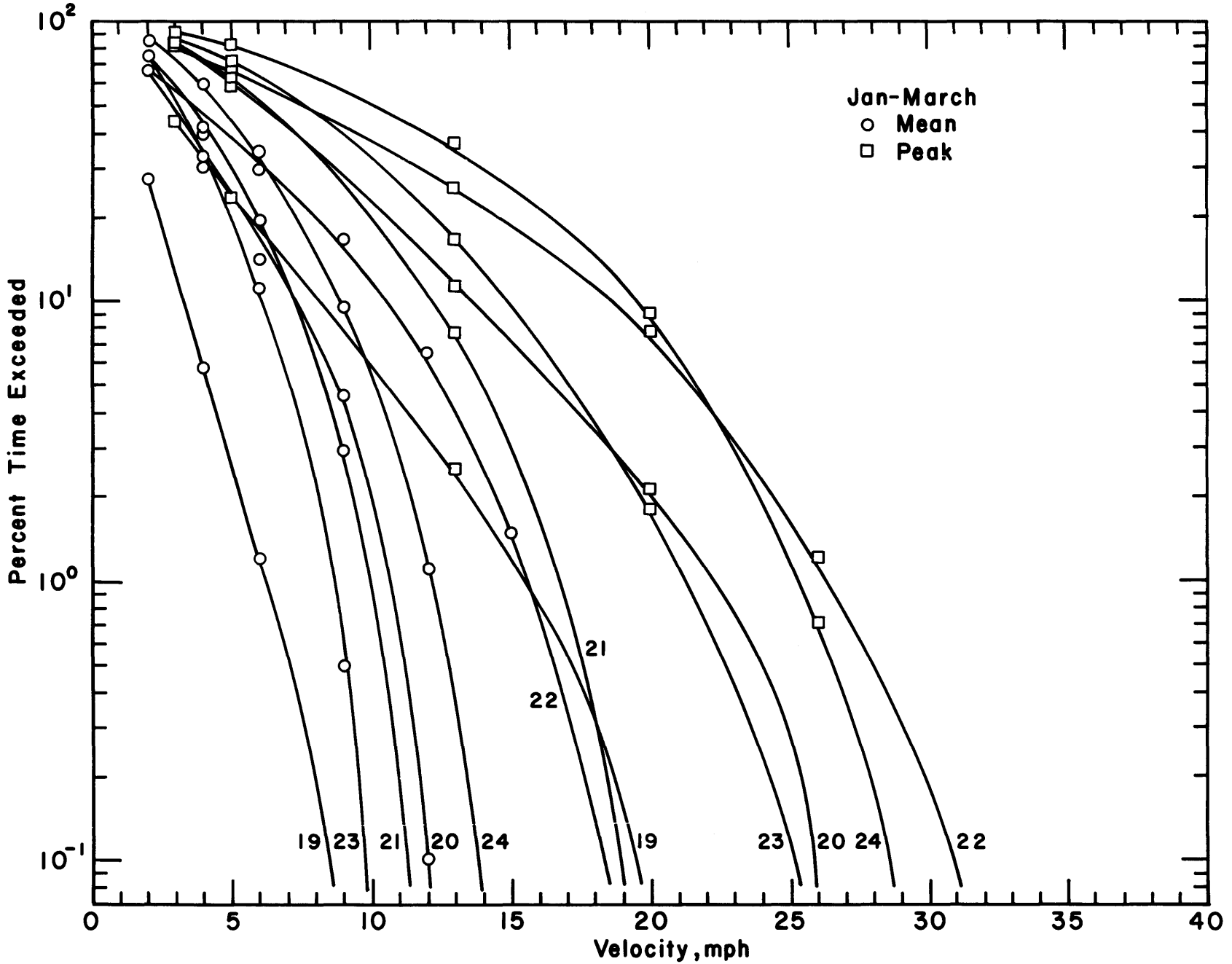


FIGURE 9d. Winter Expected Velocities at Locations 19-24.

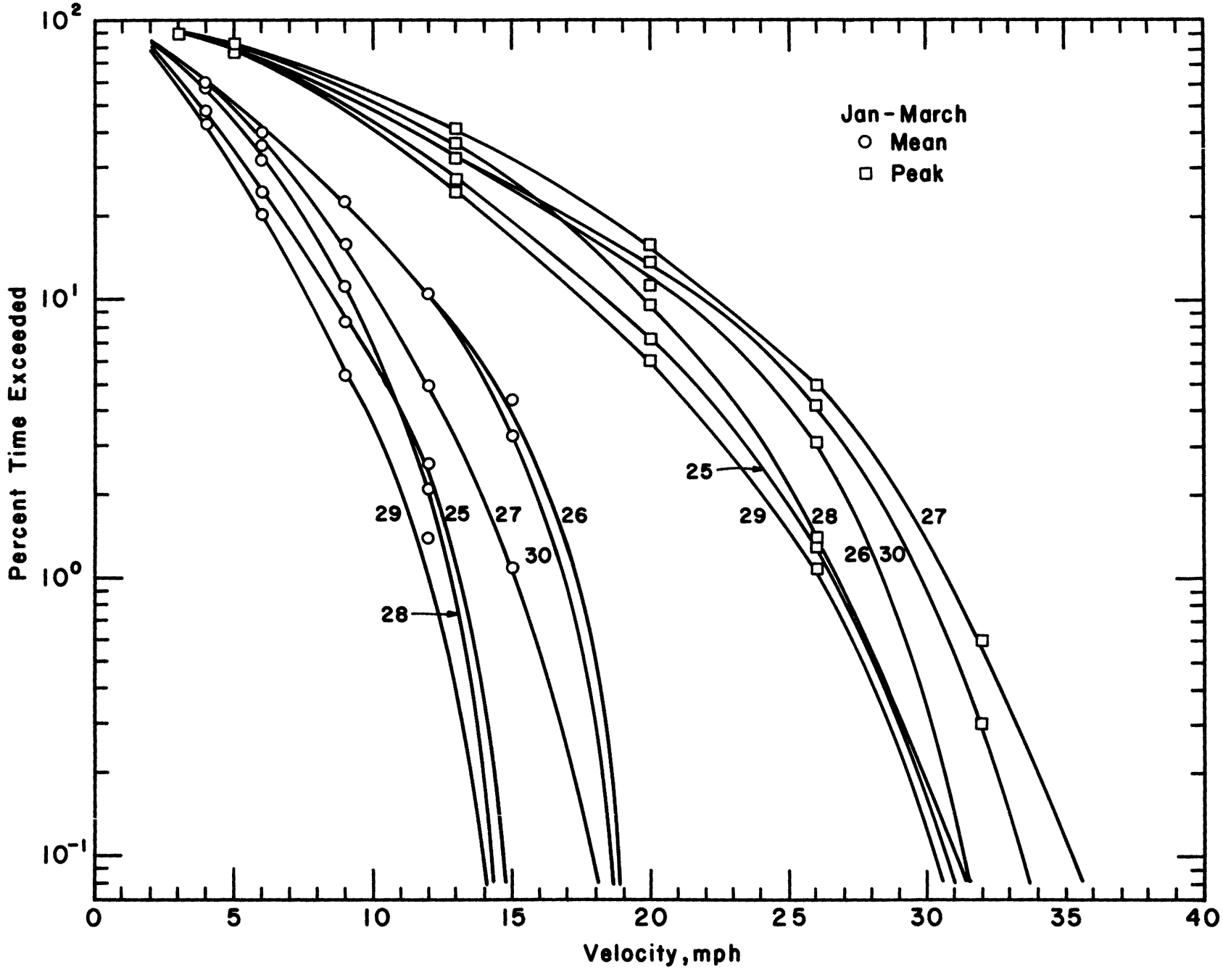


FIGURE 9e. Winter Expected Velocities at Locations 25-30

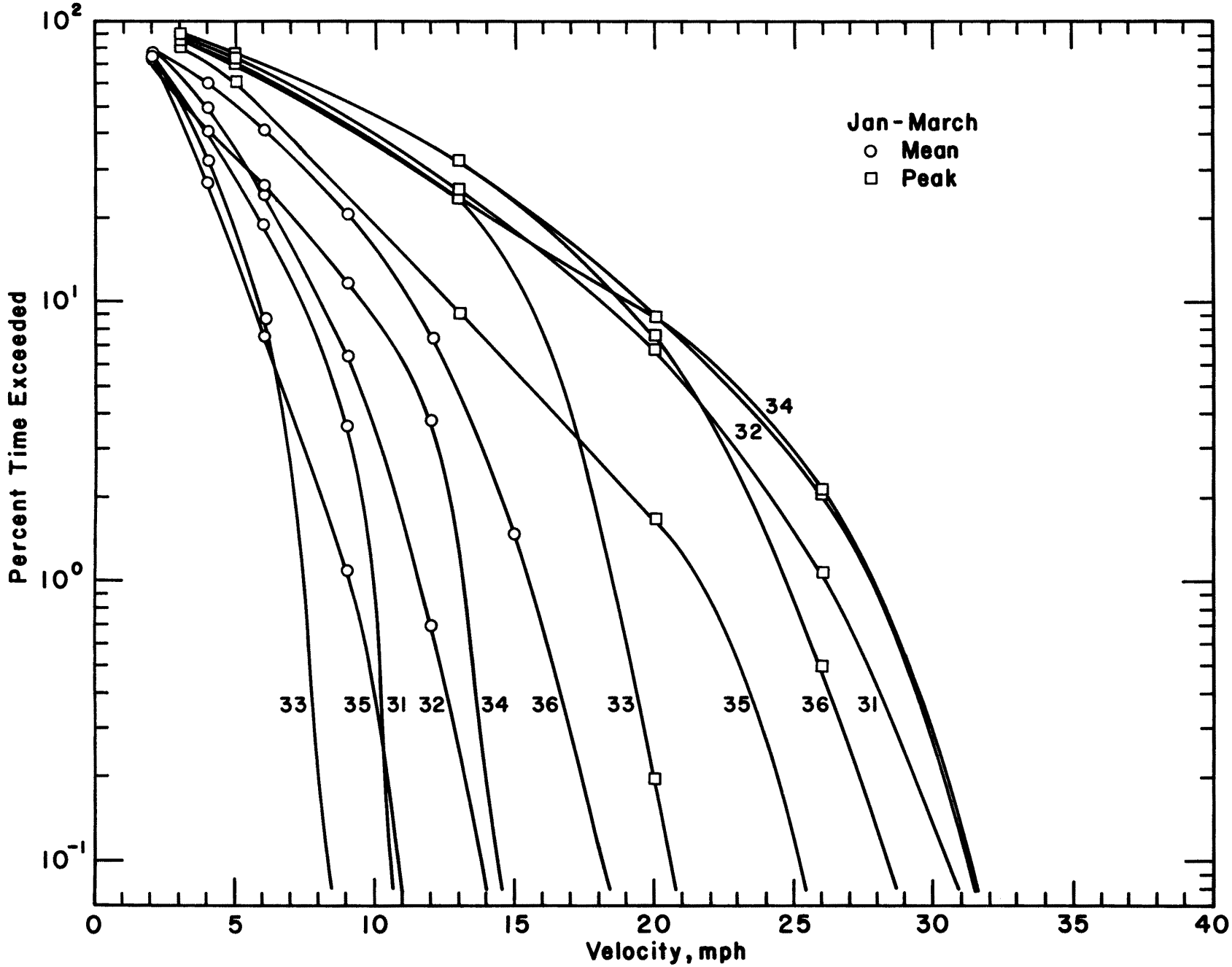


FIGURE 9f. Winter Expected Velocities at Locations 31-36.