REGION-3

U.S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45202

HAZARD EVALUATION AND TECHNICAL ASSISTANCE
REPORT NO. TA 77-79

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
WASHINGTON, D.C. 20410

FEBRUARY 1978

Study Requested By:
Assistant Secretary
Department of Housing and Urban Development

Report Written By:
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Study Dates: October 25-27, 1977

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I. SUMMARY

The National Institute for Occupational Safety and Health (NIOSH) conducted an environmental evaluation for carbon monoxide at the Department of Housing and Urban Development (HUD) Headquarter's Parking Garage on October 25-27, 1977. This evaluation was requested by HUD as a follow-up to Technical Assistance Project TA 76-61 performed May, 1976.

Results of the evaluation indicated higher carbon monoxide concentrations on October 26 as compared to October 27. This was apparently due to inclement weather on October 26 disrupting traffic flow from the garage, thus creating delays and extensive backing up of traffic. The highest concentrations measured were during the evening rush hour (5:00-6:00pm) when all three parking levels were cleared simultaneously. On October 26, peak measurements up to 300 parts per million (ppm) of carbon monoxide were recorded during this interval (5:00-6:00pm) which exceeded the NIOSH recommended ceiling of 200 ppm. Also, measurements taken throughout the day revealed various locations in the garage where a potential for overexposure could occur. At sampling locations 6, 7, 8, 11, and 19 the carbon monoxide levels average 41 to 56 ppm. On October 27, the environmental measurements did not indicate excessive carbon monoxide concentrations.

Biological monitoring data (breath samples) was collected on the parking attendants to estimate their personal exposure to carbon monoxide. The post-shift carboxyhemoglobin (COHb) determinations of the parking attendant personnel taken October 26 exceeded the 5 percent criterion. The amount of carbon monoxide absorbed by the two non-smoking attendants resulted in COHb levels of 6.7 and 7.3 percent. On October 27, the attendants had COHb levels near 5 percent, with the highest COHb level being 5.1 percent.

Recommendations are included in the report in the interest of maintaining a safe and healthful work environment.

II. INTRODUCTION

The Department of Housing and Urban Development (HUD) submitted a request for a follow-up survey regarding carbon monoxide (CO) exposure to employees in the HUD Parking Garage. A re-evaluation was requested due to conflicting results from studies conducted by the National Institute for Occupational Safety and Health (NIOSH) and the General Services Administration (GSA). Results of the NIOSH survey (TA 76-61) performed in May, 1976, indicated that a potential health hazard existed from excessive concentrations of carbon monoxide.[1]

A follow-up survey was performed by industrial hygienists, James Price and William Evans from the Hazard Evaluations and Technical Assistance Branch of NIOSH. Carbon monoxide levels were monitored on October 26 and 27, 1977 from 7:30am to 6:15pm. Data collected included: (1) CO measurements throughout the three parking levels, (2) carboxyhemoglobin determinations for parking attendants, (3) documentation of environmental controls, and (4) observations of work patterns.

III. EVALUATION

A. Description of Operations and Facility

The HUD Headquarters Parking Garage consists of three levels with 105,000 square feet (ft^2) of parking space (35,000 ft^2 per level). Based upon the exhaust capacity of the ventilation system (156,000 cubic feet per minute) and the District of Columbia ventilation regulations, GSA calculates the parking capacity of the garage to be 312 automobiles. This value is derived from Section 503.146 of the District of Columbia code which requires an exhaust volume of 500 cubic feet per minute (cfm) per automobile during active periods (frequent traffic) and 350 cfm per automobile during periods of low activity.[2] (Section 503.146 of the District of Columbia Code is used as a guideline by GSA for government facilities. Currently there is not a Federal standard for parking garages.)

During the survey dates of October 26-27, 1977, the number of automobiles parked in the garage totaled 381 and 390, respectively. The distribution of automobiles was fairly even throughout the three levels, with a range of 122-136 automobiles per level. Personnel exposed in the garage included three parking attendants (one attendant per level) and approximately 1000 car-pool members. The duration of exposure per day varied from about 30 minutes for the car-pool members to 9-10 hours for the parking attendants. The parking attendants' working hours were 7:30am to 5:30pm and 8:30am to 5:30pm.

Traffic began to enter the garage at 8:00am, with a continuous flow during the period of 8:15-9:15am. Between the hours of 9:30am-5:00pm the traffic activity was low with about 25 automobiles either entering or leaving the garage. At 5:00pm traffic started departing the garage with a continuous flow from 5:05-5:55pm.

On October 26, inclement weather affected traffic flow out of the garage creating delays and extensive backing up of traffic throughout the area. While most of the automobiles departed by 5:40pm on October 27, the rainy weather on October 26 caused a back-up of traffic from 5:20-5:55pm, which finally dissipated by 6:00pm. It should be noted that approximately 70 percent of the automobiles departed the garage during this heavy traffic period. The remaining automobiles departed up to 7:00pm, at which time the garage was closed.

B. Environmental Controls

The ventilation system is composed of two air handling units with an exhaust capacity of 78,000 cfm per unit. Most of the air is exhausted through two ducts positioned near the center of each parking level. An additional ten exhaust ducts (per level) are located six to eight feet above the floor along the center area and East wall of the garage. Air supplied to each level is provided by 12 supply ducts mounted 6 to 8 feet above the floor along the garage West wall. Refer to Figures I, II, and III for a schematic diagram of the supply and exhaust duct work.

Throughout the evaluation the ventilation system operated continuously from 7:00am to 6:00pm. In contrast, during the initial evaluation on May 19, 1976, the computer scheduling of the ventilation system was for continuous operation from 8:00-10:00am and 4:30-6:00pm, and for 15 minutes operation every one-half hour from 5:00-8:00am and 10:00am-4:30pm; the system was off during the period of 6:00pm-5:00am. In addition, only one of the air handling units was operating throughout the initial evaluation.

C. Evaluation Design and Methods

Employee exposure to carbon monoxide was evaluated using the following methodology: (1) direct reading measurements to instantaneously determine the contaminant concentration, (2) long-term sampling to determine the integrated CO concentration, (3) breath-hold technique to estimate the percent of carboxyhemoglobin, and (4) ventilation measurements of the exhaust and air supply systems.

1. Instantaneous measurements of the existing CO levels were taken in the general work area and near the employees' breathing zone. Instrumentation employed for these measurements included the Ecolyzer Model 2400* and the Drager* gas detector tube units. The Drager tubes were certified to have an accuracy of ±35 percent at one-half the exposure limit and ±25 percent at 1 to 5 times the exposure limit.[3] The Ecolyzer was calibrated periodically during the evaluation to ensure an accuracy within ±5 percent.

*Mention of commercial names or products does not constitute endorsement by NIOSH.

2. Long term sampling was performed to determine the approximate concentration of CO at various locations throughout the garage. The sampling strategy involved the collection of samples in areas frequented by employees and at specific sites considered to characterize the general air quality of the garage. The floor diagram of the garage illustrated in Figures I, II, and III, denotes the location of each sampling point. At sampling point 1, the level of CO was measured continuously during the day using an Ecolyzer in conjunction with a strip-chart recorder. At locations 2 through 20, bag samples of air were collected over periods of 0.5 to 2 hours throughout the day. The sampling train consisted of tygon tubing in series with a vacuum pump modified to accommodate a 30 liter mylar bag. Air collected in each bag was subsequently analyzed for CO content using the Ecolyzer.

3. The extent of exposure of the parking attendants to carbon monoxide was also evaluated with an expired air analysis method using a breath-hold technique.[4] The concentration of CO in the expired air provided an index of the percent of hemogloblin (Hb) bound as carboxyhemoglobin (COHb). In this procedure, the subject exhaled completely, filled his lungs rapidly and held for 20 seconds while being timed, then exhaled a small portion (several hundred milliliters) into the ambient air, and blew the remainder into an evacuated bag. The former maneuver was necessary since the expired air contained unequilibrated gas from the pulmonary dead space. The CO level in the exhaled air was measured in parts of CO per million parts of air by volume with an Ecolyzer. The COHb level in percent saturation was calculated using Ringold's equation:[4]

$$\text{COHb\%} = 0.5 + \frac{\text{CO in ppm}}{5}$$

Pre-, mid-, and post-shift breath analysis samples were collected from the parking attendants. The smoking habits of the employees were recorded.

4. Ventilation measurements were taken at the exhaust and air supply grills in the garage using a Sierra Thermalanemometer Model 440. Measurements were made at each grill with the instrument probe held at the estimated center of equal area rectangles covering the grill face. The number of measurements taken at each grill varied according to the grill size.

D. Toxic Properties of Carbon Monoxide

Carbon monoxide is a colorless, odorless, tasteless gas and consequently gives no warning of its presence. Inhalation of CO causes asphyxiation by combining with Hb to form COHb, thereby interfering with the oxygen carrying capacity of the blood.[5] The effects of CO exposure on man is increased by duration of exposure, high environmental temperatures, and work effort (oxygen demand). Symptoms such as headache, nausea, fatigue, and dizziness appear in healthy workers engaged in light labor near sea level when about 10 percent of the Hb is combined with CO. Such a degree

of saturation could be achieved by continually breathing air containing 50 ppm of CO for about six to eight hours. Disturbance of coordination, judgment, psychomotor tasks and visual acuity appear at about 2 percent COHb but do not become significant until about 5 percent COHb saturation is reached.

The medical criteria used to evaluate the breath analysis data was 5 percent COHb as recommended by NIOSH[5]. The 5 percent COHb criteria only applies to occupational exposure and does not take into account smoking. The blood of cigarette smokers may contain between 3 and 10 percent COHb depending on the number of cigarettes smoked and the manner of smoking, inhaling or not inhaling.[6] The COHb of non-smokers is approximately 0.5-0.8 percent.

E. Environmental Evaluation Criteria

Airborne exposure limits intended to protect the health of workers have been recommended or promulgated by several sources. These limits represent conditions under which it is believed that nearly all workers may be repeatedly exposed to a substance on an 8-hour per day, 40-hour per week basis without adverse effects. The criteria used in this investigation were selected from the following sources: (1) airborne exposure limits which NIOSH has recommended to OSHA for occupational health standards, (2) Threshold limit Values (TLV's) for 1977 and their supporting documentation as set forth by the American Conference of Governmental Industrial Hygienists (ACGIH), and (3) Occupational Health Standards as promulgated by the U.S. Department of Labor (Federal Register, 29 CFR 1910, pp. 506, January 1, 1976). The exposure limits cited by the various sources for carbon monoxide are presented below:

Source	Time-Weighted Average Exposure Limit (ppm)*	Ceiling Value (ppm)*
NIOSH	35	200**
TLV	50	
OSHA	50	

* Denotes parts of contaminant per million parts of air by volume (ppm).
** Designates a ceiling value which should not be exceeded at any time. All other values presented in the table are permissable exposure levels based on an 8-hour time-weighted average.

The NIOSH recommended standard for CO is given prominence in this evaluation since it is considered to be the most appropriate health criteria.

F. Evaluation Results and Discussion

1. Environmental Sampling

On October 26, 1977, the concentration of CO at levels 1, 2, and 3 averaged 33, 33, and 28 ppm, respectively. The average concentration at the various sampling locations ranged from 20 to 56 ppm, with five of the locations (sampling points 6, 7, 8, 11, and 19) exceeding the NIOSH recommended standard of 35 ppm. The highest concentration of CO occurred during the late afternoon when most of the traffic was departing the garage. The ceiling value of 200 ppm (proposed by NIOSH) was met or exceeded at locations 1, 7, and 8, where the peak measurements ranged from 200 to 300 ppm. At locations 7 and 11, the concentrations averaged 190 to 200 ppm during the interval of 4:45 to 6:05pm. (Refer to Tables I, II, and III for results of the environmental sampling.)

The concentration of CO on October 27 was lower than on October 26. On October 27, the concentration of CO at levels 1, 2, and 3 averaged 20. 16, and 17 ppm, respectively. Of the 20 sampling points monitored the highest average concentration recorded was 29 ppm at location 1. Also peak concentrations were generally lower with 150 ppm being the highest peak measured.

2. Biological Sampling

While the environmental samples did not represent personal exposures, they did reveal that a potential problem may exist whenever employees work under the conditions observed October 26. Biological monitoring of the parking attendant personnel did confirm this point. From the post-shift expired air samples (Table IV) it was found that the non-smoking attendants were exposed to sufficient CO concentrations to cause the NIOSH recommended criteria of 5 percent COHb to be exceeded. Carboxyhemogloblin values of 6.7 and 7.3 percent were recorded for these individuals. Since the contributions of CO from the work environment and smoking habits cannot be readily discerned, the data on the non-smoker was used only to evaluate the workers exposure to CO. The level of COHb for the smoker was 10.1 percent.

On October 27, the COHb levels were lower with the post-shift values ranging from 4.7 to 5.1 percent COHb. These values are essentially equal to the NIOSH recommended limit of 5 percent COHb.

3. Ventilation

Ventilation measurements were taken to approximate the volumes of air mechanically supplied and exhausted at the garage. As illustrated in Table V, considerably more air was exhausted from levels 1, 2, and 3 than was supplied through the duct work. These measurements indicated that about 115,000 cfm was supplied into the area and about 200,000 cfm was exhausted. The approximate volume of air supplied and exhausted at each level was as follows:

Level 1 - 42,000 cfm supplied, 63,000 cfm exhausted;
Level 2 - 51,000 cfm supplied, 71,000 cfm exhausted;
Level 3 - 21,000 cfm supplied, 68,000 cfm exhausted.

The ventilation survey also revealed areas where stagnant air could exist. The volume of air exhausted through ducts C, D, E, F, and G on Level 1, and H and I on level 2 was 100 cfm or less. Since these ducts have a proximity relationship (especially ducts C through G) the probability of stagnant air formations is likely.

G. Conclusions

Based on environmental and biological monitoring it was concluded that excessive concentrations of carbon monoxide were present under the conditions observed October 26, 1977. While the average concentration of CO at levels 1, 2, and 3 were within the recommended limit of 35 ppm, there were various locations in the garage where potential over-exposure could occur. At locations 6, 7, 8, 11, and 19 the average CO levels ranged from 41 to 56 ppm. Peak measurements were also excessive with CO concentrations up to 300 ppm being recorded.

Results of the post-shift carboxyhemogloblin determinations were consistent with the environmental findings. Parking attendant personnel were exposed to sufficient concentrations of carbon monoxide to produce carboxyhemogloblin values in excess of the NIOSH recommended criteria of 5 percent. The amount of CO absorbed by the non-smokers resulted in COHb levels of 6.7 and 7.3 percent. Although this is not generally considered to be a hazardous range, it does indicate appreciable absorption of carbon monoxide.

On October 27 the ambient conditions in the garage were improved. The biological monitoring did indicate COHb levels (4.9-5.1 percent COHb) at the recommended limit, however the environmental measurements were within acceptable criteria. The improved conditions were due to fewer delays and less traffic congestion during the evening rush period (5:00-6:00pm) as compared to October 26.

Observations of the ventilation system were noted during the survey. The ventilation measurements indicated a large discrepancy between the amount of air mechanically supplied and exhausted at the garage. Since the ventilation system exhausted appreciably more air than that supplied, a strong negative pressure was created thus causing the balance of make-up air to be drawn through the garage doors. Also, the ventilation survey revealed areas in the garage where stagnant air could exist. The most notable area was level 1 where several ducts at the same location were exhausting insufficient volumes of air.

IV. RECOMMENDATIONS

1. GSA should conduct a ventilation survey in the HUD headquarters garage to more accurately evaluate the capacity of the ventilation system. The following points should be considered:

a. The number of automobiles on October 26-27, 1977 exceeded the designed parking capacity of the garage by approximately 25 percent.

b. Ventilation measurements taken during the NIOSH environmental survey indicated a strong negative pressure created by the ventilation system. While a slight negative pressure should be maintained to prevent contamination of adjoining areas, excessive pressure gradients would reduce the efficiency of the exhaust system.

c. The balance of make-up air drawn through the garage doors (to compensate for the negative pressure) is not fully utilized. Much of this air is not sufficiently dispersed in the area to effectively facilitate contaminant removal.

d. At locations where the ventilation system is not exhausting sufficiently (i.e., locations C-G on level 1, and H-I on level 2) the exhaust volume should be increased to prevent occurrence of stagnant air.

2. Additional recommendations are included to ensure conditions creating the unacceptable CO exposures on October 26 do not re-occur.

a. During the evening rush period departure times should be staggered to decrease the elevated CO concentrations.

b. Capacity of the ventilation system should be increased in the event that: (1) all parking levels will continue to be evacuated simultaneously, and (2) the garage parking capacity is exceeded.

c. During periods of traffic congestion, needless idling of engines should be stopped.

d. A patrolman directing traffic from the garage ramp onto Seventh Street would reduce traffic delays.

e. The ventilation system should continue to operate until the garage is closed in the evening.

V. REFERENCES

1. Seta, J., Health Hazard and Technical Assistance Report No. TA 76-61, NIOSH, 1976.

2. Carbon Monoxide Study conducted in the Department of Housing and Urban Development Parking Garage, Report prepared by the Accident and Fire Prevention Branch, GSA, dated June 10, 1977.

3. NIOSH Certified Equipment, HEW Publication No. (NIOSH) 76-145, 1975.

4. Ringold, A., et. al., Estimating Recent Carbon Monoxide Exposures - A Rapid Method. Archives of Environmental Health 5:308, (1962).

5. Criteria for a Recommended Standard...Occupational Exposure to Carbon Monoxide, 1972. HEW Publication (NIOSH) HSM 73-11000.

6. Hutchison, M.D., A Guide to Work-Relatedness of Diseases. HEW Publication No. (NIOSH) 77-123.

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Table I

Results of Air Sampling for Carbon Monoxide

Department of Housing and Urban Development
Washington, D.C.

October 26, 1977

Location	Concentration (ppm)*					
	0730-0900	0900-1030	1200-1330	1400-1530	1645-1805	Average
1	23	18	7	6	85	28
2	20	29	5	7	37	20
3	60	13	5	6	74	32
4	57	29	5	6	71	34
5	15	17	6	6	82	25
6	15	27	15	8	140	41
7	11	35	13	8	200	53
						33
	0740-0910	0910-1130	1215-1345	1425-1550	1645-1805	Average
8	30	28	10	7	130	41
9	31	33	11	7	65	29
10	26	28	9	11	71	29
11	39	30	10	11	190	56
12	33	28	9	6	55	26
13	34	26	10	7	70	29
14	28	30	7	8	30	21
						33
	0750-0920	0920-1145	1230-1400	1440-1610	1645-1805	Average
15	39	25	8	10	70	30
16	28	25	8	7	45	23
17	40	26	8	9	22	21
18	29	26	7	6	60	26
19	29	27	12	8	140	43
20	24	25	8	7	51	23
						28

*OSHA Standard - 50 parts of carbon monoxide per million parts of air by volume (50 ppm)

Table II

Results of Air Sampling for Carbon Monoxide

Department of Housing and Urban Development
Washington, D.C.

October 27, 1977

Location	Concentration (ppm)*					
	0745-0945	1015-1045	1300-1340	1530-1615	1655-1810	Average
1	29	**	**	8	51	29***
2	24	6	8	9	39	17
3	26	7	7	9	37	17
4	31	7	8	9	31	17
5	24	7	8	7	39	17
6	38	10	9	9	63	26
7	****	10	9	9	54	20***
						20
	0750-0950	1030-1100	1305-1345	1540-1620	1655-1810	Average
8	26	7	8	8	35	17
9	20	6	8	8	28	14
10	22	6	8	8	35	16
11	23	6	8	8	35	16
12	30	6	7	8	24	15
13	44	5	8	15	35	21
14	25	5	8	8	32	16
						16
	0755-0955	1100-1130	1315-1400	1545-1625	1655-1810	Average
15	22	6	9	8	51	19
16	20	6	9	8	31	15
17	15	5	9	15	46	18
18	25	5	9	8	40	17
19	32	5	8	8	28	16
20	20	7	8	8	34	15
						17

* OSHA Standard - 50 parts of carbon monoxide per million parts of air by volume (50 ppm)
** Sample not taken
*** Average skewed due to reduced number of data points
**** Sampling bag ruptured

Table III

Carbon Monoxide Measurements Taken With Drager Indicator Tubes

Department of Housing and Urban Development
Washington, D.C.

October 26-27, 1977

Date	Location	Sample Time	Concentration (ppm)*
10/26/77	Air Supply**	1545	5
	Air Supply	1715	9
	Level 2 - Near location 8	1717	200
		1721	200
	Level 3 - Near location 15	1717	80
	Breathing zone of parking attendant	1720	100
	Level 1 - Approximately 20 feet from location 2	1725	200
	Location 1	1728	190
	Level 2 - Within 20 to 30 feet of location 8	1731	250
	Within 20 to 30 feet of location 8	1735	200
	Within 20 to 30 feet of location 8	1740	300
	Level 3 - Near location 15	1800	70
10/27/77	Level 3 - Breathing zone of parking attendant	0820	10
	Air Supply	0830	5
	Air Supply	1330	8
	Level 1 - Near location 1	1730	150
	Air Supply	1730	5-10

* PPM - parts of carbon monoxide per million parts of air by volume
** Measurements taken at air supply grill outside of building

Note: OSHA has not established a ceiling value for carbon monoxide.

Table IV

Expired Air Carbon Monoxide and Carboxyhemoglobin (COHb) Level

Department of Housing and Urban Development
Washington, D.C.

October 26-27, 1977

			Pre-Exposure		Mid-Exposure		Post-Exposure	
Date	Job Classification	Smoker	Time	% COHb	Time	% COHb	Time	% COHB
10/26/77	Parking Attendant - Level 1	no	0750	2.9	1210	3.5	1730	6.7
10/26/77	Parking Attendant - Level 2	no	0845	3.7	1230	4.5	1730	7.3
10/26/77	Parking Attendant - Level 3	yes*	0730	3.3	1230	4.3	1730	10.1
10/27/77	Parking Attendant - Level 1	no	0730	3.3	1200	4.3	1740	4.9
10/27/77	Parking Attendant - Level 2	no	0845	3.5	1200	4.5	1740	5.1
10/27/77	Parking Attendant - Level 3	yes*	0800	3.5	1200	3.7	1730	4.7
	NIOSH Environmental Criteria							5% COHB

* Parking attendant (Level 3) smoked three cigars on 10/26/77 and 2 cigars on 10/27/77

Table V

Results of Ventilation Measurements Taken at the Supply and Exhaust Grills Located on Levels 1, 2, and 3

Data Reported in Cubic Feet Per Minute (cfm)*

Department of Housing and Urban Development
Washington, D.C.

October 27, 1977

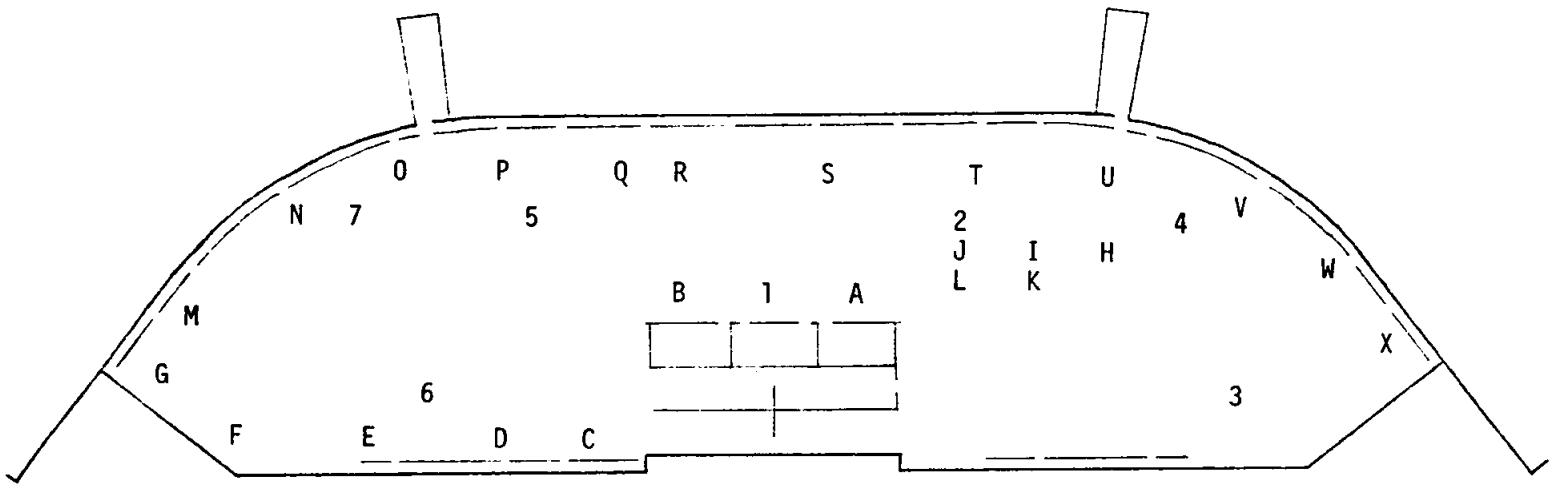
	Level 1		Level 2		Level 3	
Location	Supply	Exhaust	Supply	Exhaust	Supply	Exhaust
A		26,000		600		1,100
B		30,000		1,000		1,600
C		100		1,500		700
D		<100		1,000		400
E		<100		1,100		800
F		100		25,000		25,000
G		<100		36,000		33,000
H		2,000		100		500
I		1,200		<100		1,000
J		1,200		600		1,200
K		1,300		2,000		1,100
L		1,100		1,800		1,500
M	400		4,100		1,600	
N	400		4,800		1,400	
O	200		4,800		1,200	
P	5,100		4,400		1,800	
Q	4,700		4,100		2,100	
R	7,600		2,200		2,200	
S	1,900		4,600		1,100	
T	2,700		5,300		2,100	
U	6,900		4,400		1,300	
V	5,100		3,700		2,000	
W	3,300		3,800		1,200	
X	3,400		4,600		2,500	

*Measurements presented in the table are approximate values. Probe was held at the estimated center of equal area rectangles covering the entire grill. The number of measurements taken at each grill varied according to grill size.

Figure I

Dual-Purpose Diagram
Schematic of Supply and Exhaust Duct Work, and Location of Air Sampling Points
Parking Level 1

Department of Housing and Urban Development
Washington, D.C.

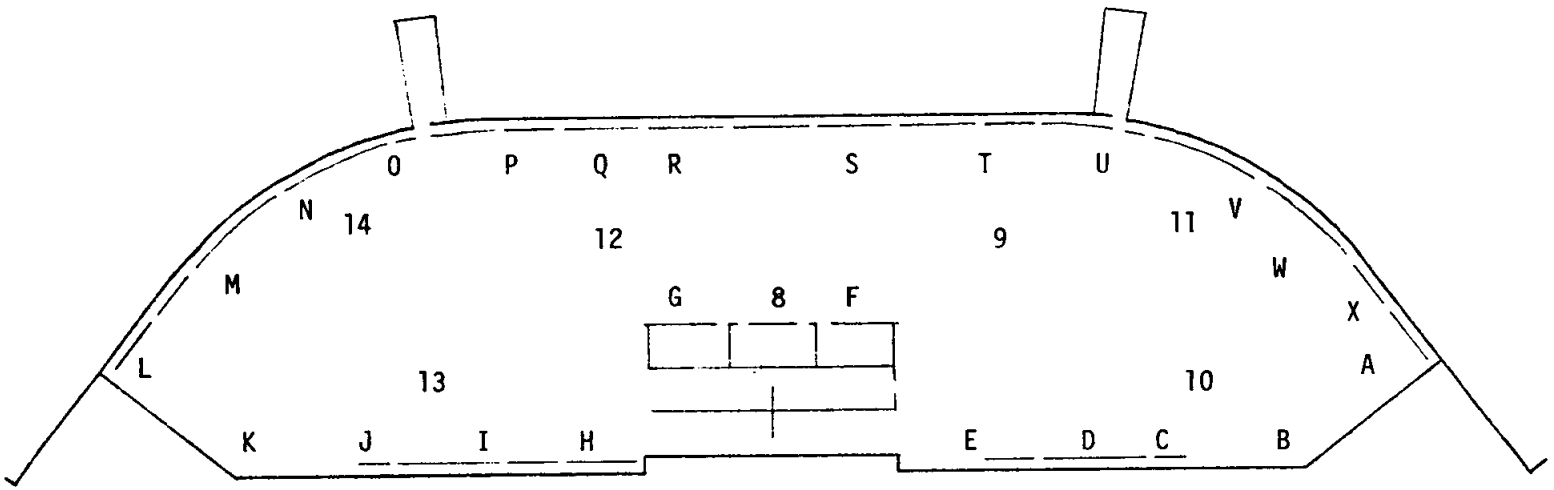


1-7 Air Sampling Points
A-L Exhaust Duct Work
M-X Supply Duct Work

Figure II

Dual-Purpose Diagram
Schematic of Supply and Exhaust Duct Work, and Location of Air Sampling Points
Parking Level 2

Department of Housing and Urban Development
Washington, D.C.

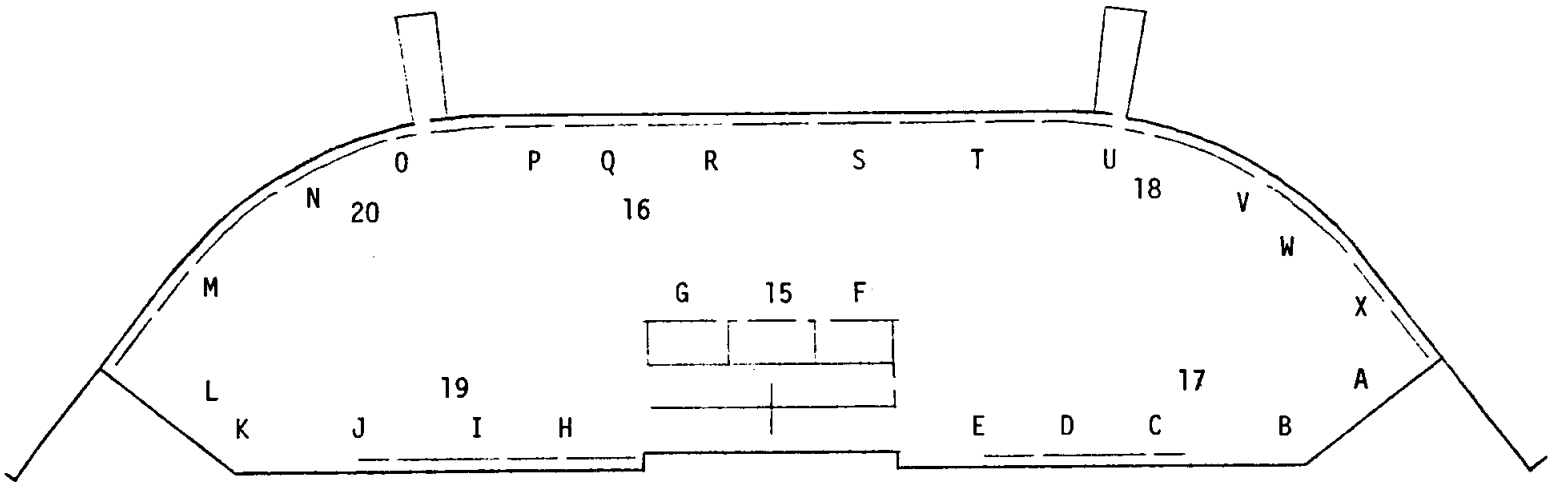


8-14 Air Sampling Points
A-L Exhaust Duct Work
M-X Supply Duct Work

Figure III

Dual-Purpose Diagram
Schematic of Supply and Exhaust Duct Work, and Location of Air Sampling Points
Parking Level 3

Department of Housing and Urban Development
Washington, D.C.



15-20 Air Sampling Points
A-L Exhaust Duct Work
M-X Supply Duct Work