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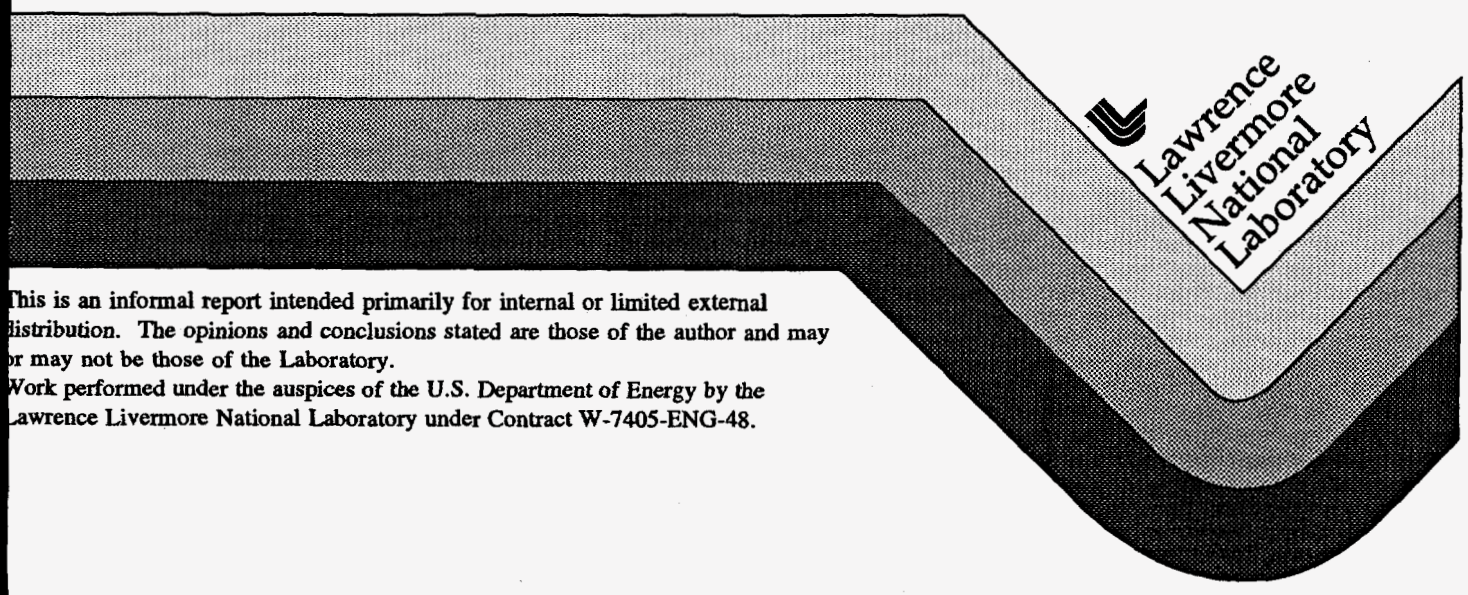
Seismic Induced Architectural Damage to Masonry Structures at Mercury, Nevada

J. F. Wall, Jr.

June 1966



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UNIVERSITY OF CALIFORNIA
Lawrence Radiation Laboratory
Livermore, California

SEISMIC INDUCED ARCHITECTURAL DAMAGE TO MASONRY STRUCTURES AT MERCURY, NEVADA

(Title: Unclassified)

John F. Wall, Jr.

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SEISMIC INDUCED ARCHITECTURAL DAMAGE TO MASONRY STRUCTURES AT MERCURY, NEVADA

John F. Wall, Jr.
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Livermore, California

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ABSTRACT

Selected masonry structures in Mercury were inspected for cracking before and after certain nuclear detonations and during periods of no significant nuclear activity. Detonations gave peak particle velocities whose magnitudes approached those experienced in Mississippi during the Salmon event. Findings include evidence that peak particle velocities of 0.1 to 0.3 cm/sec caused more cracking than normal; however, cracks at these low levels of motion are not more severe than those occurring naturally.

INTRODUCTION

There has been and continues to be much controversy as to the proper ground motion criteria for seismic damage to residential structures. Presently, there are at least five sets of criteria, each with some basis of credulity.

In independent analyses, L. Cauthen[1,2] (see Fig. 1) and Duvall and Fogelson[3] deemed peak particle velocity a better damage criterion than displacement and acceleration. However, it is probable that a true damage criterion should be based on analysis of the complete wave train. Until recently, 8 to 10 cm/sec represented the threshold of

[1] L. J. Cauthen, Jr., "The Effects of Seismic Waves on Structures and Other Facilities," Third Plowshare Symposium, Engineering with Nuclear Explosives, University of California at Davis, Apr. 1964.

[2] L. J. Cauthen, Jr., "Survey of Shock Damage to Surface Facilities and Drilled Holes Resulting from Underground Nuclear Detonations," Lawrence Radiation Laboratory, Livermore, Report UCRL-7964, 1964.

[3] W. I. Duvall and D. E. Fogelson, "Review of Criteria for Estimating Damage to Residences from Blasting Vibrations," Bureau of Mines Report of Investigation 5968, Apr. 1961.

minor damage (plaster cracking) to masonry residential-type structures. Duvall and Fogelson[3] state that about 5 cm/sec is a safe velocity for a high percentage (about 94%) of cases. In heavily populated areas, however, 1 or 2 percent damage could well affect the feasibility of certain proposed Plowshare projects. For example, Hattiesburg citizens claimed damage to about 3 percent of their structures after the Salmon event, a 5-kt underground detonation 20 miles distant. Hattiesburg peak particle velocity was between 0.5 and 1 cm/sec. Figure 2 indicates claimed damage versus peak particle velocity, based on Salmon data compiled by D. Power.[4] Complaints/number of families include damage complaints to timber and steel structures as well as masonry. If Fig. 2 were based on only masonry structures, higher damage would be expected and the curve would shift to the right. Claims are being settled at an average cost of $500 each.[4]

PURPOSE

An investigation of selected representative buildings in Mercury, Nevada, close to many nuclear detonations within the Nevada Test Site, was designed to determine

1) the validity of peak particle velocity as a damage criterion,
2) the peak particle velocity which causes minor architectural damage to selected masonry structures,
3) the validity of the Hattiesburg experience, and
4) the natural cracking rate for masonry structures in Nevada.

DISCUSSION

Implementation

Building exteriors of 43 masonry structures at Mercury, Nevada, were inspected before and after detonations which gave peak particle velocities at Mercury whose magnitudes approached those experienced in the Hattiesburg area.

As far as practical, the time interval between preshot and postshot inspections of structures was held to a minimum to reduce the effect of the natural cracking phenomenon

[4]Dean V. Power, "A Survey of Complaints of Shock-related Damage to Surface Structures Resulting from the Salmon Event," Lawrence Radiation Laboratory, Livermore, Report UCRL-14110, Mar. 1965.

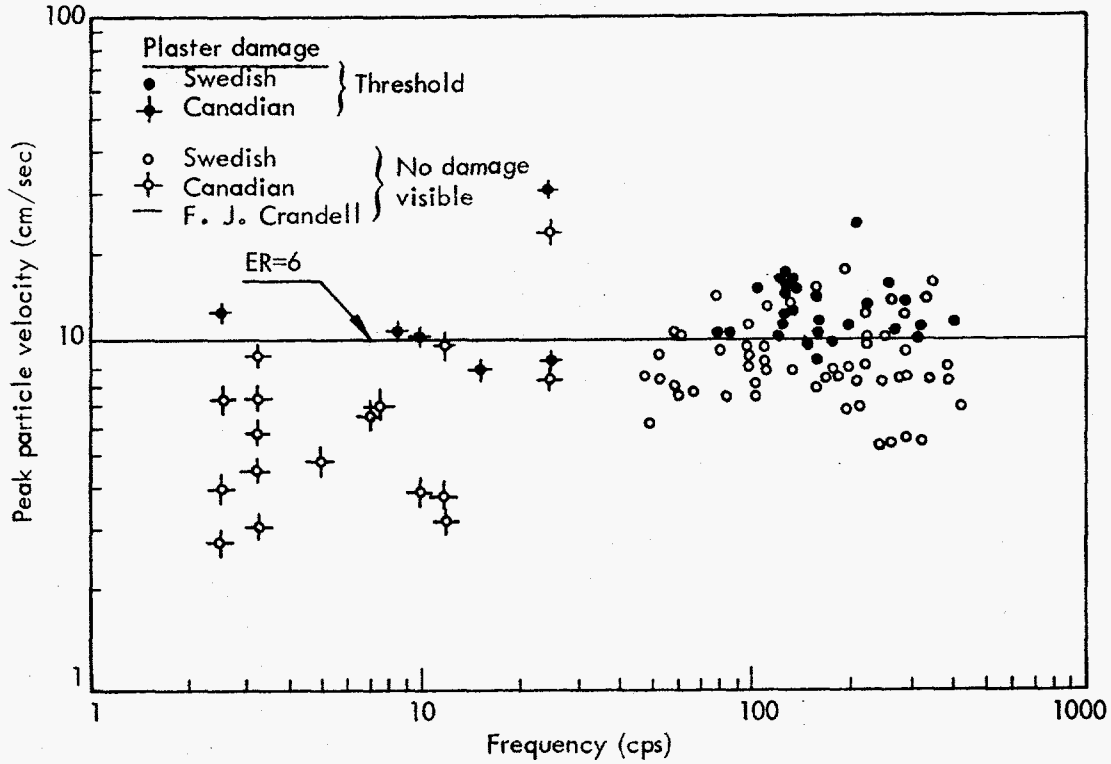

Fig. 1. Damage as a function of velocity showing independence of frequency (after L. Cauthen, UCRL-7964).[2]

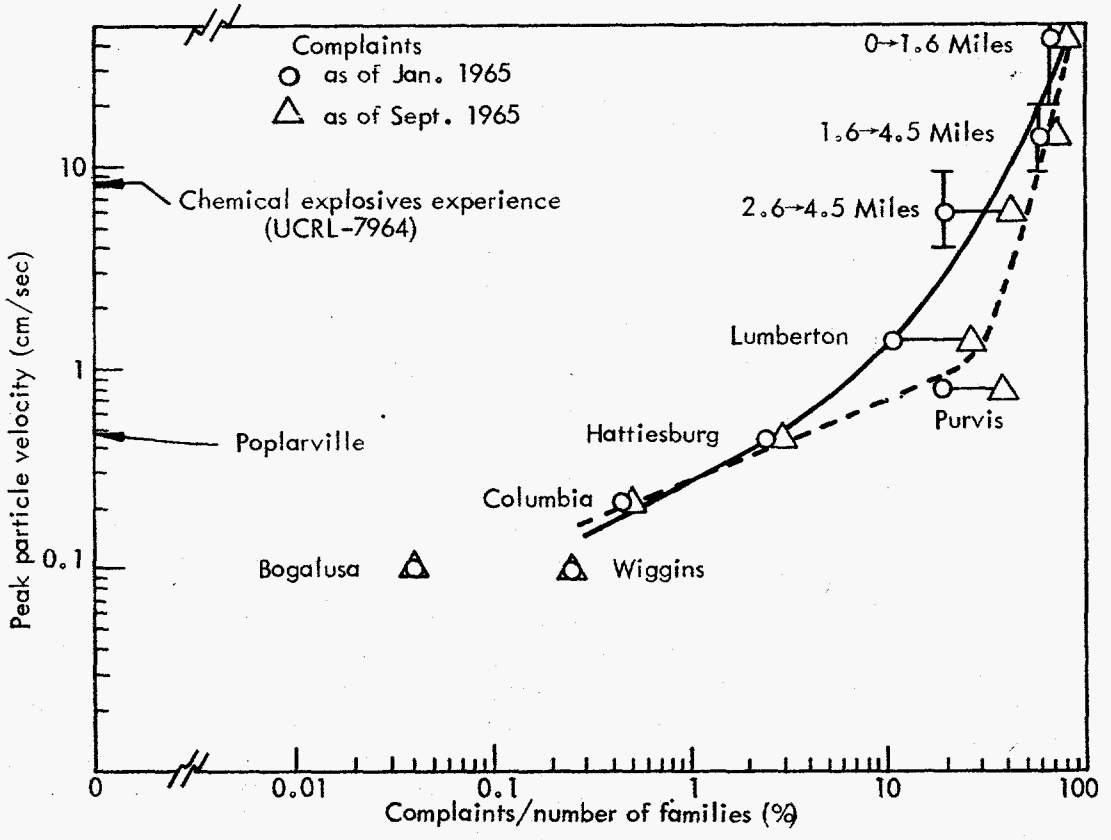

Fig. 2. Claimed architectural damage from Salmon as a function of peak particle velocity (after D. Power, UCRL-14110).[4]

which is large at Mercury. In order to determine this natural rate of cracking, inspections were made of these 43 buildings during periods when there were no significant nuclear tests.

The primary emphasis was at Mercury, but spot-check inspections were also conducted on structures at Beatty and Indian Springs Air Force Base in Nevada.

Instrumentation

Instrumentation for the first two events (3 Dec. 1965 and 16 Dec. 1965) is shown in Fig. 3. It consisted of the following:

1. Mercury
   a. Six components, NGC-21 moving-coil geophones
   b. Two components, Hall-Sears 10-1 geophones
   c. Accelerograph
   d. Sprengnether
2. Beatty
   a. Wood-Anderson
   b. Two accelerographs
3. Indian Springs
   a. Accelerographs to the northwest
   b. NGC-21 at Station SE-2, east of town

Subsequent events had the following coverage:

1. Mercury
   a. Three components, NGC-21
   b. Accelerograph
2. Beatty
   a. Wood-Anderson
   b. Accelerograph
   c. Three components, NGC-21 (when available)
3. Indian Springs
   a. Accelerograph to the northwest
   b. Three components, NGC-21, at Station 2E
4. Tonopah
   a. Wood-Anderson
   b. Three components, NGC-21 (when available)

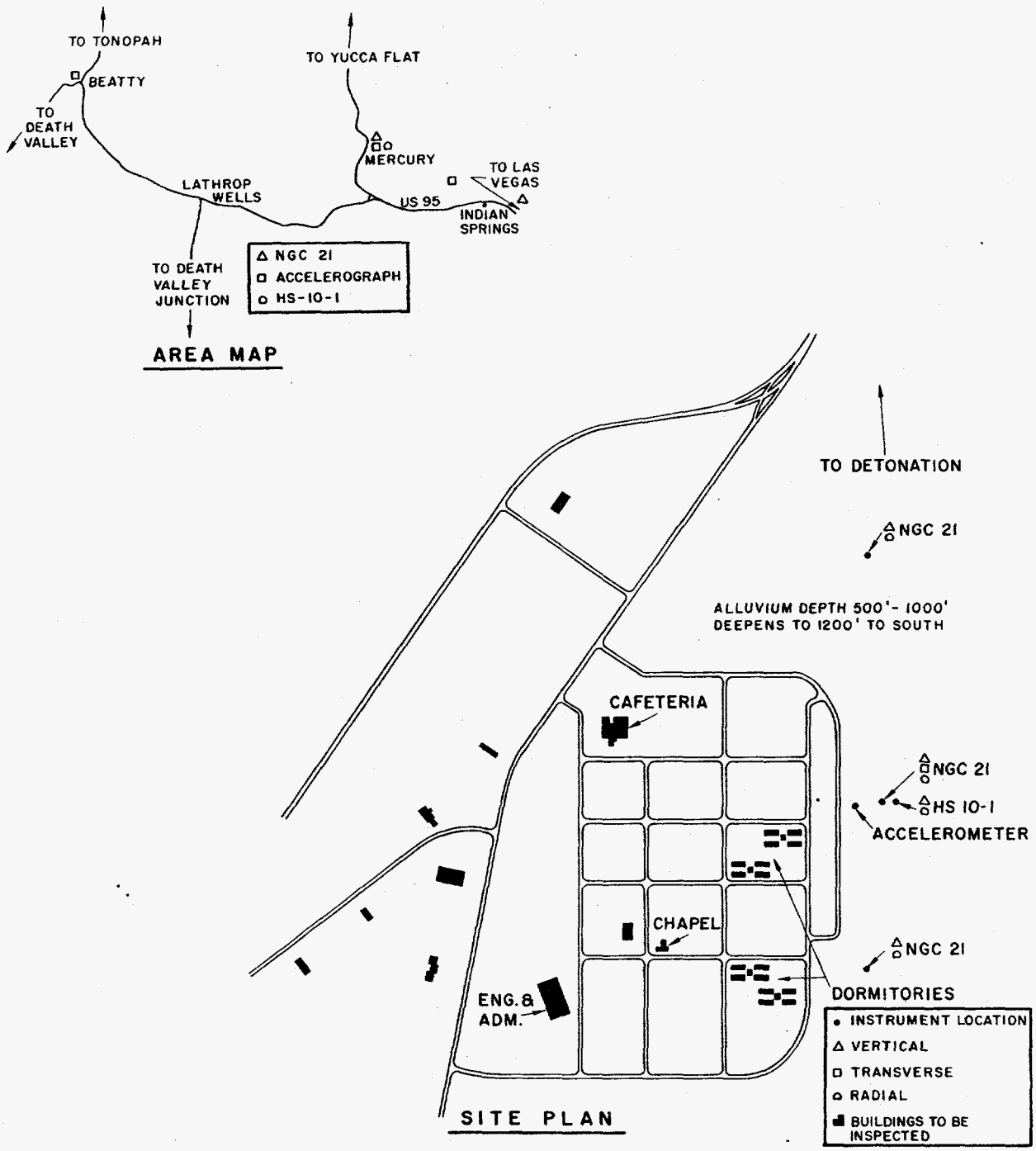

Fig. 3. Schematic of Mercury, Beatty, and Indian Springs and the available instrumentation for the 3 Dec. 1965 and 16 Dec. 1965 nuclear detonations.

In addition, U. S. Coast and Geodetic Survey (USC&GS) made available their NGC-21 instrumentation records from stations on a line southeast from Mercury towards Las Vegas and at various locations within Las Vegas.

Relative Seismic Response

Frequently, ground motion amplitudes vary by factors of 2 to 3, even within a small area. In order to establish the relative seismic response of the ground at various locations in Mercury, Dr. E. D. Alcock, USC&GS, is continuing to record and analyze peak particle velocities with NGC-21 seismometers within the campsite during low-yield detonations. Vectorial addition of velocity components is incomplete.

Refer to Fig. 4 for building locations and approximate resultant peak particle velocities relative to Quonset 25. Relative seismicity is based on the master station at Quonset 25. Preliminary results indicate relatively higher motions at instruments located from east to west across the center of camp with lower motions at instruments in the north and south extremes. There appear to be high relative responses near Buildings 482, 477, 677, 525, and 550.

Proximity Gages

Since there are extreme temperature changes in the desert near Mercury, existing building cracks might respond more to this type of stress than to Hattiesburg-type ground motion during events. In order to ascertain this movement, proximity gages were mounted across cracks in different locations during several events and during periods of no large nuclear activity. Results are found in Appendix C.

Crack Definition

What constitutes a crack? During the conduct of the experiment, a determined effort was made to include only those cracks similar to those for which claims were filed in the Hattiesburg area. In other words, only those new cracks or crack enlargements which would be objectionable to a fastidious building owner were considered. Shrinkage cracks were ignored. New, moderate (some flaking or spalling, easily distinguishable) cracks, spalling or flaking of old cracks, and obvious crack extensions were considered as reasonable objectionable damage. Such categories were noted and marked. Only new cracks in the category moderate or severe were considered in the final tabulation of the data.

Masonry damage is gradual and not sharply defined. Probably several small existing cracks were judged insignificant and subsequently widened, extended, and/or spalled to an objectionable extent. These developed cracks were entered in inspectional

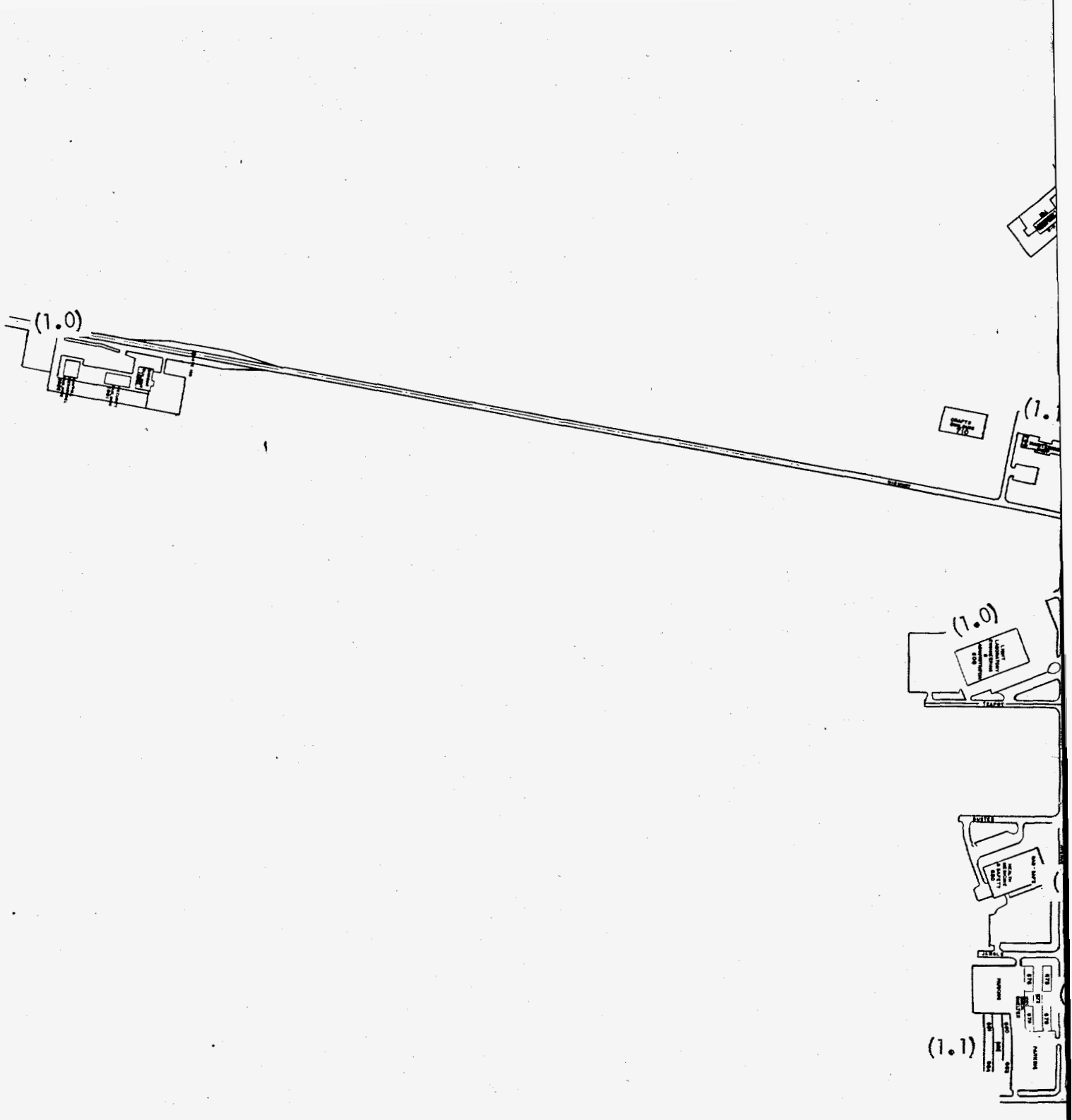

Fig. 4. Buildings and instrument loca
velocities relative to Quonset

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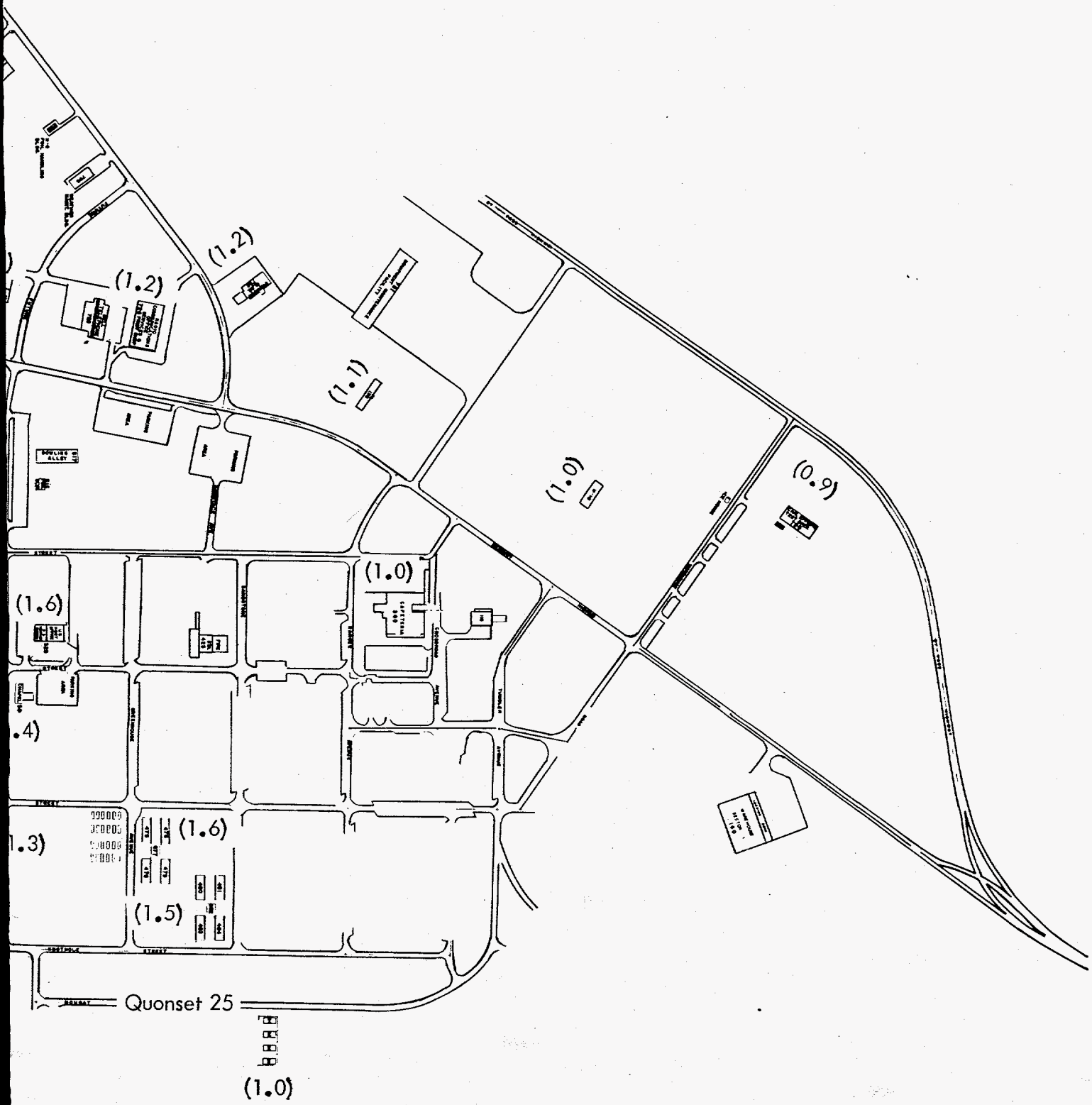

ions with approximate peak particle
25.

[redacted]

data at the time of the "significant" determination, whether after a detonation or during a period of no induced seismic motion. There are wide differences in the conditions of different Mercury buildings, and each was judged on its own merit.

Conduct of Inspection

Due to the relatively large sample of 43 buildings and lack of experienced personnel, less than desirable techniques were employed initially. Inspections were not made during the same time of day, which allowed sun, shadow, and temperature to interfere with crack detection and evaluation. These deficiencies were corrected after the second inspection. On several occasions, the time interval between inspections was excessively long due to event delays and cancellations. Doubtful cracks discovered after an event were generally assumed to have been present during the pre-event inspection; likewise, doubtful cracks discovered during inspections unconnected with an event were assumed to have occurred during the time interval between inspections.

RESULTS

The first two inspections included 20 interiors as well as all exteriors of the 43 selected buildings. Due to limited personnel, subsequent inspections were conducted solely on exteriors. Data quoted reflect only exterior conditions. It is possible that more cracks were detected from a gain in experience after the first several inspections. As previously noted, doubtful cracks were assumed nonevent connected. The buildings were first examined on 1 Dec. 1965 for an event on 3 Dec. No weighted significance was given to length of cracks.

Table I summarizes inspection dates, new cracks detected, and, when applicable, peak particle velocities. In some inspections, buildings were not examined in a single day; in all cases the time between consecutive inspections was weighed and averaged. Other categories of cracking (extensions and new flaking or spalling of existing cracks) are included in the data sheets of Appendix A. Table II lists maximum components of displacement or acceleration recorded on an accelerograph at Quonset 24.

In Appendix B, evidence is photographically presented that there is relatively little difference in severity between cracks detected after detonations and those found during periods of no significant seismic activity. However, it is apparent from Fig. 5, in which the data of Table I are plotted, that cumulative cracks significantly increase after seismic motion comparable to that experienced from Salmon. Natural cracking rates, i.e., new

Table I. Summary of inspection data for masonry buildings at Mercury.

Inspection date	Number of buildings	Number of moderate cracks	Inspection interval (days)	Weighted average interval	Slope (crack/day /43 buildings)	Approx resultant peak particle velocity (cm/sec)[a]
1/12/65 + 2 days	43	Initial Inspection			2.5[b]	
3/12/65	10	0	2	2.8 → 3		0.18 (3/12/65) Corduroy
3/12/65	22	4	1-2			
7/12/65	11	7	7			
Detonation scheduling precluded preshot inspection					2.5[b]	
16/12/65	11	3	9	12		0.21 (16/12/65) Buff
16/12/65	32	55	13			
12/1/66	6	7	27	27.8 → 28	2.68	
13/1/66	37	68	28			
18/1/66	6	6	6	5.1 → 5		0.13 (18/1/66) Lampblack
18/1/66	37	24	5			
15/2/66	43	69	28	28	2.46	
16/2/66	43	2	1	1	2.0	
22/3/66	43	77	34	34	2.26	
13/4/66	43	49	22	22	2.23	
14/4/66	43	20	1	1	2.5[b]	0.18 (14/4/66) Duryea
20/4/66	43	28	6	6	2.5[b]	Possible sonic boom cracking (19/4/66)
26/4/66	43	46	6			0.32 (25/4/66) Pinstripe
5/5/66	43	19	9	9	2.1	
6/5/66	43	37	1	1		0.21 (6/5/66) Chartreuse
12/5/66	43	15	6	6	2.5	
13/5/66	43	28	1	1		0.17 (13/5/66) Piranha
18/5/66	42	11	5	5	2.2	
19/5/66	42	9	1	1		0.31 (19/5/66) Dumont

[a] Where indicated, velocity was measured at Quonset 25; estimated accuracy ±20%.

[b] Postulated.

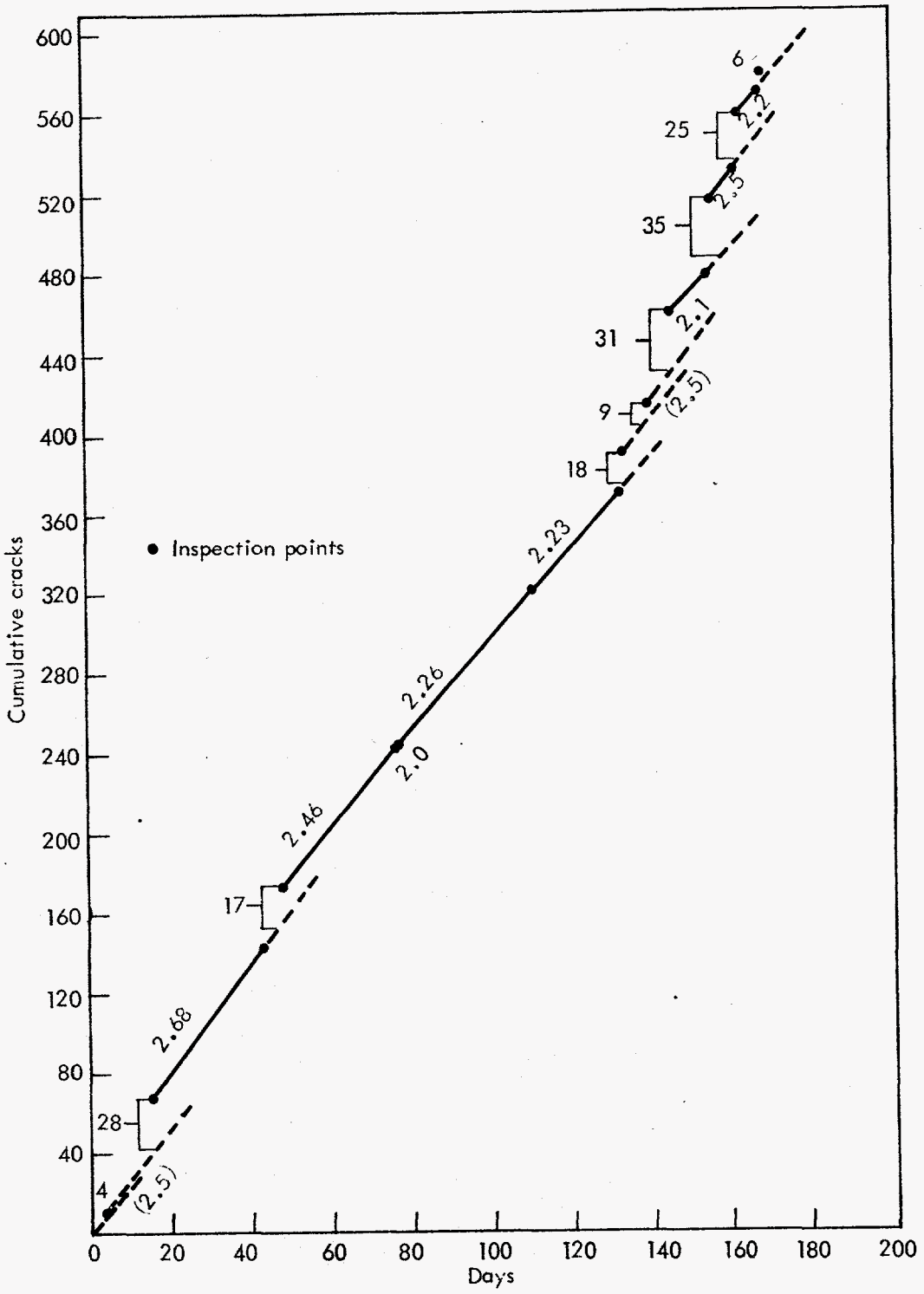

Fig. 5. Cumulative cracks and natural cracking rates for masonry buildings at Mercury.

Table II. Summary of accelerograph data recorded at Quonset 24, Mercury.

Date	Component	Acceleration (g)	Period (sec)	Displacement (cm)	Period (sec)	Velocity[a] (cm/sec)
3/12/65	Z	0.00256	0.3	0.02015	0.3	0.229
	T	0.004	0.3	0.0883	2.0	0.589
	R	0.0031	0.25	0.0682	2.3	0.456
16/12/65	Z	0.0041	0.4	0.0201	0.6	0.281
	T	0.00171	0.3	0.053	2.3	0.299
	R	0.00265	0.5	0.0398	1.6	0.322
18/1/66	Z	0.0012	0.2	b		
	T	0.00114	0.12	0.0295	1.8	0.182
	R	0.0014	0.4	0.0204	1.8	0.170
14/4/66		Accelerograph failure				
25/4/66		Not operated				
6/5/66		b				
13/5/66	Z	0.00214	0.32	b		
	T	0.00236	0.4	0.204	3.4	0.69
	R	0.00246	0.4	0.0624	2.4	0.389
19/5/66	Z	b		b		
	T	b		0.0265	2.36	
	R	0.002	b	0.034	1.6	0.245

[a]Velocity computed from $v = \omega d$, where $\omega = \sqrt{\frac{a}{d}}$.
[b]Unreadable at instrument maximum gain.

cracks in 43 buildings divided by days since last inspection, are depicted as slopes. An average cracking rate of 2.5 cracks/day/43 buildings appears reasonable.

After comparison with results of other detonations, the inspections subsequent to the detonations of 3 Dec. 1965 and 19 May 1966 indicated fewer new cracks than would be anticipated.

During an intermediate survey conducted 20 Apr. 1966, inspectors detected 9 cracks over the number normally associated with a commensurate time period. A possible source might have been a sonic boom which occurred 19 Apr. It startled several long-term Mercury residents, and was widely noted within the confines of the campsite. At the time of this reported shock wave, the barograph inside the Mercury weather building indicated an instantaneous rise of approximately 0.02 in. Wind gusts in excess of 35 knots were also reported during the interval since the preceding inspection, and the daily high temperatures dropped from 80 to 55°F between 17 and 18 Apr. However, comparable temperature and wind gust differentials were noted during other inspection intervals.

CONCLUSIONS

1. Variability of construction, age, traffic, use, temperature cycling, settling, and shrinkage cause damage to masonry. Such factors render difficult the accurate determination of a peak particle velocity damage index which is applicable to all cases.

2. During the period Dec. 1965 to May 1966, the Mercury normal cracking rate was approximately 2.5 cracks/day/43 buildings. It is anticipated that cracking rates will vary seasonally.

3. Except for two large detonations in Yucca Valley where there may have been a relatively greater mismatch in the building and ground motion frequencies, the number of cumulative cracks increased appreciably with increases in peak particle velocities. If it is recognized that "it is the kinetic energy represented in the building vibration that is the measure of damaging potential and not necessarily the energy indicated in the ground motion,"[5] peak particle velocity appears valid as a criterion for masonry damage to residential and single-story commercial type structures.

4. The Mercury inspection data indicated no flagrant inconsistencies with the Salmon experience in Mississippi. Peak particle velocities of 0.1 to 0.3 cm/sec caused more cracks than normal. However, cracks at these low levels of motion are not more severe than those occurring naturally.

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[5] F. Neumann, "Damaging Earthquake and Blast Vibrations," The Trend in Engineering, Jan. 1958.

5. It is suggested that the Salmon damage complaints relative to peak particle velocity, Fig. 2, follows a log probability relationship (Fig. 6). If the ratio of number of families to number of structures is assumed to be one, the Salmon data indicates about 50% of the structures would suffer damage at peak particle velocities of 8 to 10 cm/sec. Since Fig. 2 places no restriction on type of construction (steel, timber, masonry), higher damage would be expected on masonry structures and the curve would shift to the right. Such a postulated curve is also shown in Fig. 6 where percent masonry buildings in Mercury which were cracked over the normal rate are plotted and a parallel curve drawn.

These curves suggest two conclusions. If Salmon damage claims to all types of construction are valid, the 94% safe masonry cracking velocity of 5 cm/sec is invalid. Secondly, the postulated Mercury curve indicates masonry cracking probabilities of over 0.95 for peak particle velocities of 8 to 10 cm/sec which reaffirms the conclusions of Cauthen et al.

If the Salmon points of Hattiesburg, Purvis, and Lumberton were adjusted for approximate percentages of concrete block structures claimed to have been damaged, fairly good agreement with the postulated Mercury concrete block curve is shown in Fig. 7. However, it is recognized that little statistical validity can be attributed to only three points.

It is obvious that masonry damage thresholds should be expressed in terms of probability.

RECOMMENDATIONS

Experiments should be programmed to clarify seismic effects and to determine residential building amplification of ground motion.

Many factors determine the damaging potential of a nuclear detonation near metropolitan areas. Structural damage depends not only on yield and distance, but on coupling, soil amplification, building amplification, and travel path propagation and attenuation. Technical knowledge in the above areas is fairly advanced. Information on relative seismic response within small areas within a city is obtainable. There is little guidance, however, on what constitutes acceptable damage levels and the degree of liability which might be imposed by law.

Dominant periods of the average nuclear detonation are 0.2 to 4 sec which correspond to the resonant frequencies of the majority of any city's structures, i.e., homes, small commercial buildings, and low public buildings.[5] F. Neumann writes, "...the cause of excessive damage on deep alluvial soils may be due as much to the existence of resonant ground and

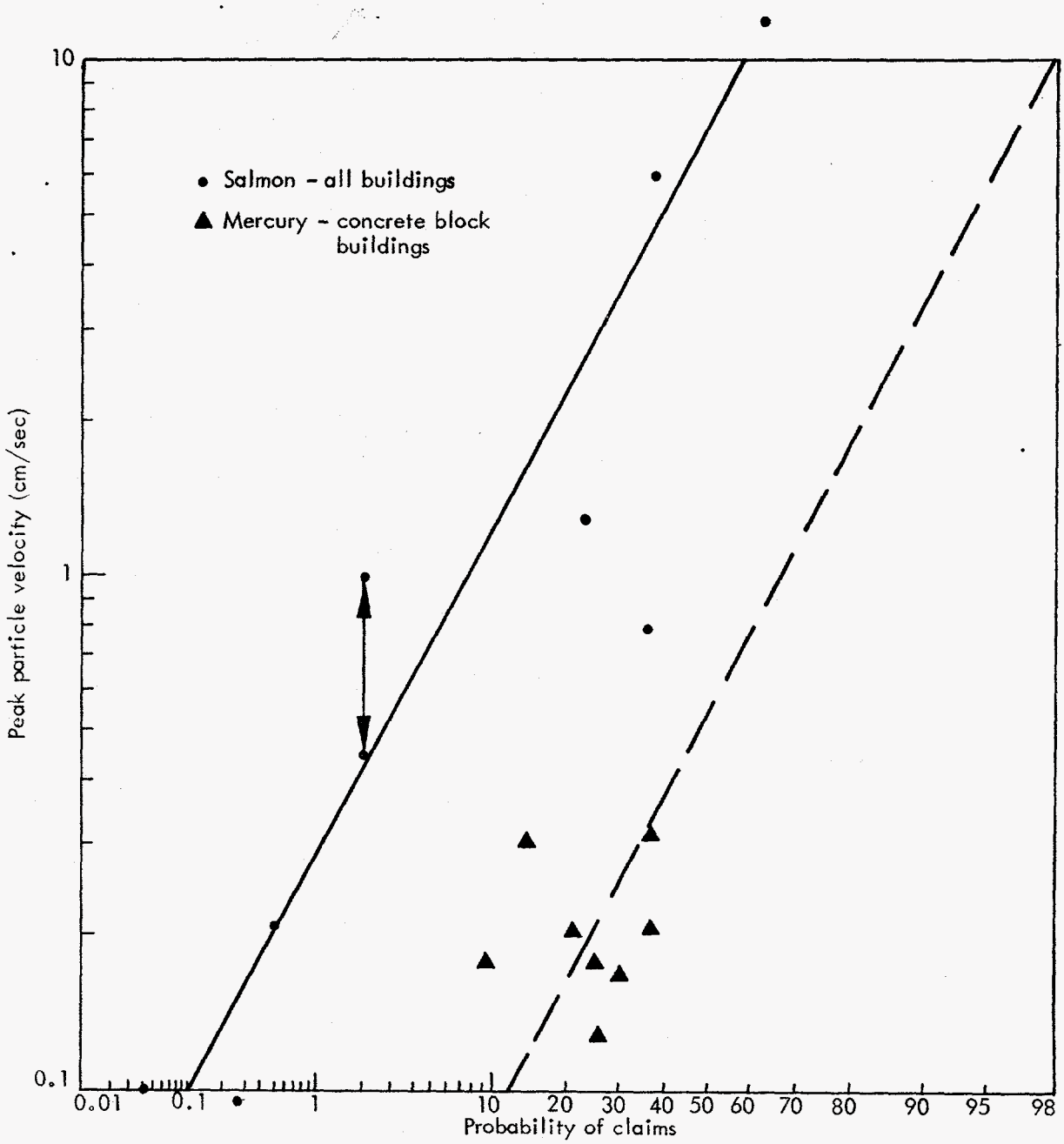

Fig. 6. Probability of claims as a function of peak particle velocity.

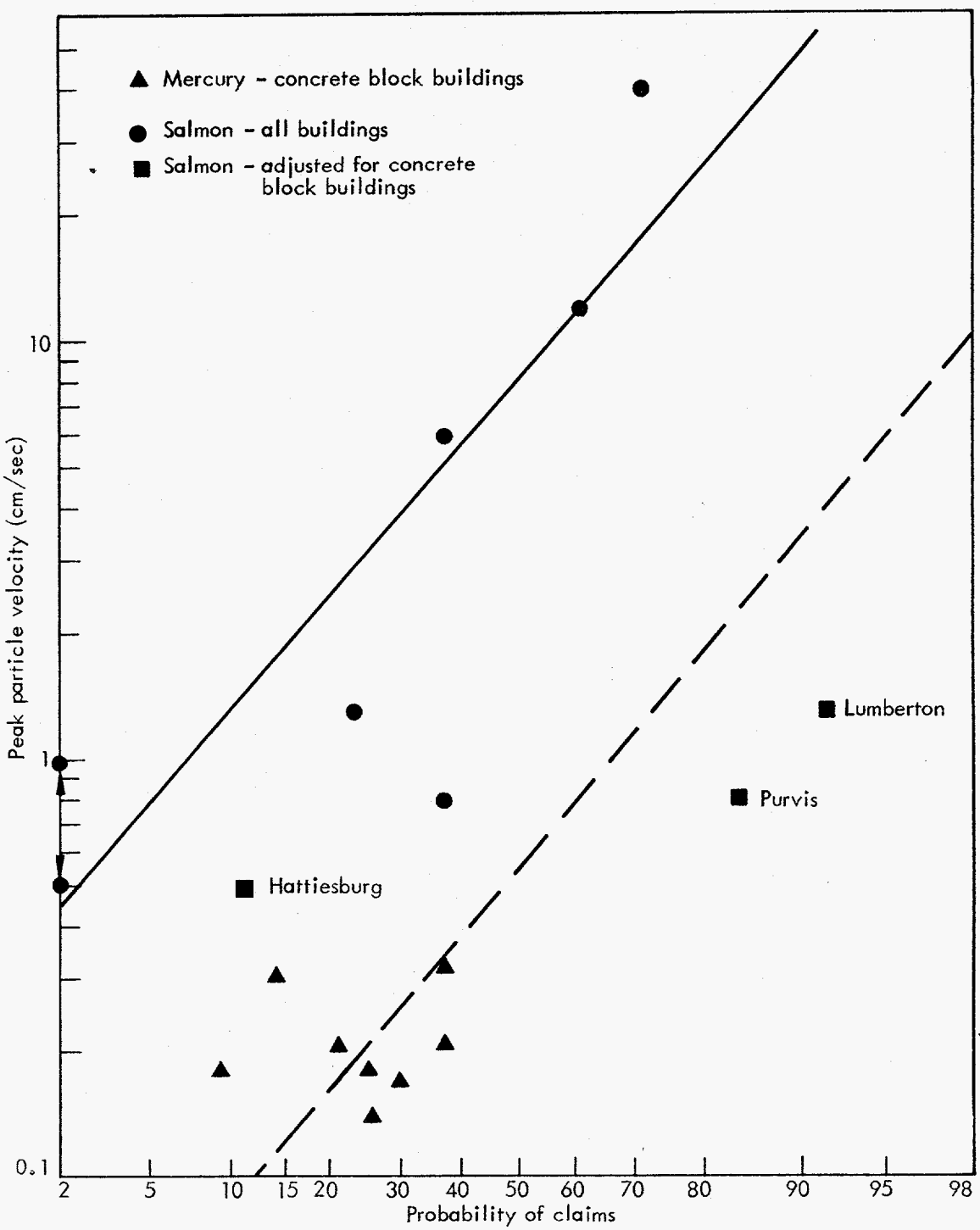

Fig. 7. Probability of claims as a function of peak particle velocities with three Salmon locations adjusted for approximate percentages of concrete block structures claimed to be damaged.

building periods as to the greater ground amplitudes generally found on such formations."[5] He proposes a factor of 4 as representative of this amplification at resonance for low buildings and from 4 to 10 for tall structures. At resonance, damping limits the damage as shown in the classical amplification expression,[6]

$$A = 1\Big/\sqrt{\left(1 - \frac{T_0^2}{T^2}\right)^2 + \left(\alpha \frac{T_0}{T}\right)^2} ,$$

where T = ground oscillation period, T_0 = natural period of the structures, and α = damping coefficient of the natural oscillation of the structure.

Sadoviskii[6] indicates that α is rarely over 0.2, which yields a maximum resonant amplification of 5. The above considerations underline the significance of building amplification. Unless building amplitude modification is understood, ground motion criteria for masonry damage has little meaning.

In anticipating seismic damage from future nuclear detonations, the following areas might present a more optimistic view.

Longer periods are associated with higher yields and lower coupling media. Detonations of this type would tend to give a mismatch between periods of low structures and those of the ground, especially at greater distances. Figure 8 indicates fewer cracks at Mercury from two large-yield events in Yucca Valley than smaller detonations giving the same relative peak particle velocities in Mercury. More experience with relatively large yields in Yucca Valley might generate a line with the same slope as that drawn in Fig. 8 but with crack values down by a factor of 5.

Mercury experience indicates that at a particular location, cracks occur naturally in concrete block structures at a standard rate. Also from Mercury, there is evidence that ground peak particle velocities in the range from 0.1 to 0.3 cm/sec cause some prompt cracking; however, it appears that this cracking would have occurred naturally in a matter of time.

Superficial damage in structures is first noted in grades V-VI as defined by the Modified Mercalli Scale which corresponds to tentative peak particle velocities of 2.25-4.5 cm/sec.[5,7] If we assume that the building and ground act in resonance with a maximum amplification of 5, ground velocities may be as low as 0.45-0.9 cm/sec to cause these intensities within the structure. Therefore, a technically legitimate approach to claim adjustments for justifiable damage to low and residential masonry structures from ground

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[6] F. A. Kirillov, "The Problem of Investigation of the Seismic Effect of Explosions at the Institute of Physics of the Earth, USSR Academy of Sciences," Problems of Engineering Seismology, edited by S. V. Medvedev, Translation from the Russian, Consultants Bureau, New York, 1963.

[7] F. Neumann, "Seismological Aspects of the Earthquake Engineering Problem," Third Northwest Conference of Structural Engineers, Washington State University, Pullman, Washington, Mar. 1959.

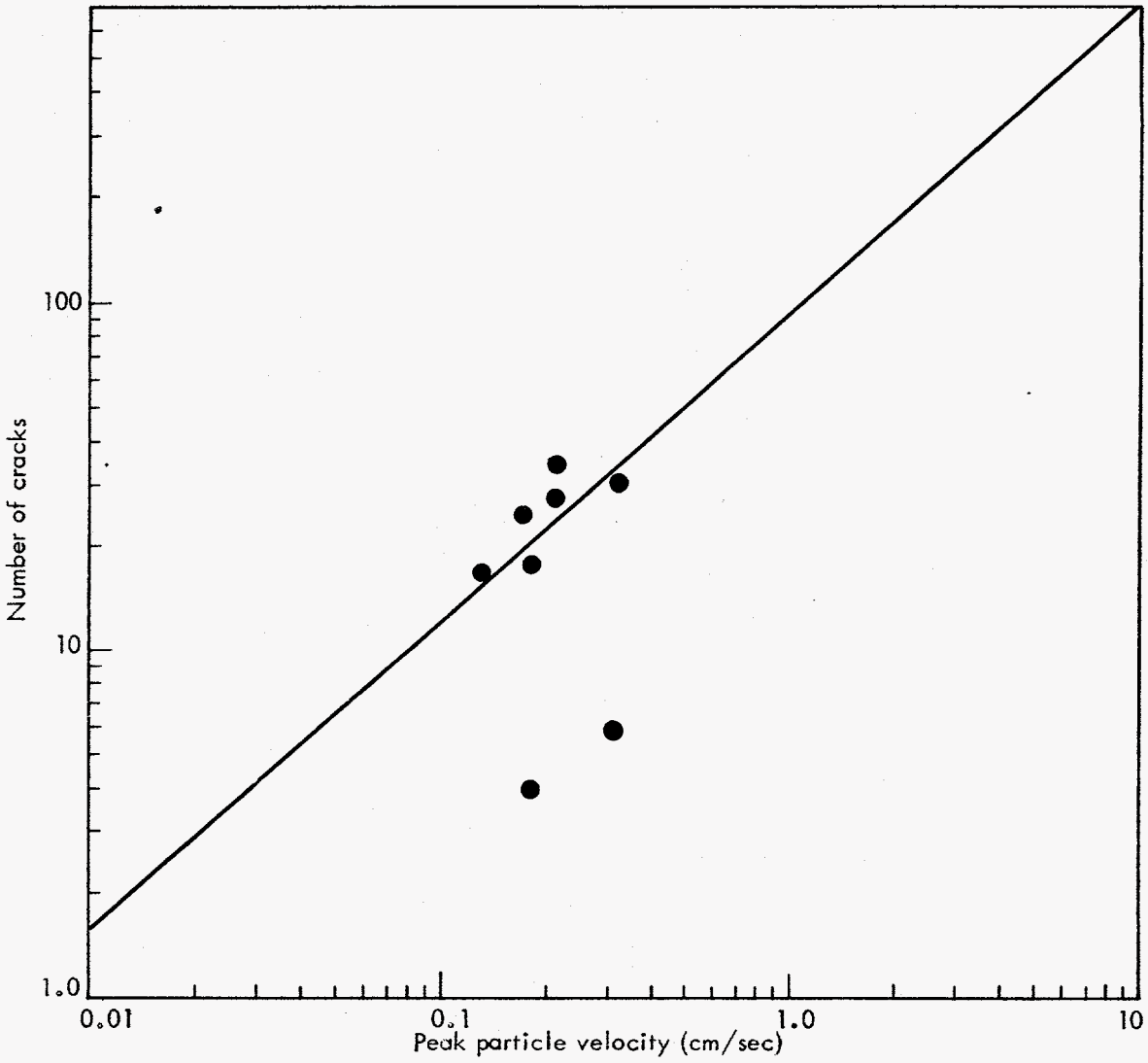

Fig. 8. Peak particle velocities and number of associated cracks over the normal cracking rate for Mercury concrete block structures.

velocities lower than 0.45-0.9 cm/sec would be to evaluate the estimated prompt cracking damage in terms of the normal structural cracking rate, and allowing payment of equivalent temporal depreciation of the value of the structure. For example, a peak particle velocity of 0.3 cm/sec generates 33 cracks over the normal Mercury crack rate of 2.5 cracks/day (Fig. 8) which corresponds to 13 days of cracking precipitated in a single day.

ACKNOWLEDGMENTS

Grateful acknowledgment is extended to the following persons: Mr. D. D. Rabb, for not only collecting much of the information, but also assisting immeasurably in assembling and presenting the data; Messrs. S. E. Warner and J. T. Lane, who fielded and operated proximity gages, strain gages, and moving coil geophones during long periods of time without relief; Mr. W. J. Herlihy and Major P. Bazilwich, Jr. for their kind assistance in collecting data; Dr. E. D. Alcock and Mr. K. King and his associates from the United States Coast and Geodetic Survey, who made their velocity instrumentation records available; Dr. D. N. Montan, who gave valuable suggestions on data interpretation, and Messrs. F. R. Perry and C. H. Drury for their inspections on Building 425.

APPENDIX A
INSPECTION DATA SHEETS

INSPECTION DATE: 3, 7 December 1965
PREVIOUS INSPECTION: 1-2 December 1965
INTERVAL: 1, 2, 7 days (see below for interval-days between inspections)
TOTALS: Cracks, 11; Flaking, 2; Extensions, 16

A. BOQ

	Time	Interval	Additional Flaking	New Cracks	Extensions	Remarks
678	*0800-1700	7				
679	"	7				
677	"	7				
676	"	7				
675	"	7				
680	"	7				
681	"	7		3		W corners - two severe
682	"	7				
683	"	7		1		SE corner
684	"	7		3	1	W and SE corner
479	** 0930-1700	2				
478	"	2				
477	"	2				
476	"	2				
475	"	2				
484	"	2			2	
483	"	2			1	
482	"	2				
481	"	2			3	
480	"	2			4	
SUBTOTAL			0	7	11	

* 7 December 1965

** 3 December 1965

INSPECTION DATE: 3, 7 December 1965

B. Other Bldgs.

	Time	Interval	Additional Flaking	New Cracks	Extensions	Remarks
1002	** 0930-1700	1				
1001	"	1				
1000	"	1		1		above E door
710	"	1				
700	"	1				
725	"	1				
726	"	1				
703	"	1				
702	"	1				
701	"	1			1	
752	"	1		1	1	above N door
751	"	1		1		left of N small door
155	"	1			1	
790	"	1				
160	"	1				
300	"	1	2	1		
425	"	1				
525	"	1				
550	"	1			1	
650	"	1			1	
600	* 0800-1700	7				
516	** 0930-1700	1				
517	"	1				
SUBTOTAL			2	4	5	

* 7 December 1965

** 3 December 1965

[redacted]

INSPECTION DATE: 16 December 1965 (39° - 32° F, wind 11 knots)

PREVIOUS INSPECTION: 3, 7 December 1965

INTERVAL: 9, 13 days (* denotes 9-day interval)

TOTALS: Cracks, 58; Flaking, 5; Extensions, 6.

A. BOQ

	Time	Additional Flaking	New Cracks	Extensions	Remarks
678*	0800-1700		1		SE corner
679*	"		1		NE corner
677*	"				
676*	"				
675*	"				
680*	"		1		NW corner
681*	"				
682*	"				
683*	"				
684*	"				
479	1130-1700	1	6	2	E & W ends, S side
478	"		5		NE corner & W end, N side
477	"				
476	"		2		Under air conditioner, E end, N side
475	"		3		Under air conditioner, E and W ends, S side
484	"				
483	"		1		Under air conditioner, E end S side
482	"				
481	"		6		Under air cond., E & W ends N & S sides; NW corner
480	"	1	5		NE corner, under air cond. W & E ends, S side
SUBTOTAL		2	31	2	

[redacted]

[redacted]

INSPECTION DATE: 16 December 1965

B. Other Bldgs.

	Time	Additional Flaking	New Cracks	Extensions	Remarks
1002	1130-1700		2	1	SE corner, above N door
1001	"		2		above S door, SW corner
1000	"				
710	"				
700	"		7		mostly S side
725	"				
726	"		2	1	door, south side
703	"				
702	"				
701	"		4		E and W sides
752	"		1		E side
751	"		1		N side
155	"	1	2	1	E side
790	"		4		E wall only
160	"				
300	"	2			
425	"				
525	"				
550	"			1	
650	"		1		E side
600*	"				
516	"		1		E side
517	"				
SUBTOTAL		3	27	4	

[redacted]

INSPECTION DATE: 12, 13 January 1966 (56° - 38° F, 6 knots)

PREVIOUS INSPECTION: 16 December 1965

INTERVAL: 27, 28 days (* denotes 27 day interval)

TOTALS: Cracks, 75 - Flaking, 15 - Extensions, 5

A. BOQ

	Time	Additional Flaking	New Cracks	Extensions	Remarks
678	1320		1		
679	1340		1		Many car nicks E. end
677	1355				
676	1400	1	1		
675	1415	1	1	1	
680	1427				
681	1510		1		E. end S. side
682	1505		1		E. side
683	1456		1		E. side
684	1445		2		W. end & S.E. corner
479	0956		1	1	E. end S. side
478*	1645		1		E. end S. side
477	1218				
476	1255				
475	1230		2		W. side
484*	1550				
483*	1450				
482*	1510				
481*	1320	1	3		S. end E. side
480*	1405		3		sides of SE corner
		--	--	--	
SUBTOTAL		3	19	2	

INSPECTION DATE: 12, 13 January 1966

B. Other buildings

	Time	Additional Flaking	New Cracks	Extensions	Remarks
1002	1100		1		NE corner
1001	1530	1	2		NE corner & S side
1000	1550		1		E side
710	1415		4		
700	1430	2	5		
725	1515	1	1		
726	1530		1		
703	1550		2		N & S sides
702	1610		1		W side
701	1615		2		
752	1635	1	3		
751	1010		3		
155	1030			1	
790	1440	2	5		E & N sides
160	1635		2		
300	1050		3		
425	1230				Cracks at construction joints
525	1330				
550	1345	1	5	1	E. side
650	1405		3		E side
600	1305	4	10		mostly S & W sides
516	1320		1		E side
517	1300	—	1	1	N side
SUBTOTAL		12	56	3	

INSPECTION DATE: 18 January 1966 (51° - 33° F, 9 knots)

PREVIOUS INSPECTION: 12-13 January

INTERVAL: 5, 6 days (* denotes 6-day interval)

TOTALS: Cracks, 30 - Flaking, 3 - Extensions 6

A. BOQ

	Time	Additional Flaking	New Cracks	Extensions	Remarks
678	1442				
679	1446				
677	1440				
676	1437				
675	1429				
680	1452				
681	1500		1		NE corner
682	1510				
683	1522				
684	1512		1		NW corner
479	1300		1		NE corner
478*	1600				
477	1545		2		E end S side
476	1530				
475	1540				
484*	1405		2		NE corner
483*	1415		1		E end S side
482*	1400				
481*	1335		1		
480*	1350		2		E end N side
SUBTOTAL		0	11	0	

INSPECTION DATE: 18 January 1966

B. OTHER BLDGS.

	Time	Additional Flaking	New Cracks	Extensions	Remarks
1002	1430		1		E wall
1001	1420		3		SW corner & W wall
1000	1410				
710	1445		2	1	S side
700	1500	1	4	1	
725	1650		4		
726	1645				
703	1550				
702	1520				
701	1525	1	2	1	NE corner
752	1550		1		above door W side
751	1600			1	
155	1610			2	
790	1440		1		Fire hydrant W side
160	1635				
300	1145				
425	1700				
525	1205	1			
550	1225				
650	1230				
600	1305				
516	1345				
517	1355		1		Front screen wall
SUBTOTAL		3	19	6	

INSPECTION DATE: 15 February 1966 (45^{o} - 31^{o} F, 30 knots)

PREVIOUS INSPECTION: 18 January 1966 (14^{o} F differential in reported daily highs, 12^{o} F in daily lows, gusts of 30 knots)

INTERVAL: 28 days

TOTALS: Cracks, 69; Flaking, 32; Extensions, 11

A. BOQ

	Time	Additional Flaking	New Cracks	Extensions	Remarks
678	1000	4	1		W. end
679	1021	2	2		E end S side
677	1045				
676	1050	3	2		E end N & S side
675	1122	2	3	1	NW corner & E end; S side
680	1344				
681	1310		1		W end
682	1305				
683	1230				
684	1250	1	1		W end S side
479	0845				479 & 478 predicted "hot spots"
478	0950		2		W end & E end N side
477	1040				
476	1616	2			
475	1645	1		1	
484	1415				
483	1435	1	1		W end N side
482	1510				
481	1542	1	3		W end-Hard to detect
480	1515	1	2		Under air conditioner; W. end N. side
SUBTOTAL		18	18	2	

INSPECTION: 15 February, 1966

B. Other Bldgs.

	Time	Additional Flaking	New Cracks	Extensions	Remarks
1002	0915		7	1	
1001	0905		9	3	mostly W. wall
1000	0855		10		
710	1030		4		
700	1045	1	2		
725	1105		1		NE corner
726	1125				
703	1250				
702	1300	1	1		W end N. side
701	1315				
752	1325	1		1	
751	1345		4		S side
155	1410	1			
790	1650	4			
160	1640	1	2		
300	1430	1	1		
425	1505				
525	1630	1		1	
550	1545		1	3	E. wall
650	1605		2		No change E. wall
600	0945	1	7		Mostly S & W sides
516	1515	1			
517	1530	1			
SUBTOTAL		14	51	9	

INSPECTION DATE: 16 February 1966 (52^{o} - 31^{o} F, 13 knots)

PREVIOUS INSPECTION: 15 February

INTERVAL: 1 day

TOTALS: Cracks, 2; Flaking, 1; Extensions, 5

A. BOQ

	Time	Additional Flaking	New Cracks	Extensions	Remarks
678	1100				
679	1135				
677	1150				
676	1240				
675	1310				
680	1425				
681	1330				
682	1420				
683	1410				
684	1400				
479	1625				
478	1645				
477	1700				
476	1600			1	
475	1612				
484	1445				
483	1500				
482	1510				
481	1530				
480	1515				
SUBTOTAL		0	0	1	

INSPECTION: 16 February 1966

B. Other Bldgs.

	Time	Additional Flaking	New Cracks	Extensions	Remarks
1002	1600		1		W side
1001	1715				
1000	0845		1	2	E wall foundation
710	1140				
700	1115				
725	1210				
726	1315				
703	1330				
702	1340				
701	1345				
752	1400				
751	1415				
155	1430				
790					
160	1650				
300	1400				
425	1450				
525	1520				
550	1510				
650	1545			2	
600	1040	1			NW corner
516	1600				
517	1605				
SUBTOTAL		1	2	4	

[redacted]

INSPECTION DATE: 22 March 1966 (55° - 33° F, 28 knots)

PREVIOUS INSPECTION DATE: 16 February 1966 (20° F differentials in reported daily highs and in lows, gusts 0f 33 knots)

TOTALS: Cracks, 77; Flaking, 30; Extensions, 17.

A. BOQ Area

Bldg.	Interval since Last Insp.	Time of Inspection	Additional Spalling or Flaking	New Cracks	Crack Extensions	Remarks
678	34	0910	1	0	0	
679	"	0920	0	0	0	
677	"	0928	0	2	0	W. Side
676	"	0950	0	2	0	W side & NE corner
675	"	0937	0	1	0	W side
680	"	1035	0	1	0	W side
681	"	1050	0	2	0	SE corner & W side
682	"	1025	0	1	0	W side near NW corner
683	"	1012	1	2	0	W side & NE overhang
684	"	1000	0	1	0	W side
479	"	1515	0	3	0	E side & at SE corner
478	"	1455	1	0	1	
477	"	1300	0	0	0	
476	"	1415	2	1	0	S side near SW corner
475	"	1432	1	1	0	eastern end, N side
484	"	1115	2	1	0	
483	"	1100	1	0	0	W side
482	"	1130	0	0	0	
481	"	1350	2	1	0	SE corner S side
480	"	1325	3	0	1	
SUBTOTAL			14	19	2	

[redacted]

[redacted]

INSPECTION DATE: 22 March 1966

B. Other Buildings

Bldg.	Interval Since Last Insp.	Time of Inspection	Additional spalling or Flaking	New Cracks	Crack Extensions	Remarks
1002	34	1645	0	2	2	South wall starting to move
1001	"	1630	0	1	0	
1000	"	1655	0	4	0	
710	"	1015	0	0	1	
700	"	0955	1	1	1	N side loosened up
725	"	1055	0	3	0	
726	"	1035	0	8	0	6 cracks, south side, in series
703	"	1305	0	2	0	starting
702	"	1320	0	2	0	very fine
701	"	1345	1	2	1	
752	"	1415	1	1	1	
751	"	1430	0	1	1	
155	"	1445	0	0	3	doubtful
790	"	1540	7	7	0	N and E sides around NE corner
160	"	1640	0	4	2	
30[illegible]	"	1730	2	2	0	
42[illegible]	35	23/3/66 0900	0	7	0	
525	34	1510	1	1	0	
550	"	1545	0	3	0	
650	"	1525	0	4	0	
600	"	0900	2	2	2	NW corner worse
516	"	1715	1	0	0	
517	"	1720	0	1	1	
SUBTOTAL			16	58	15	

[redacted]

INSPECTION DATE: 13 April 1966

GENERAL WEATHER AND TEMPERATURE RANGE : 74 - 48° F, 9 knots

PREVIOUS INSPECTION DATE(S): 22 March 1966

GENERAL WEATHER EXTREMES SINCE LAST INSPECTION: 35° F differential in reported daily high and 25° in daily low; gusts of 20 knots.

TOTALS: Cracks, 49 ; Flaking, 30 ; Extensions, 18 .

A. BOQ Area

Bldg.	Interval since Last Insp.	Time of Inspection	Additional Spalling or Flaking	New Cracks	Crack Extensions	Remarks
678	22 days	1300	1	3	0	W. end
679	"	1330	2	1	2	SW and SE corners
677	"	1350	0	0	0	
676	"	1425	0	0	0	
675	"	1405	0	0	1	East end
680	"	1605	1	0	0	
681	"	1620	0	2	0	
682	"	1550	1	3	0	West side
683	"	1530	0	3	0	East end, Severe spall overhang SW corner
684	"	1510	0	0	0	
479	"	1040	0	0	0	
478	"	1100	0	0	0	
477	"	1115	0	0	0	
476	"	1125	1	0	0	Overhang NW corner
475	"	1145	3	1	0	
484	"	0900	0	0	1	
483	"	0915	2	4	0	West end
482	"	0935	0	0	0	
481	"	0950	1	0	1	West corners
480	"	1015	1	1	1	
SUBTOTAL			13	18	6	

INSPECTION DATE:

B. Other Buildings

Bldg.	Interval Since Last Insp.	Time of Inspection	Additional spalling or Flaking	New Cracks	Crack Extensions	Remarks
1002	22 days	1630	0	0	0	
1001	"	1640	0	0	0	
1000		1650	1	1	0	
710	"	0935	0	1	0	
700	"	1000	2	0	1	
725	"	1015	0	1	0	
726	"	1035	0	0	0	
703	"	1050	0	0	0	
702	"	1100	0	0	1	1/2 inch
701	"	1105	2	1	1	Building appears loosened.
752	"	1315	1	2	1	
751	"	1330	0	1	2	
155	"	1350	4	0	4	
790	"	1215	2	9	0	Mult.H.L. throughout, S&W walls better shape than N & E
160	"	1320	0	1	0	
300	"	1420	2	2	0	
425	"	1450	0	1	0	
525	"	1510	0	0	1	
550	"	1550	0	1	0	
650	"	1530	0	2	1	
600		0855	2	5	0	Noticeable change
516	"	1610	1	3	0	
517	"	1620	0	0	0	
SUBTOTAL			17	31	12	

[redacted]

INSPECTION DATE: 14 April 1966

GENERAL WEATHER AND TEMPERATURE RANGE : 79 - 53° F, 20 knots

PREVIOUS INSPECTION DATE(S): 13 April 1966

GENERAL WEATHER EXTREMES SINCE LAST INSPECTION: None

TOTALS: Cracks, 20 ; Flaking, 13 Extensions, 7 .

A. BOQ Area

Bldg.	Interval since Last Insp.	Time of Inspection	Additional Spalling or Flaking	New Cracks	Crack Extensions	Remarks
678	1 day	1115	0	0	0	
679		1125	1	0	0	
677		1135	0	1	0	Overhangs E side
676		1150	0	1	0	
675		1140	0	0	1	
680		1400	0	0	0	
681		1300	0	0	0	
682		1225	0	0	0	
683		1210	0	0	0	
684		1200	0	1	0	
479		1030	0	0	0	
478		1040	0	0	0	
477		1050	0	0	0	
476		1055	0	0	0	
475		1105	0	0	0	
484		0700	1	0	1	
483		0715	1	1	0	
482		0730	1	0	0	
481		0740	2	2	0	
480		0755	1	0	1	
SUBTOTAL			7	6	3	

[redacted]

INSPECTION DATE: 14 April 1966

B. Other Buildings

Bldg.	Interval Since Last Insp.	Time of Inspection	Additional spalling or Flaking	New Cracks	Crack Extensions	Remarks
1002	1 day	1515	0	0	0	
1001		1455	0	0	0	
1000		1530	0	0	0	
710		0900	0	0	1	
700		0840	0	3	0	
725		0915	0	0	0	
726		0925	0	0	0	
703		0940	0	1	0	
702		0950	0	0	0	
701		0955	1	0	0	
752		1010	0	3	1	
751		1030	0	1	2	
155		1055	0	0	0	
790		1430	2	4	0	
130		1505	0	0	0	
300		1255	0	0	0	
425		1325	0	0	0	
525		1340	0	0	0	
550		1355	0	0	0	
650		1410	0	0	0	
600		0800	2	1	0	All on NW corner
516		1425	1	0	0	
517		1435	0	1	0	
SUBTOTAL			6	14	4	

INSPECTION DATE: 20 April 1966

GENERAL WEATHER AND TEMPERATURE RANGE: 61 - 31° F, 9 knots

PREVIOUS INSPECTION DATE(S): 14 April 1966

GENERAL WEATHER EXTREMES SINCE LAST INSPECTION: See footnotes

TOTALS: Cracks, 28 ; Flaking, 20 ; Extensions, 12 .

A. BOQ Area

Bldg.	Interval since Last Insp.	Time of Inspection	Additional Spalling or Flaking	New Cracks	Crack Extensions	Remarks
678	6 days	0825	0	1	0	SW corner
679		0815	0	0	0	
677		0840	1	1	0	W side
676		0905	0	0	0	
675		0850	0	0	2	
680		0925	0	0	0	
681		0915	0	0	0	
682		0935	0	0	0	
683		0950	0	0	0	
684		0940	0	0	0	
479		1105	0	1	0	Near SE corner
478		1115	0	1	0	Near SE corner
477		1130	0	0	0	
476		1145	0	0	0	
475		1135	1	0	0	
484		1015	0	0	0	
483		1005	1	0	0	
482		1025	0	0	0	
481		1030	2	0	1	
480		1045	0	0	0	
SUBTOTAL			5	4	3	

1) Temperature decreased 25° F, 17 and 18 April; 2) Widely noted sonic boom which caused Mercury weather station barograph to instantaneously rise 0.02 inch, 19 April.
3) Gusting winds up to 36 knots from 14-19 April.

[redacted]

INSPECTION DATE: 20 April 1966

B. Other Buildings

Bldg.	Interval Since Last Insp.	Time of Inspection	Additional spalling or Flaking	New Cracks	Crack Extensions	Remarks
1002	6 days	1235	0	0	0	
1001		1245	0	0	0	
1000		1300	0	0	0	
710		0840	0	1	0	
700		0850	0	2	0	
725		0950	0	0	0	
726		0915	0	1	0	
703		0925	0	1	0	
702		0930	0	0	0	
701		0935	3	0	1	
752		0950	2	1	2	
751		1005	0	4	1	
155		1030	1	0	1	
790		1150	3	1	0	
160		1220	0	0	1	
300		1045	2	2	0	
425		1220	0	1	0	
525		1230	1	0	0	
550		1235	0	2	2	
650		1255	0	2	0	
600		0800	2	4	0	predominantly N side
516		1310	1	0	0	
517		1315	0	2	1	
SUBTOTAL			15	24	9	

[redacted]

[redacted]

INSPECTION DATE: 26 April 1966

GENERAL WEATHER AND TEMPERATURE RANGE: 83 - 58° F, 25 knots

PREVIOUS INSPECTION DATE(S): 20 April 1966

GENERAL WEATHER EXTREMES SINCE LAST INSPECTION: None

TOTALS: Cracks, 46 ; Flaking, 12 ; Extensions, 14 .

A. BOQ Area

Bldg.	Interval since Last Insp.	Time of Inspection	Additional Spalling or Flaking	New Cracks	Crack Extensions	Remarks
678	6 days	0715	1	0	0	SE corner
679		0700	0	0	0	
677		0730	0	0	0	
676		0750	0	0	0	
675		0735	0	0	0	
680		1035	0	0	0	
681		1020	0	0	0	
682		1050	0	1	0	SE corner
683		1105	0	0	0	
684		1115	0	0	0	
479		0930	0	0	0	
478		0940	1	1	0	W end
477		0950	0	0	0	
476		1015	0	1	0	W side
475		1000	1	0	0	
484		0810	0	0	0	
483		0825	0	1	0	SE corner
482		0840	0	0	1	SW corner
481		0915	0	0	0	
480		0850	0	2	0	SE corner & W end
SUBTOTAL			3	6	1	

[redacted]

[redacted]

INSPECTION DATE: 26 April 1966

B. Other Buildings

Bldg.	Interval Since Last Insp.	Time of Inspection	Additional spalling or Flaking	New Cracks	Crack Extensions	Remarks
1002	6 days	1345	0	0	0	
1001		1330	0	0	1	
1000		1330	0	2	0	
710		0920	0	1	0	
700		0920	0	0	0	
725		0940	0	1	0	
726		0940	1	2	0	major HL and spalls
703		1015	0	2	0	
702		1005	0	0	0	
701		1005	0	1	3	
752		1035	0	5	3	W side, major HL and spalls
751		1035	0	7	1	
155		1110	0	3	1	
790		1355	1	5	1	
160		1400	0	0	0	
300		1130	1	0	0	
425		1230	0	1	0	
525		1230	1	1	0	
550		1250	2	2	1	opening of old crack
650		1250	0	3	2	
600		0845	3	1	0	
516		1430	0	2	0	
517		1435	0	1	0	
SUBTOTAL			9	40	13	

[redacted]

[redacted]

INSPECTION DATE: 5 May 1966

GENERAL WEATHER AND TEMPERATURE RANGE: Fair, 88° to 66° F

PREVIOUS INSPECTION DATE(S): 26 April 1966

GENERAL WEATHER EXTREMES SINCE LAST INSPECTION: Daily lows ranged from 42-69° F; had wind gusts during interval of 30 knots

TOTALS: Cracks, 19 ; Flaking, 13 ; Extensions, 12 .

A. BOQ Area

Bldg.	Interval since Last Insp.	Time of Inspection	Additional Spalling or Flaking	New Cracks	Crack Extensions	Remarks
678	9 days	0750	0	0	0	
679		0745	1	0	0	NW corner
677		0800	1	0	0	NE corner
676		0820	0	0	0	
675		0810	0	1	0	W end near NW corner
680		0710	0	0	0	
681		0700	0	0	0	
682		0720	0	0	0	
683		0735	1	0	0	NW corner
684		0725	0	0	0	
479		0945	0	1?	0	(would not count if after Center S side shot)
478		0935	0	0	0	
477		0930	0	1?	0	(would not count if after SE corner shot)
476		0910	0	0	0	
475		0920	0	0	0	
484		1035	0	0	0	
483		1025	0	0	0	
482		1020	0	0	0	
481		1010	0	0	0	
480		0955	0	0	0	
SUBTOTAL			3	3	0	

[redacted]

[redacted]

INSPECTION DATE: 5 May 1966

B. Other Buildings

Bldg.	Interval Since Last Insp.	Time of Inspection	Additional spalling or Flaking	New Cracks	Crack Extensions	Remarks
1002	9 days	1440	0	0	0	
1001		1500	1	1	0	SE corner
1000		1600	1	0	0	
710		1815	0	0	0	
700		1725	3	2	4	1 new crack, probably old; spalls & Ext. S enc
725		1340	0	0	0	
726		1400	0	0	0	
703		1620	0	0	0	
702		1615	0	0	0	
701		1600	0	1	0	
752		1630	1	4	0	
751		1645	0	1	0	
155		1230	0	0	0	
790		1705	2	2	0	
160		1210	0	0	0	
300		1310	0	0	1	Retaining wall; S side
425		1150	0	1	0	
525		1135	0	0	0	
550		1905	0	2	7	Extensions probable on planter box
650		1115	0	1	0	Looks old
600		1835	1	0	0	
516		1045	1	0	0	Low S side
517		1055	0	1	0	Wall screen by kitchen
SUBTOTAL			10	16	12 (7 of these probably old)	

[redacted]

INSPECTION DATE: 6 May 1966

GENERAL WEATHER AND TEMPERATURE RANGE : Fair, 90° - 64° F

PREVIOUS INSPECTION DATE(S): 5 May 1966

GENERAL WEATHER EXTREMES SINCE LAST INSPECTION: None

TOTALS: Cracks, 37 ; Flaking, 13; Extensions, 10 .

A. BOQ Area

Bldg.	Interval since Last Insp.	Time of Inspection	Additional Spalling or Flaking	New Cracks	Crack Extensions	Remarks
678	1 day	1245	0	0	0	
679		1220	1	2	0	
677		1230	0	1	0	E. Side patched crack reopened
676		1300	1	1	0	S end
675		1300	0	0	0	
680		0920	0	0	0	
681		0915	0	1	0	16" horizontal; end at NE corner
682		0925	0	0	0	
683		0930	0	0	0	
684		0935	0	1	0	S center wall-low
479		0835	1	0	0	NE corner
478		0845	0	0	0	
477		0850	0	0	0	
476		0900	0	0	0	
475		0855	1	0	0	NW corner
484		0810	0	0	0	
483		0815	0	1	0	NE corner
482		0820	0	0	0	
481		0825	1	0	0	N side
480		0830	1	0	0	SE corner
SUBTOTAL			6	7	0	

INSPECTION DATE: 6 May 1966

B. Other Buildings

Bldg.	Interval Since Last Insp.	Time of Inspection	Additional spalling or Flaking	New Cracks	Crack Extensions	Remarks
1002	1 day	1555	0	2	0	
1001		1545	0	0	0	
1000		1535	0	1	0	
710		1630	0	0	0	
700		1645	4	3	0	
725		1700	0	0	0	
726		1615	0	3	1	
703		1500	0	0	0	
702		1530	0	0	0	
701		1545	1	3	1	
752		1420	0	4	0	
751		1445	0	3	0	
155		1420	1	1	0	
790		1500	0	3	2	
160		1430	0	0	0	
300		1405	0	0	0	
425		1400	0	0	0	
525		1345	0	0	0	
550		1330	0	1	1	
650		1325	0	2	5	
600		1340	0	4	0	
516		1630	1	0	0	S. Side
517		1610	0	0	0	
SUBTOTAL			7	30	10	

[redacted]

INSPECTION DATE: 12 May 1966

GENERAL WEATHER AND TEMPERATURE RANGE : Fair, 73° - 44° F

PREVIOUS INSPECTION DATE(S). 6 May 1966

GENERAL WEATHER EXTREMES SINCE LAST INSPECTION: 20° F variation in highs and in lows during interval.

TOTALS: Cracks, 14; Flaking, 15; Extensions, 3.

A. BOQ Area

Bldg.	Interval since Last Insp.	Time of Inspection	Additional Spalling or Flaking	New Cracks	Crack Extensions	Remarks
678	6 days	1700-1840	0	0	0	
679		"	0	0	0	
677		"	0	0	0	
676			0	0	0	
675		"	0	0	0	
680		"	1	0	0	SE corner
681		"	0	0	0	
682		"	0	0	0	
683		"	0	0	0	SW corner
684		"	1	0	0	
479		"	2	0	1	E corners
478		"	0	0	0	
477		"	0	0	0	
476		"	0	1	0	NE corner
475		"	0	0	0	
484		"	0	0	0	
483		"	0	0	0	
482		"	0	0	0	
481		"	1	0	0	W side
480		"	0	0	0	
SUBTOTAL			5	1	1	

[redacted]

INSPECTION DATE: 12 May 1966

B. Other Buildings

Bldg.	Interval Since Last Insp.	Time of Inspection	Additional spalling or Flaking	New Cracks	Crack Extensions	Remarks
1002			0	0	0	
1001		1910	0	1	1	
1000		1915	0	0	0	
710		1820	1	1	0	
700		1805	2	2	0	
725		1920	0	0	0	
726		1915	0	1	0	S side
703		1855	0	0	0	
702		1850	0	0	0	
701		1725	0	0	0	
752		1730	2	1	0	N side
751		1740	0	1	0	
155		1915	0	0	0	
790		1750	1	2	0	
160		1920	0	0	0	
300		1925	0	0	0	
425		1900	0	0	0	
525		1840	0	0	0	
550		1700	0	1	0	Planter Box
650		1835	0	1	1	1 block, continuing in bad shape
600		1955	3	2	0	w/spalling
516		1905	1	0	0	
517		1905	0	0	0	
SUBTOTAL			10	13	2	

[redacted]

INSPECTION DATE: 13 May 1966

GENERAL WEATHER AND TEMPERATURE RANGE : Fair, 75° - 50° F

PREVIOUS INSPECTION DATE(S): 12 May, 1966

GENERAL WEATHER EXTREMES SINCE LAST INSPECTION: None

TOTALS: Cracks, 28 ; Flaking, 22; Extensions, 3 .

A. BOQ Area

Bldg.	Interval since Last Insp.	Time of Inspection	Additional Spalling or Flaking	New Cracks	Crack Extensions	Remarks
678	1 day	1140	0	0	0	
679		1135	0	0	0	
677		1125	0	0	0	
676		1115	0	0	0	
675		1120	0	0	0	
680		1215	0	0	0	
681		1210	0	0	0	
682		1200	0	0	0	
683		1150	0	0	0	
684		1155	0	0	0	
479		1025	0	1	1	
478		1020	0	0	0	
477		1015	0	0	0	
476		1005	0	0	0	
475		1000	0	0	0	
484		1055	0	0	0	
483		1100	2	0	0	
482		1045	0	0	0	
481		1040	1	1	0	
480		1035	1	1	0	
SUBTOTAL			4	3	1	

[redacted]

INSPECTION DATE: 13 May 1966

B. Other Buildings

Bldg.	Interval Since Last Insp.	Time of Inspection	Additional spalling or Flaking	New Cracks	Crack Extensions	Remarks
1002	1 day	1015	0	1	0	major step; W side
1001		1005	0	0	0	
1000		0950	0	0	0	
710		1020	0	0	1	
700		1030	1	2	0	W and N side
725		1900	0	0	0	
726		1630	0	2	0	
703		1600	0	1	0	SE corner
702		1620	0	0	0	
701		1245	1	2	0	
752		0850	1	5	0	N and W sides
751		1040	2	3	0	All thru blocks
155		1540	0	0	0	
790		1110	3	2	0	N side
160		1525	0	0	0	
300		1725	4	0	0	retaining walls
425		1505	0	1	0	
525		1450	0	0	0	
550		1430	0	3	0	
650		1130	1	2	1	Most on W side
600		1300	5	1	0	1 new w/spall
516		1905	0	0	0	
517		1850	0	0	0	
SUBTOTAL			18	25	2	

[redacted]

INSPECTION DATE: 18 May 1966

GENERAL WEATHER AND TEMPERATURE RANGE: Fair, 89° - 69° F

PREVIOUS INSPECTION DATE(S): 13 May 1966

GENERAL WEATHER EXTREMES SINCE LAST INSPECTION: 15° F variation in highs and in lows during interval

TOTALS: Cracks, 11; Flaking, 25; Extensions, 3.

A. BOQ Area

Bldg.	Interval since Last Insp.	Time of Inspection	Additional Spalling or Flaking	New Cracks	Crack Extensions	Remarks
678	5 days	1000	0	0	0	
679		1030	1	1	0	
677		1240	1	0	0	
676		1255	0	0	0	inside worse than out.
675		1105	1	0	0	
680		1310	1	1	0	
681		1330	1	0	0	
682		1345	0	0	0	
683		1400	0	0	0	
684		1415	1	0	0	
479		1445	1	0	0	
478		1505	1	0	0	
477		1518	1	0	0	
476		1550	1	1	0	
475		1535	2	0	1	
484		1705	0	0	0	
483		1635	0	0	0	
482		1650	1	0	0	
481		1720	1	0	0	
480		1615	1	0	0	
SUBTOTAL			15	3	1	

[redacted]

INSPECTION DATE: 18 May 1966

B. Other Buildings

Bldg.	Interval Since Last Insp.	Time of Inspection	Additional spalling or Flaking	New Cracks	Crack Extensions	Remarks
1002	5 days	1440	0	0	0	
1001		1445	1	1	0	
1000		1450	0	0	0	
710		1435	0	0	0	
700		1420	1	1	0	
725		1500	0	0	0	
726			0	0	0	
703		0935	0	0	0	
702		0945	0	0	0	
701		1515	1	0	0	
752		1525	0	0	0	
751		1534	1	0	0	
155		0950	0	2	0	1 probably old
790		1355	3	0	0	
160		1000	0	1	2	
300		1005	0	0	0	
425		1030	1	0	0	
525		1040	0	0	0	
550		1630	1	1	0	
650		1615	0	1?	0	
600		No record of inspection				
516		1705	1	0	0	
517		1710	0	1	0	
SUBTOTAL			10	8	2	

INSPECTION DATE: 19 May 1966

GENERAL WEATHER AND TEMPERATURE RANGE: Fair, 92° - 61° F

PREVIOUS INSPECTION DATE(S): 18 May 1966

GENERAL WEATHER EXTREMES SINCE LAST INSPECTION: None

TOTALS: Cracks, 9 ; Flaking, 28 ; Extensions, 1 .

A. BOQ Area

Bldg.	Interval since Last Insp.	Time of Inspection	Additional Spalling or Flaking	New Cracks	Crack Extensions	Remarks
678	1 day	0800	1	0	0	
679		0812	0	0	0	
677		0825	2	1	0	w/new spalls
676		0835	1	0	0	
675		0847	0	0	0	
680		0750	1	0	0	
681		0705	1	0	0	
682		0715	0	0	0	
683		0740	1	0	0	
684		0725	0	0	0	1 new t.h.l. not counted
479		0940	1	1	0	
478		0900	0	0	0	
477		0910	0	0	0	
476		0930	0	0	0	
475		0920	0	0	0	
484		1020	0	0	0	
483		1030	1	0	0	
482		1007	0	0	0	
481		0955	2	0	0	
480		1045	0	0	0	
SUBTOTAL			11	2	0	

INSPECTION DATE: 19 May 1966

B. Other Buildings

Bldg.	Interval Since Last Insp.	Time of Inspection	Additional spalling or Flaking	New Cracks	Crack Extensions	Remarks
1002	1 day	1336	0	0	0	
1001		1340	0	1	0	
1000		1345	0	0	0	
710		1350	0	2	0	
700		1405	1	0	0	
725		1337	1	0	0	
726		1325	0	0	0	1 H1 not really counted
703		1340	0	0	0	
702		1330	0	0	0	
701		1333	0	0	0	
752		1310	2	0	1	
751		1250	0	1	0	
155		1305	0	0	0	
790		1100	5	1	0	
160		1125	0	0	0	
300		1230	3	0	0	
425			Not inspected			
525		1425	0	0	0	paint flaking
550		1407	0	0	0	
650		1410	0	0	0	
600		1245	2	0	0	Probably four new spalling areas
516		1400	3	1	0	
517		1352	0	1	0	
SUBTOTAL			17	7	1	

APPENDIX B

Photographs in this section depict typical Mercury structures and cracking. Peak particle velocity, where indicated, was measured at Quonset 25.

Figures B-1 to B-4	Typical Mercury structures
Figure B-5	Typical new dormitory crack, 1 Dec. 1965
Figures B-6 to B-8	Cracking after 0.18 cm/sec
Figures B-9 to B-14	Cracking after 0.21 cm/sec
Figures B-15 to B-19	Cracking after 0.13 cm/sec
Figures B-20 to B-25	Cracking after 28-day interval of no significant seismic motion

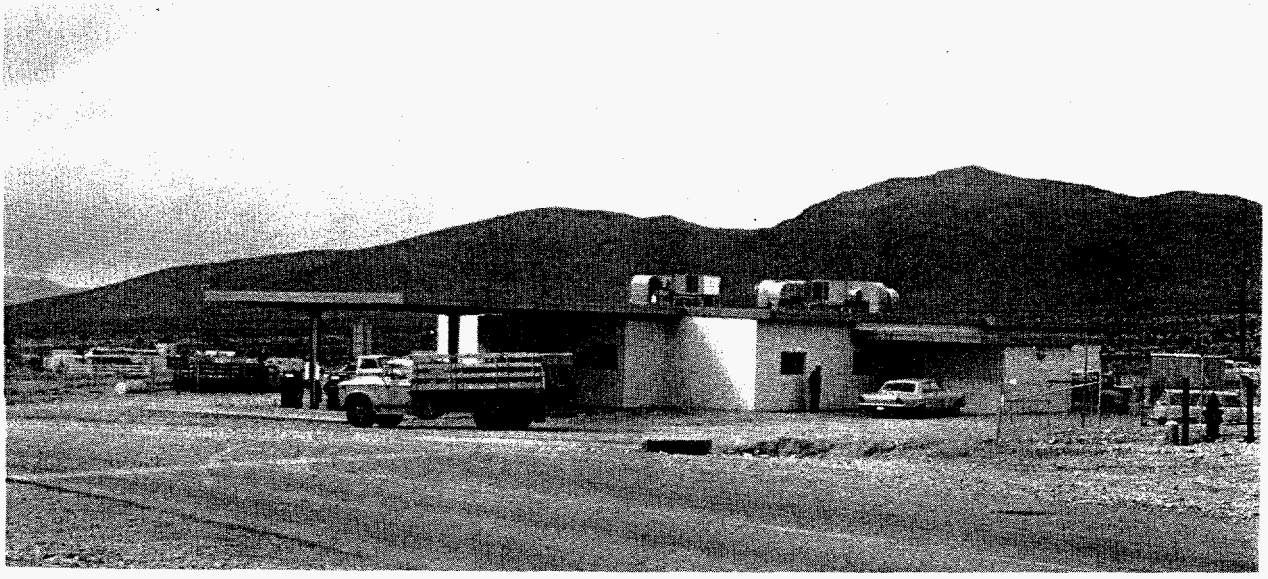

Fig. B-1. Typical Mercury masonry construction.

Fig. B-2. Typical Mercury dormitory.

Fig. B-3. New fire house, Building 425.

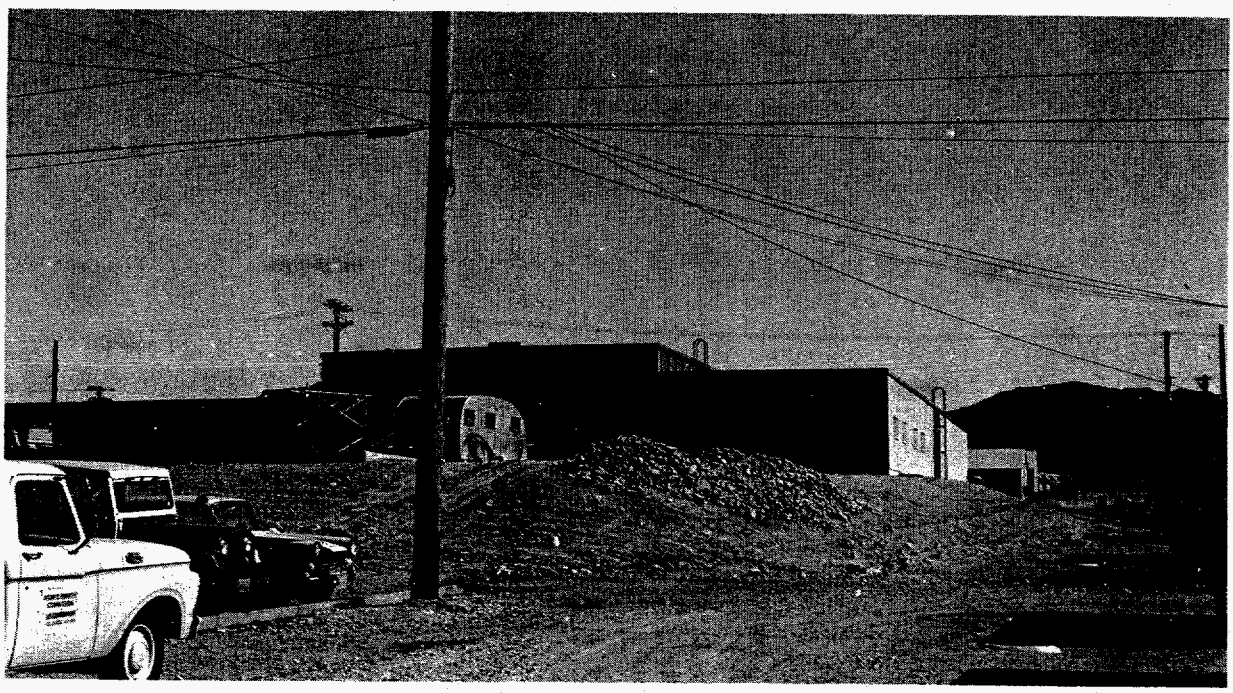

Fig. B-4. Building 425, from rear showing contour.

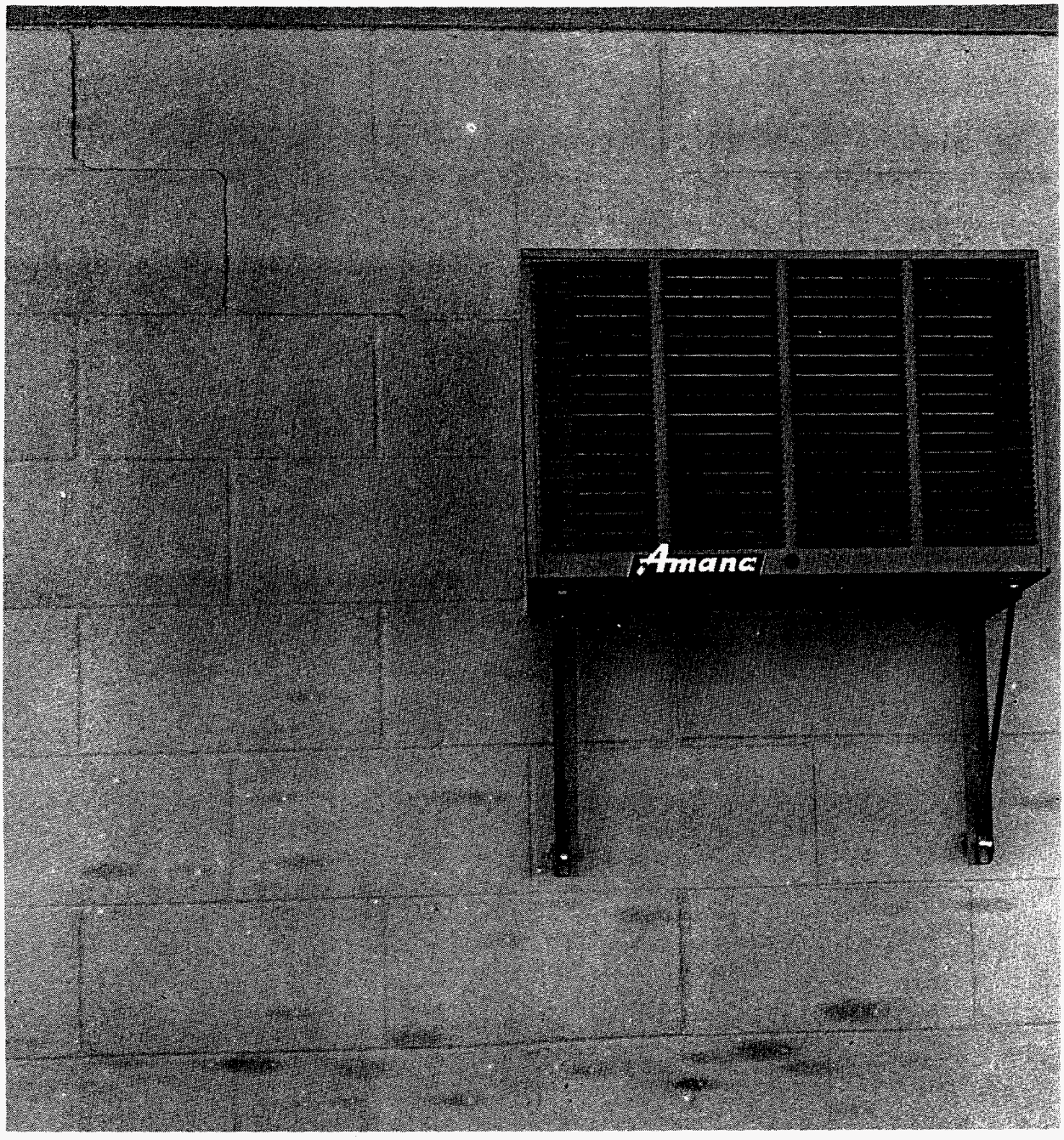

Fig. B-5. Typical existing crack, 1 Dec. 1965.

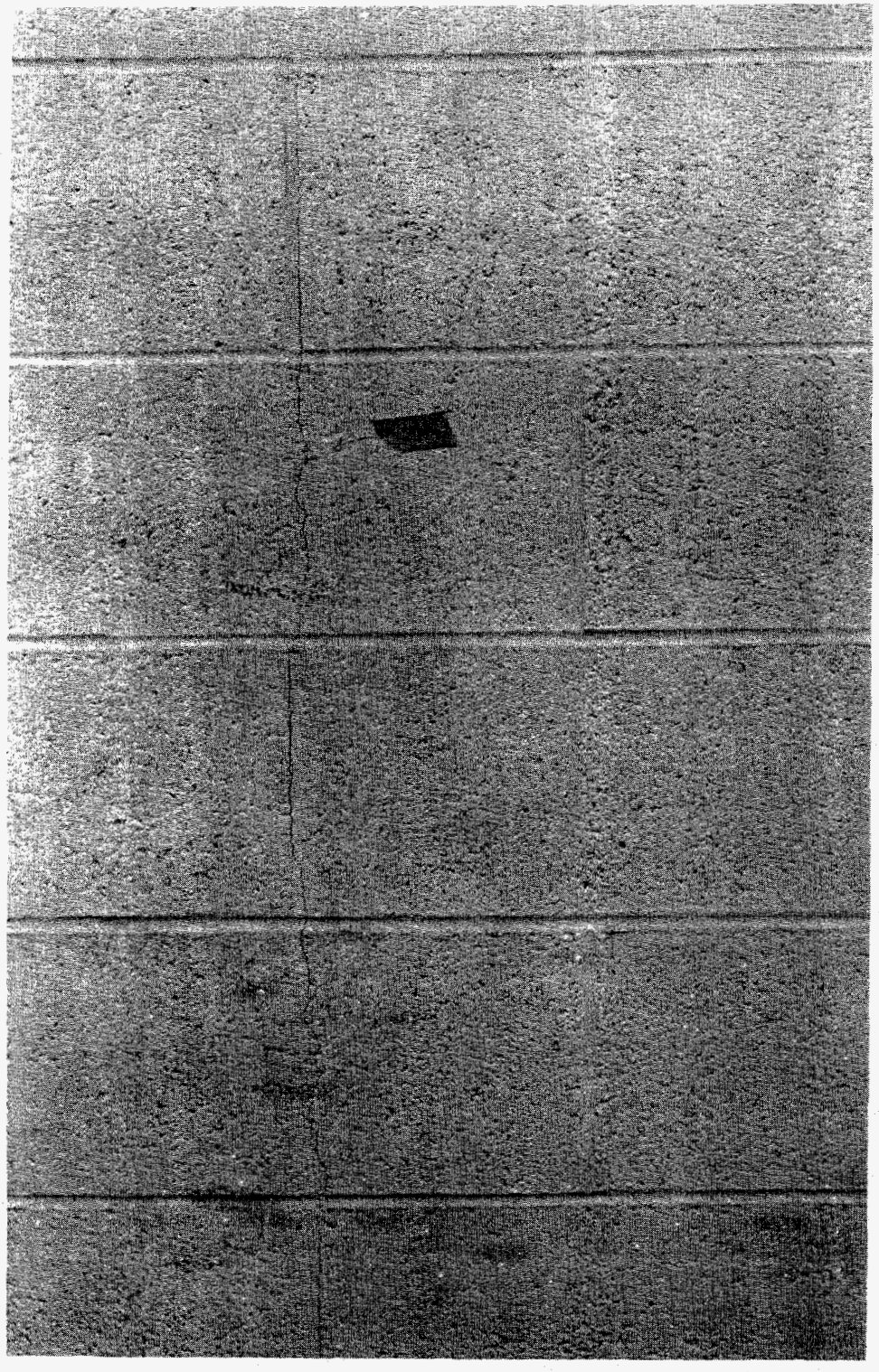

Fig. B-6. Building 751, north side, 0.18 cm/sec.

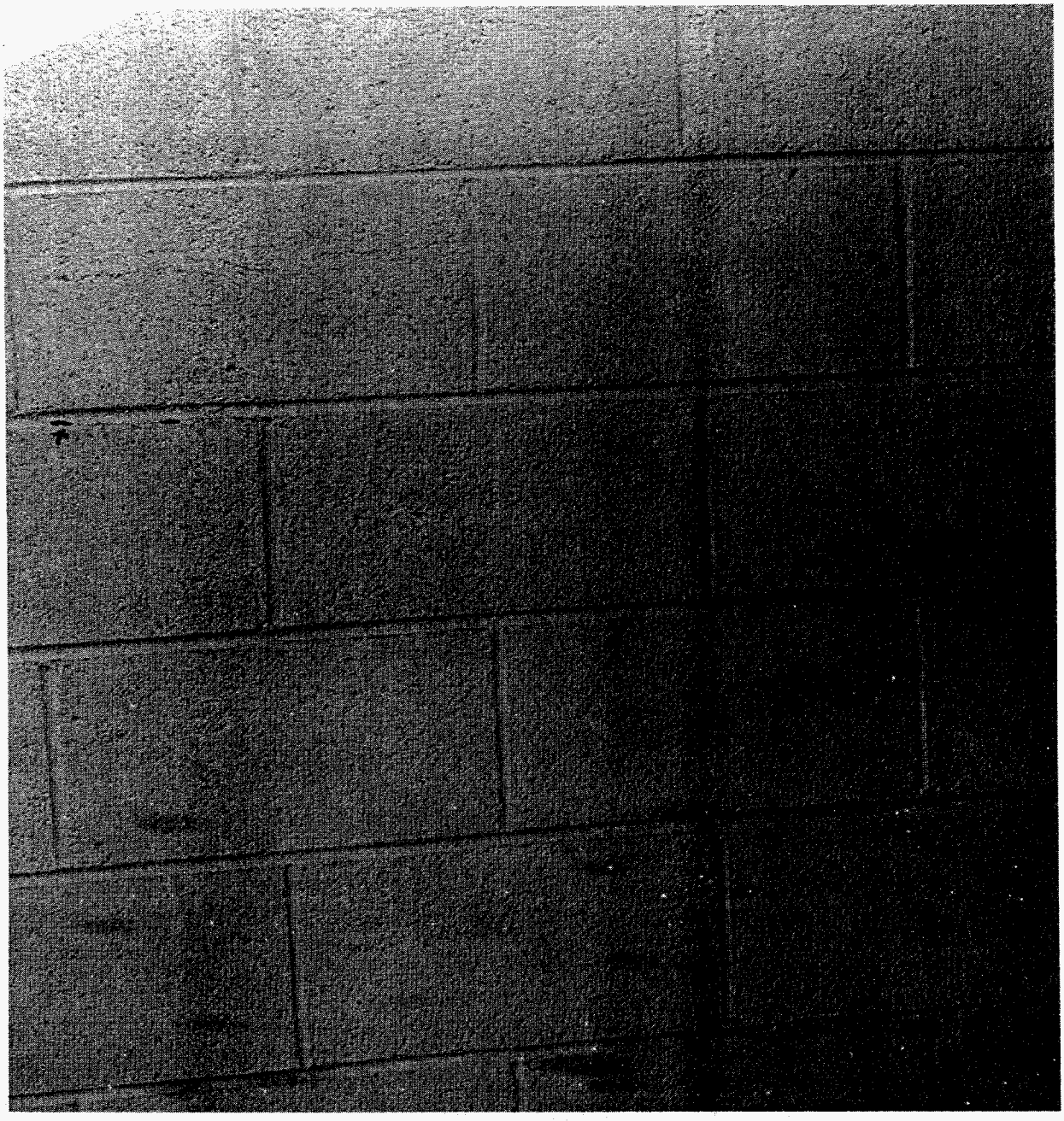

Fig. B-7. Building 681, west end, 0.18 cm/sec.

Fig. B-8. Building 752, north end (fresh flakes were found on ground) 0.18 cm/sec.

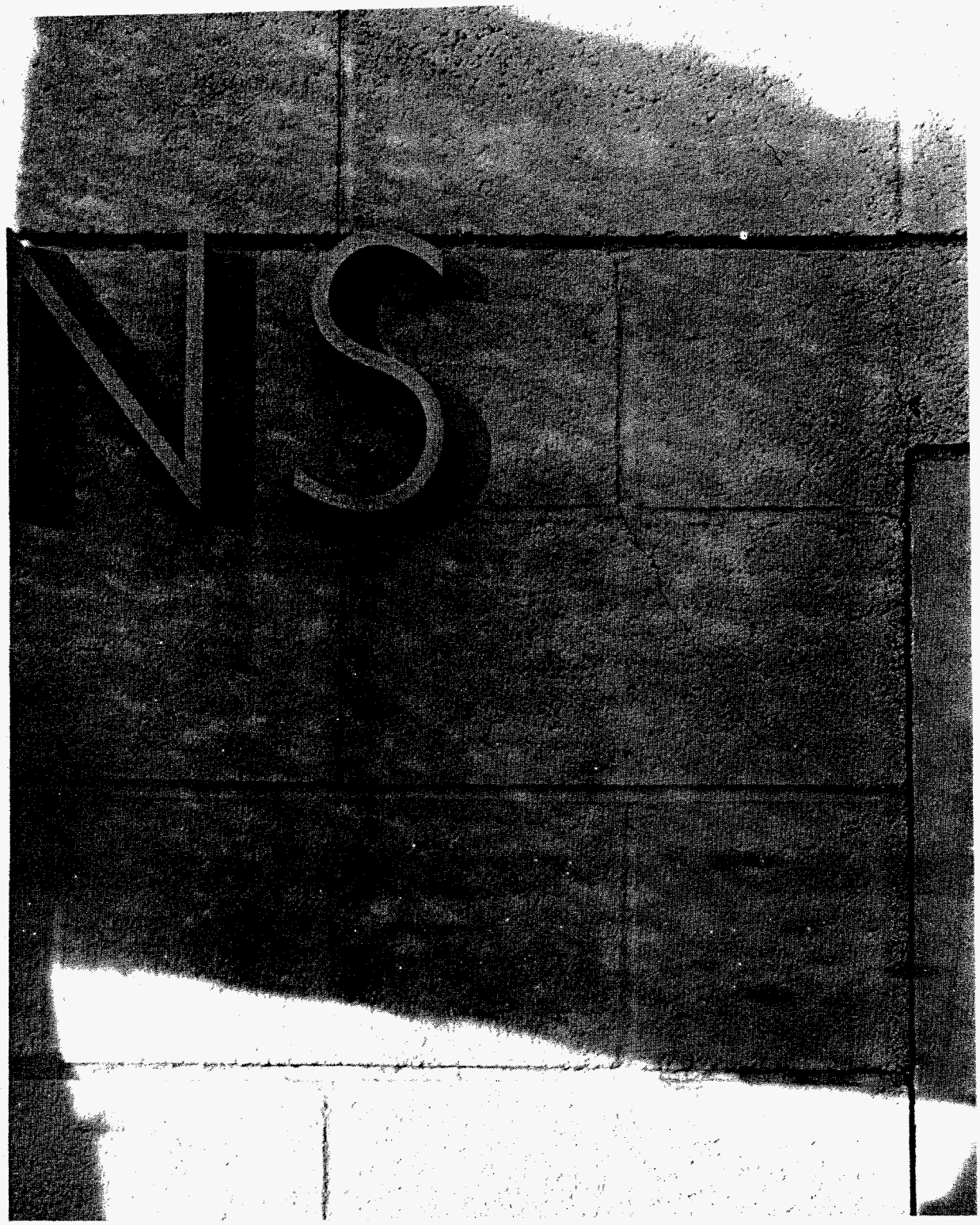

Fig. B-9. Building 726, 40-in. crack above "S" present on 1 and 7 Dec.; 16-in. extension of crack through "S" and a new 19-in. crack to the right present on 16 Dec., 0.21 cm/sec.

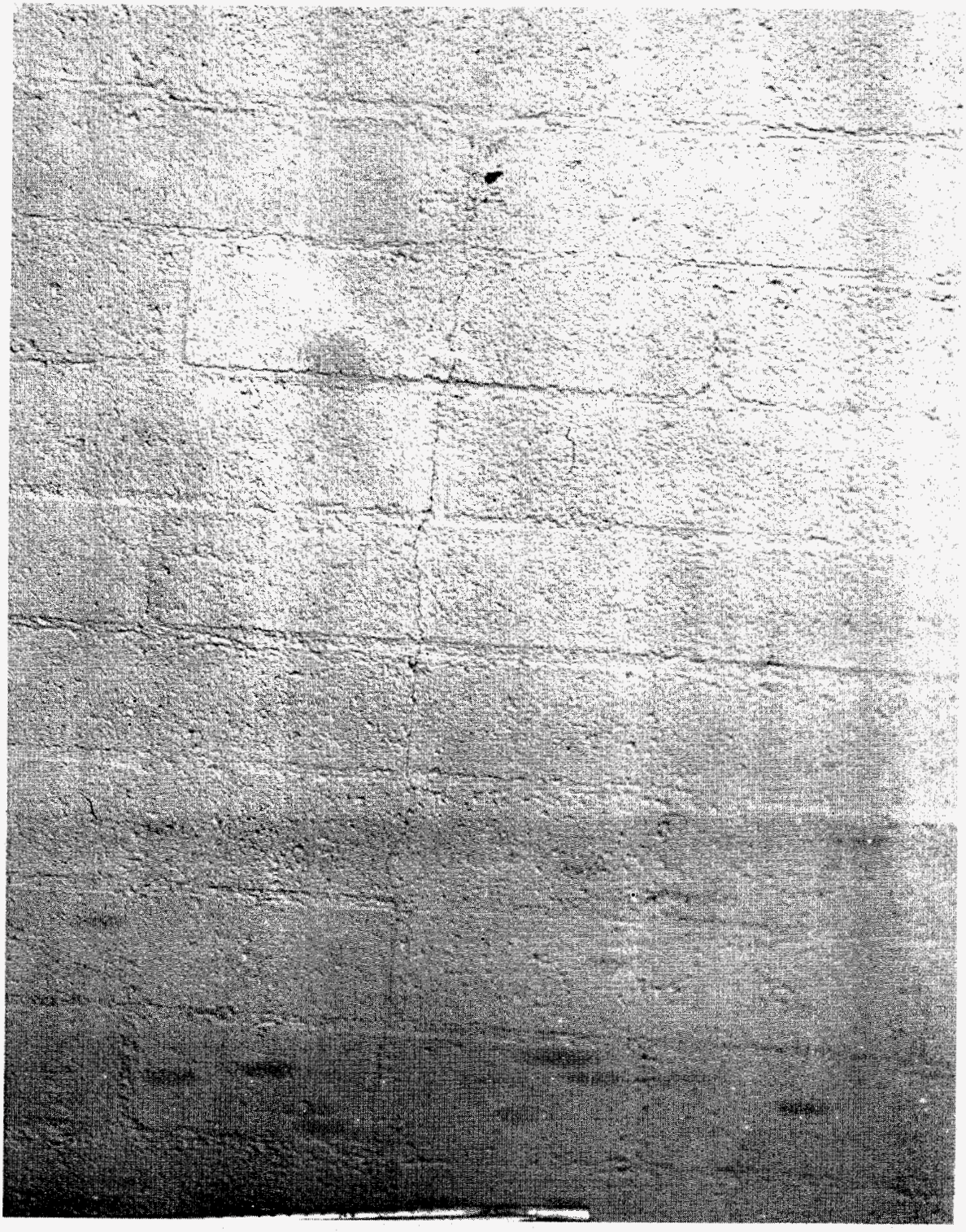

Fig. B-10. Building 155, east side, 0.21 cm/sec.

Fig. B-11. Building 1002, horizontal hairline over south door present on 1 and 7 Dec.; 16-in. vertical extension of crack present on 16 Dec., 0.21 cm/sec.

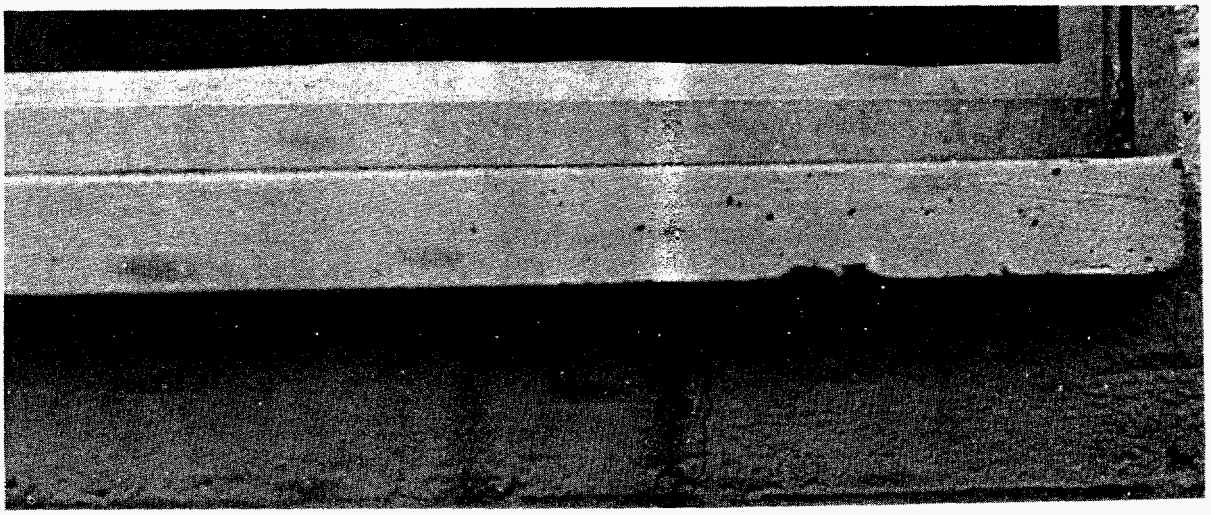

Fig. B-12. Building 700, vertical hairline under front window ledge, 0.21 cm/sec.

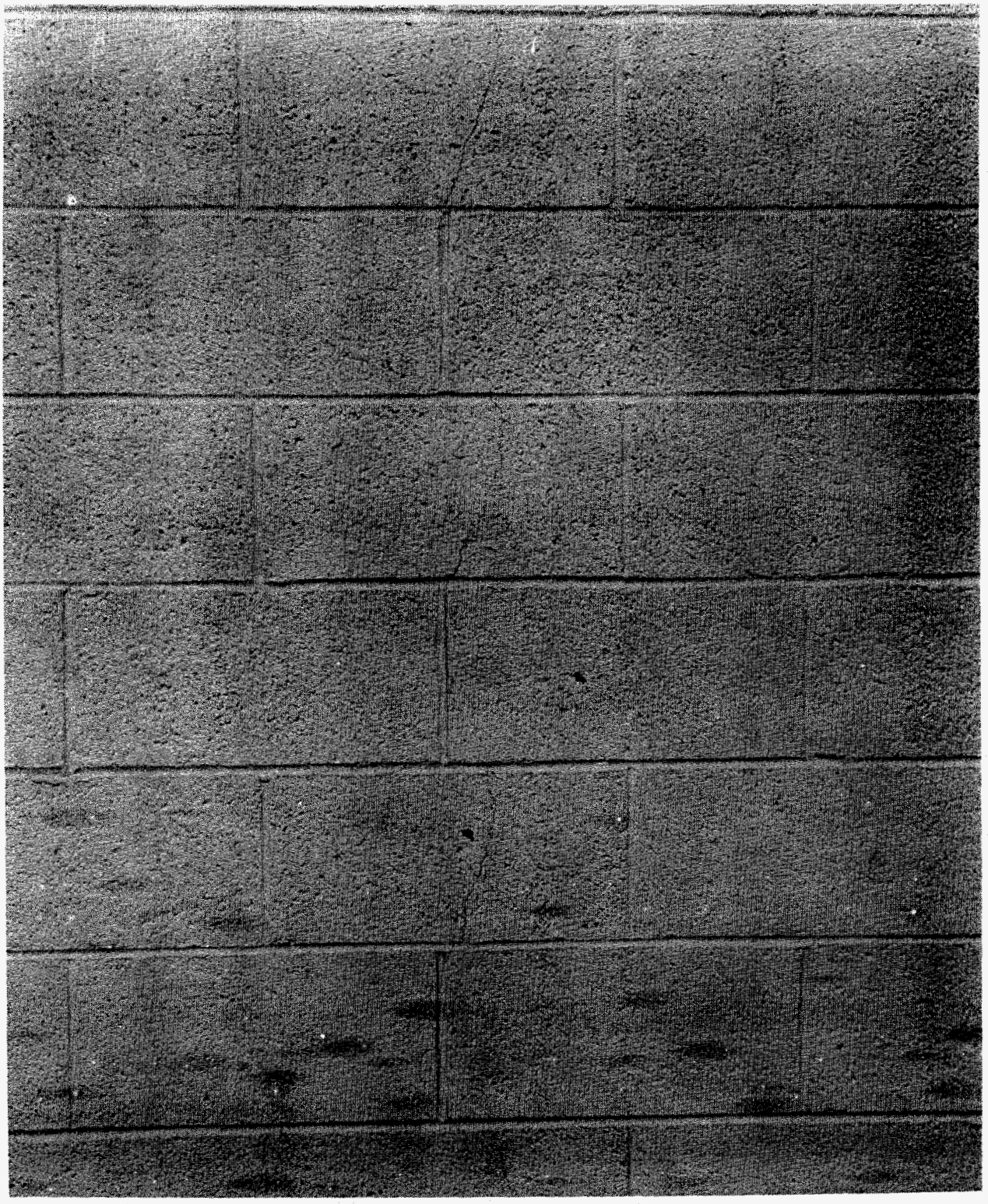

Fig. B-13. Building 700, south wall, 0.21 cm/sec.

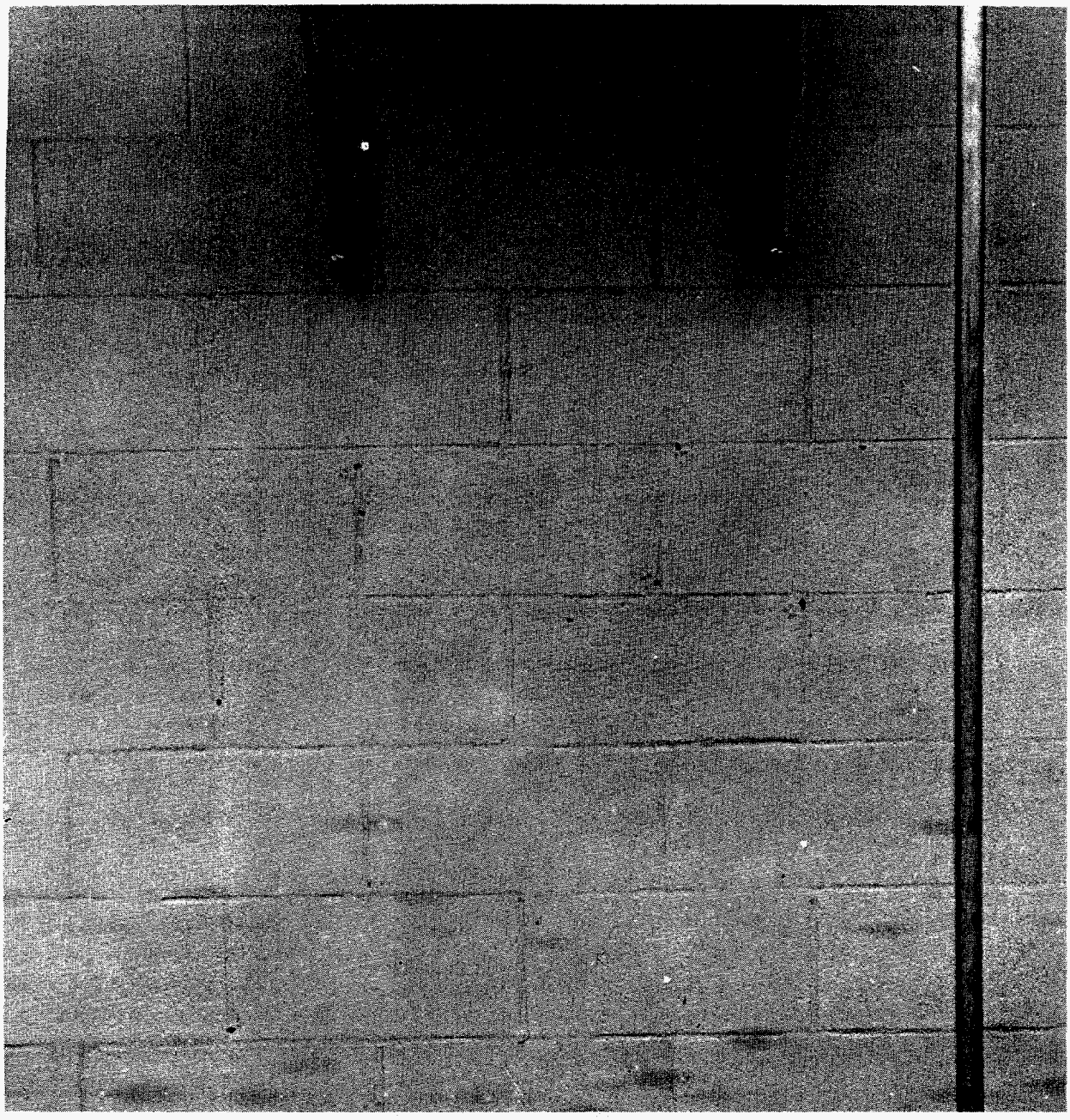

Fig. B-14. Building 479, extensive cracking under air conditioner, 0.21 cm/sec.

Fig. B-15. Building 710, south side, 0.13 cm/sec.

Fig. B-16. Building 701, north end of east side, crack over fan room door, 0.13 cm/sec.

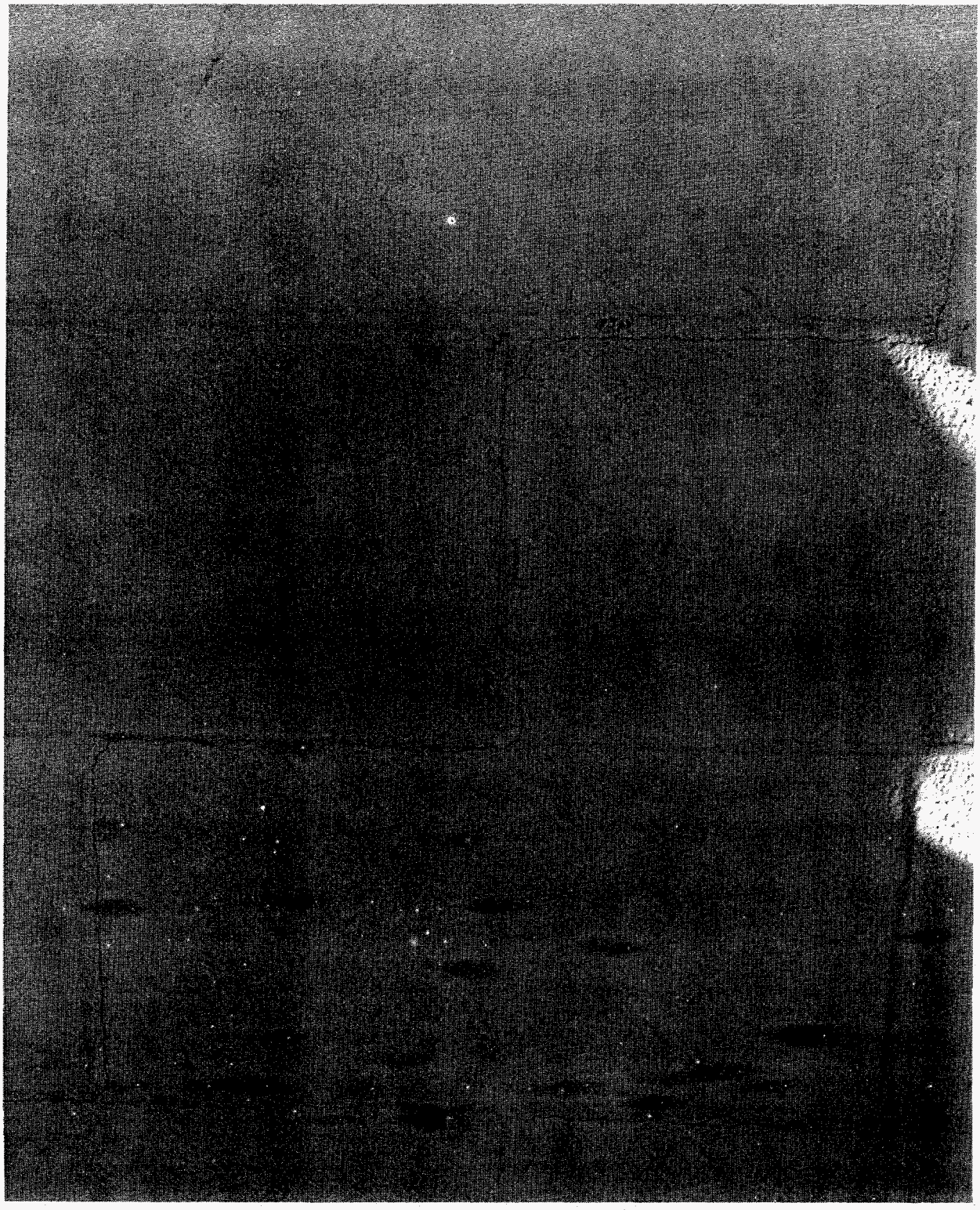

Fig. B-17. Building 479, 80-in. hairline crack at northeast corner, 0.13 cm/sec.

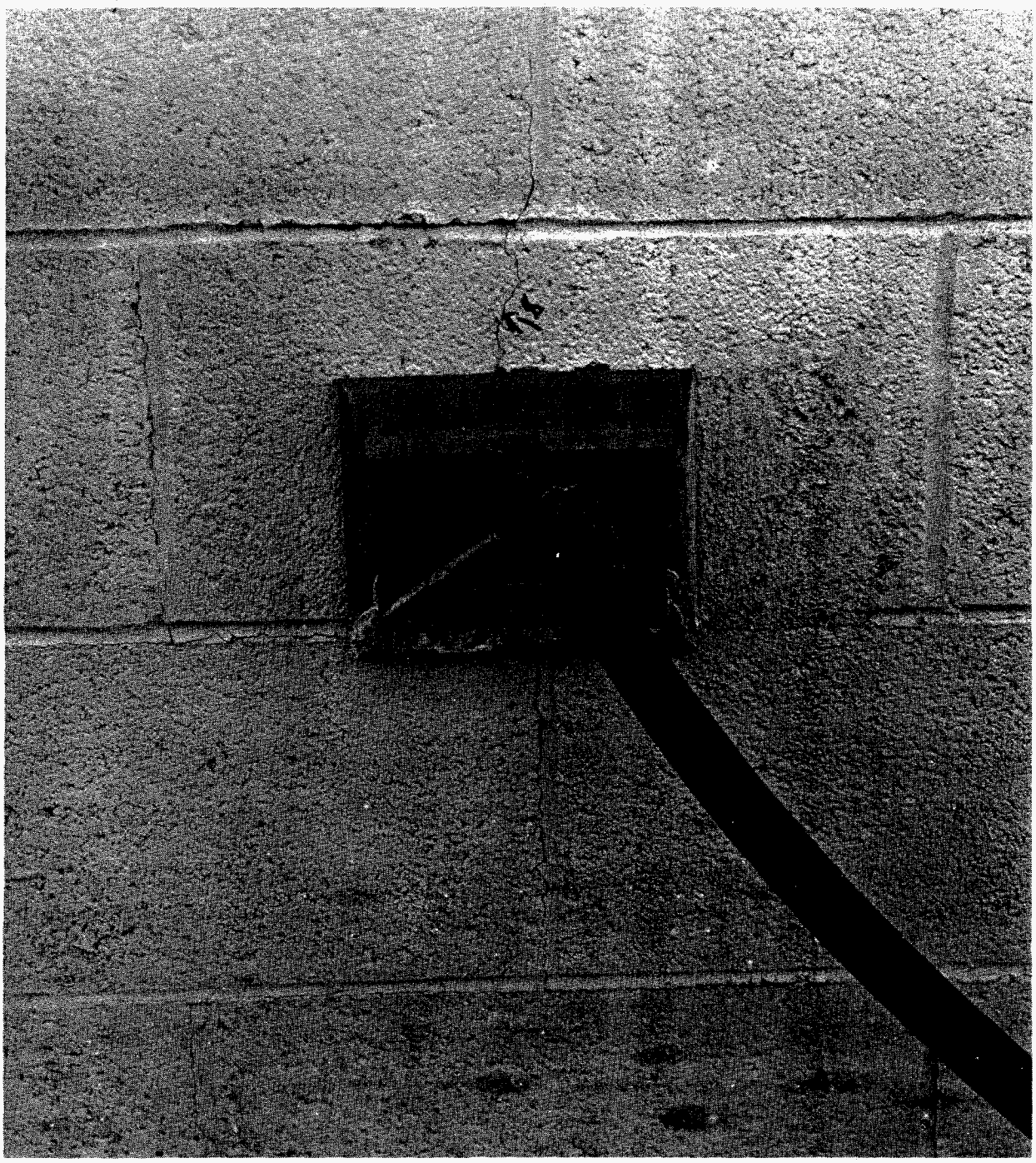

Fig. B-18. Building 790, west side, 0.13 cm/sec.

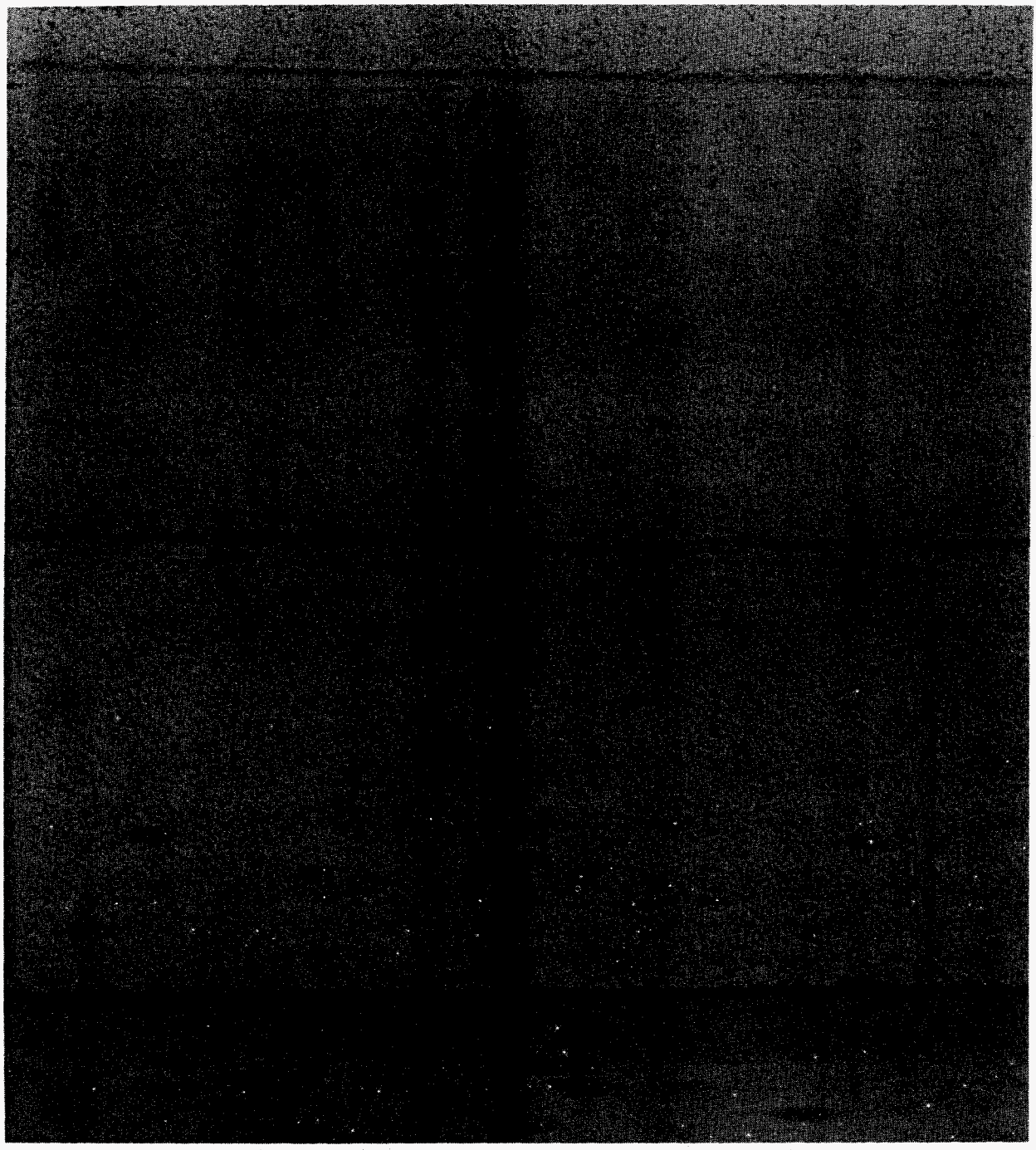

Fig. B-19. Building 684, northwest end, flaking along old hairline, 0.13 cm/sec.

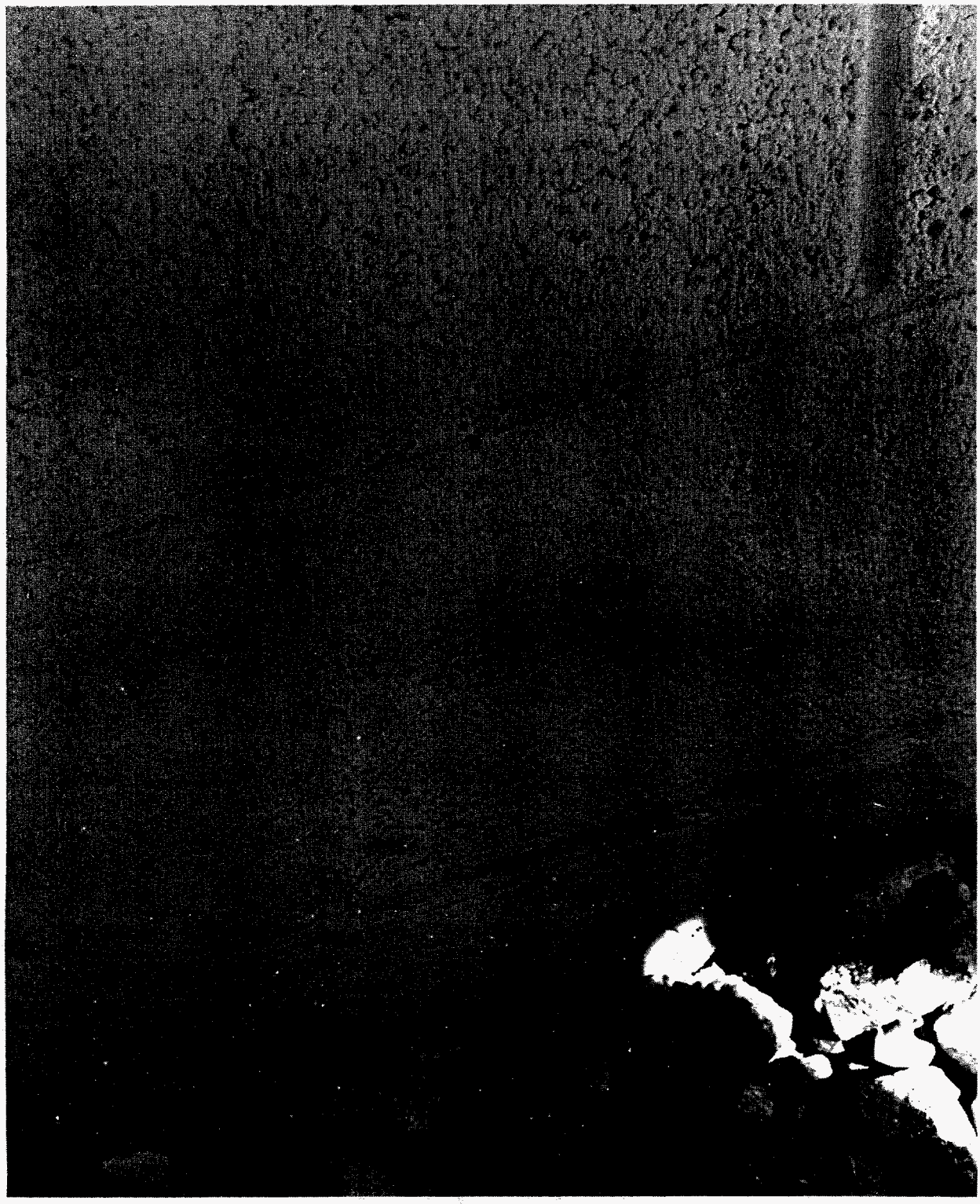

Fig. B-20. Building 676, step crack with some flaking, intermediate inspection.

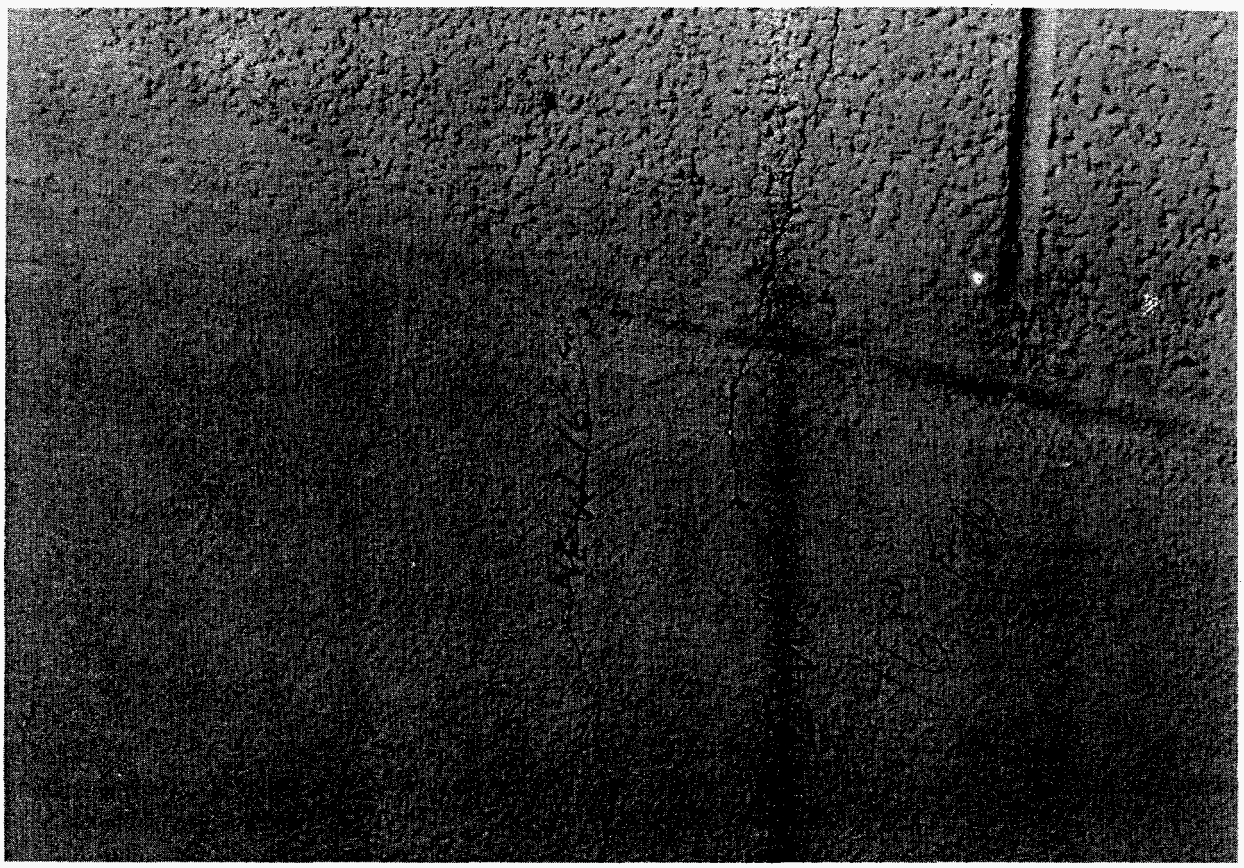

Fig. B-21. Building 1000, east side, intermediate inspection.

Fig. B-22. Building 679, several new flakes along old, low horizontal crack, intermediate inspection.

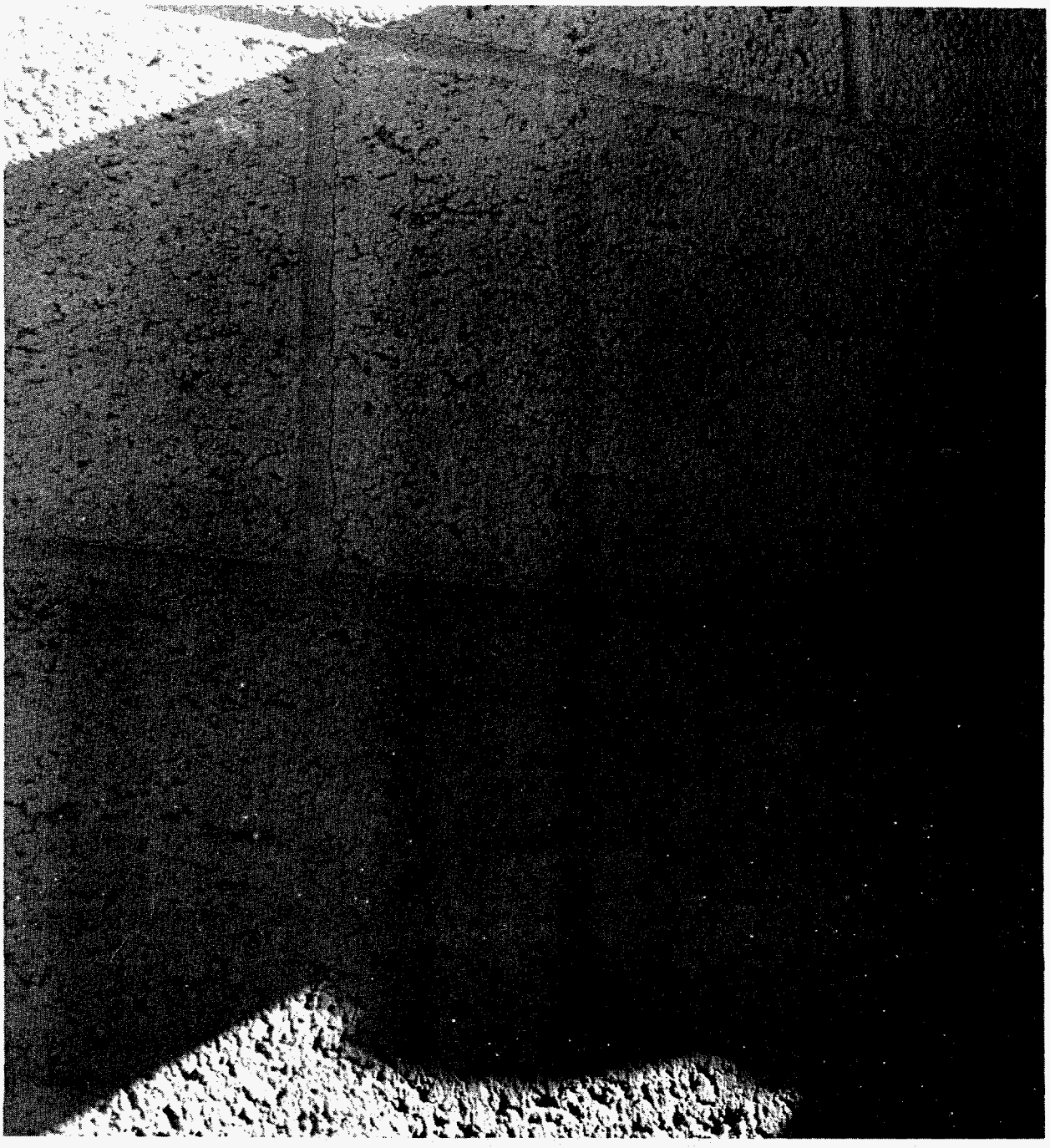

Fig. B-23. Building 790, step crack with flaking near east door, intermediate inspection.

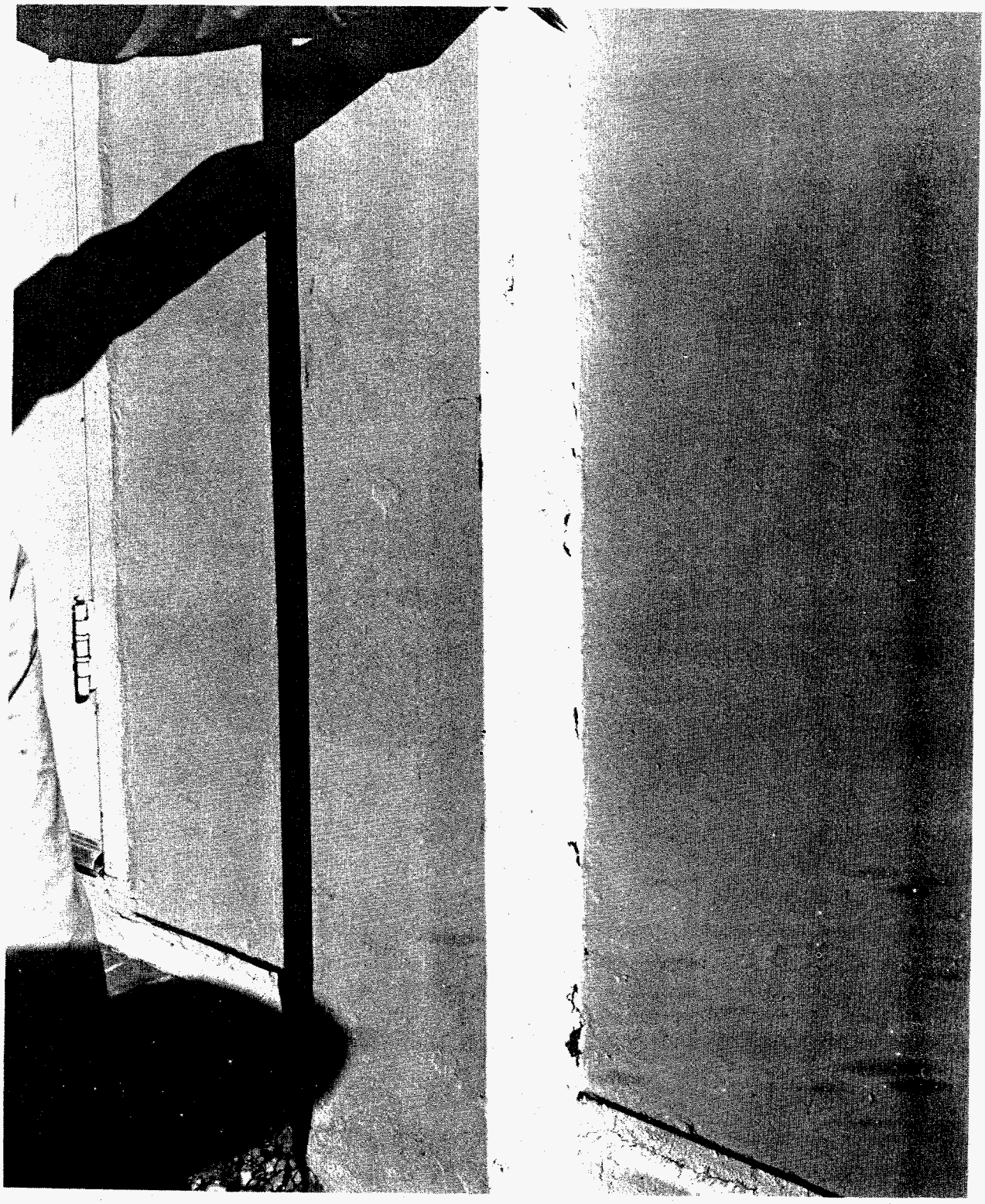

Fig. B-24. Building 725, south side, additional spalling at panel-post junction, intermediate inspection.

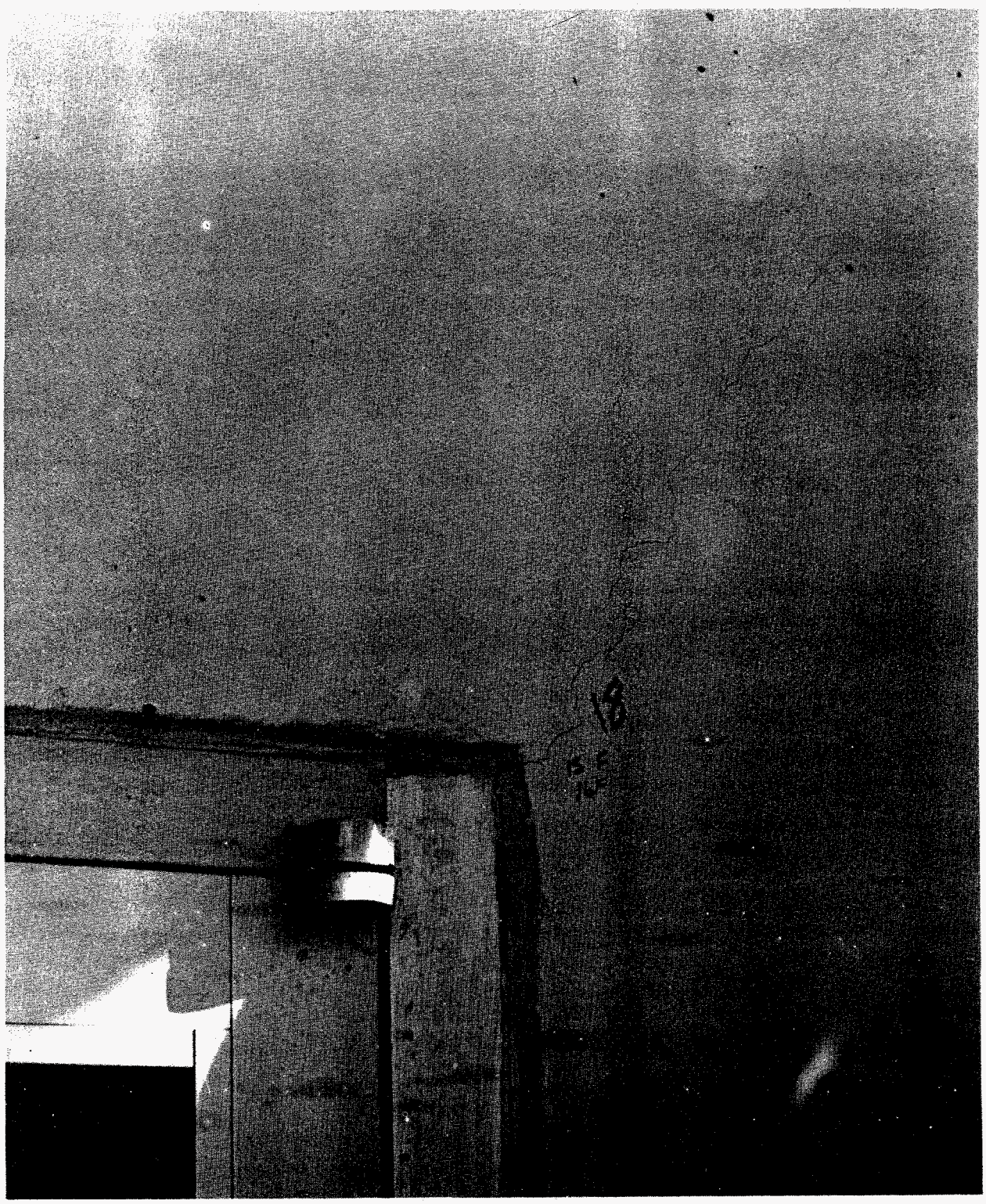

Fig. B-25. Building 725, minute diagonal crack over main door, intermediate inspection.

APPENDIX C
PROXIMITY GAGES

Daily logs were kept of high and low temperatures at Mercury and maximum wind gusts at Yucca weather station (Fig. C-1). The expansion and contraction associated with the daily Mercury temperature extremes are capable of causing large movements in existing cracks. A temperature sensing unit, Fig. C-2, installed within the south, sunny, wall of Building 481 indicated about a 43°C daily difference between high and low wall temperatures during the period 16-19 Jan. 1966 (Fig. C-3). A hydrograph, in a shaded location by Building 480, indicated air temperature differences of 12°F. Figure C-4 gives temperature and humidity data of the hydrograph for 17-19 Jan. 1966.

In order to record temperature and seismic induced movements, Bentley proximity gages with Sanborn and Massa-Cohu recorders were mounted across six existing cracks at five locations during a 24-hour background test and during a nuclear event 18 Jan. 1966. Ordinary thermometers were placed at each detecting unit. Typical installations are found in Figs. C-5, C-6, and C-7.

One crack was instrumented by Bentley gages and strain gages subsequent to 19 Jan. 1966. Bakelite-mounted detectors using a dual-channel Sanborn recorder were installed on both sides of this crack on the exterior and interior wall of the west end of Building 681. Gages were not opposite each other. Daily crack movements were large. Figures C-8 and C-9 present data taken on the outside and inside of an existing crack in the west wall of Building 681. Background instrumentation on 18 Jan. indicated crack width differences of 3.9 and 4.6 mils on the inside and outside, respectively. Measurements of 20 Apr. showed differences of 4.0 and 8.3 mils, respectively.

The same instrumentation was employed during nuclear detonations on 18 Jan. 1966 and 25 Apr. 1966; resultant peak particle velocities at Building 681 were approximately 0.14 and 0.32 cm/sec, respectively. Crack movements were negligible during both events. Crack movements could be inferred by using an etched scale magnifier and reading amplitudes to the nearest 0.1 mm. Arrival times ascertained by this method appeared reasonable for distance and geology to the detonation.

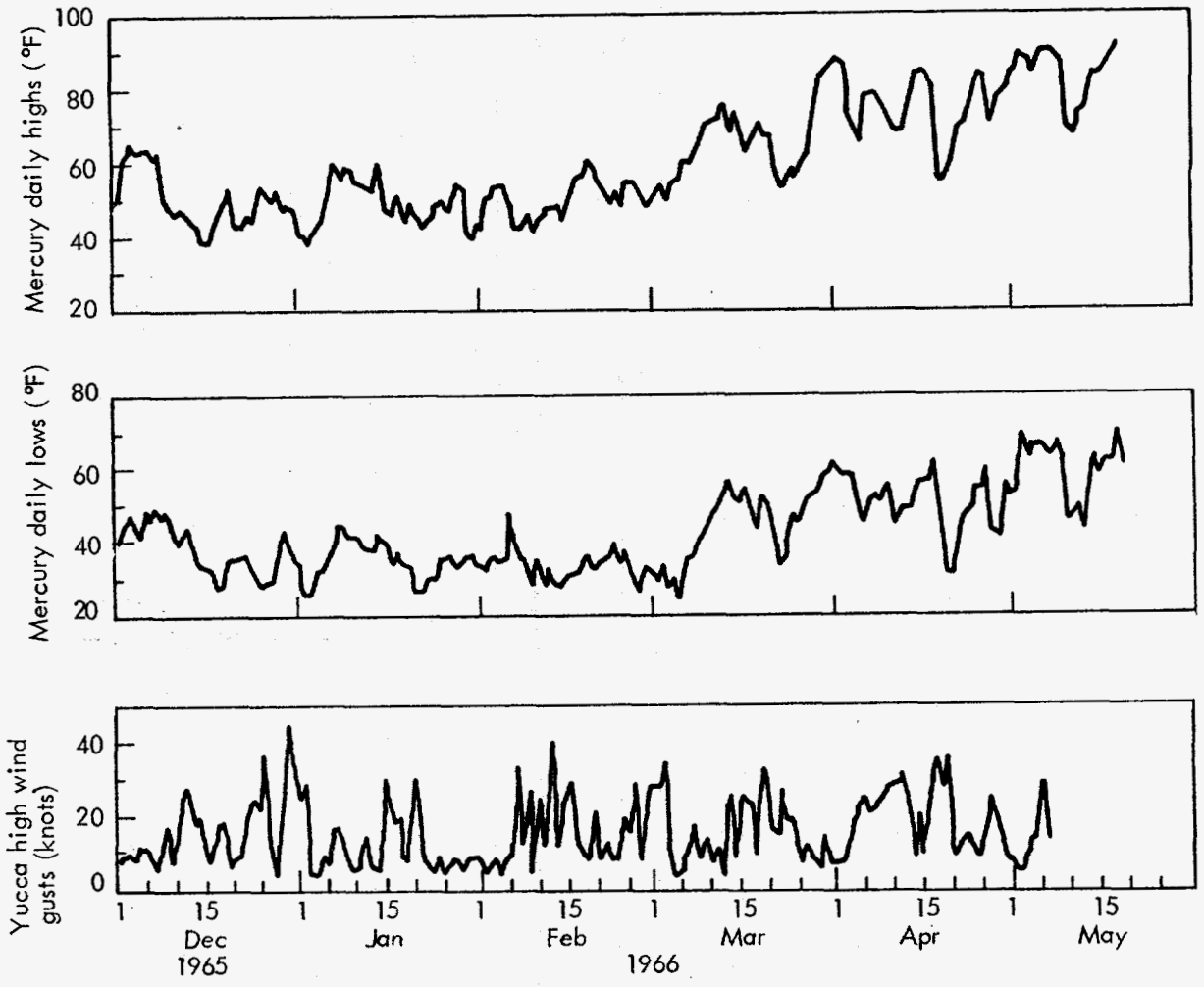

Fig. C-1. Daily high and low temperatures at Mercury and maximum wind gusts at the Yucca weather station.

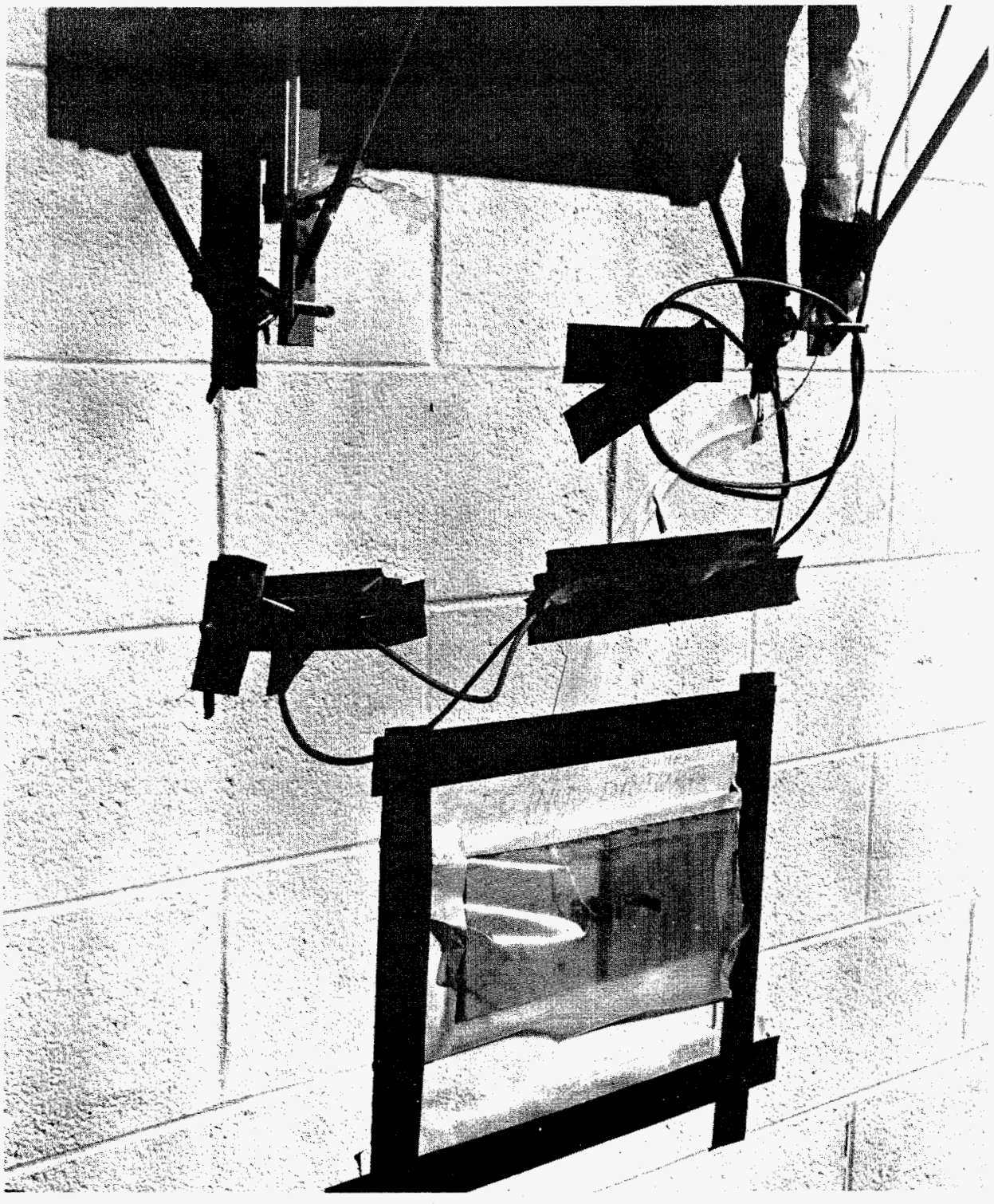

Fig. C-2. Covered Bentley detector and wall temperature sensing unit, south wall of Building 481.

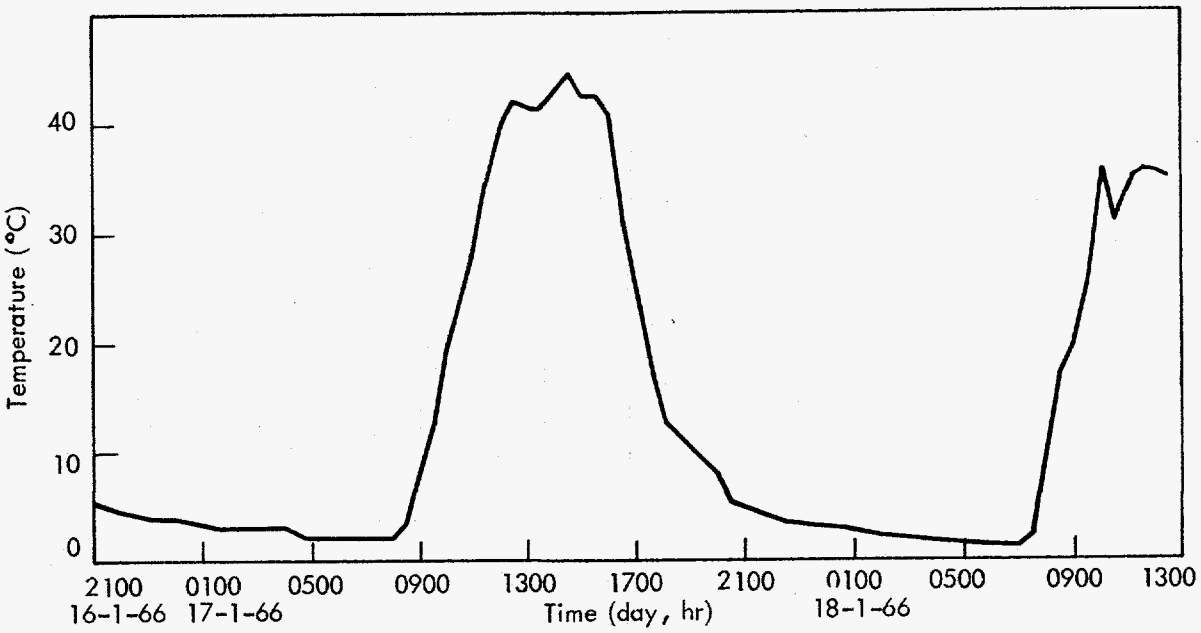

Fig. C-3. Sample temperatures as measured with the wall temperature sensing unit installed in south wall of Building 481.

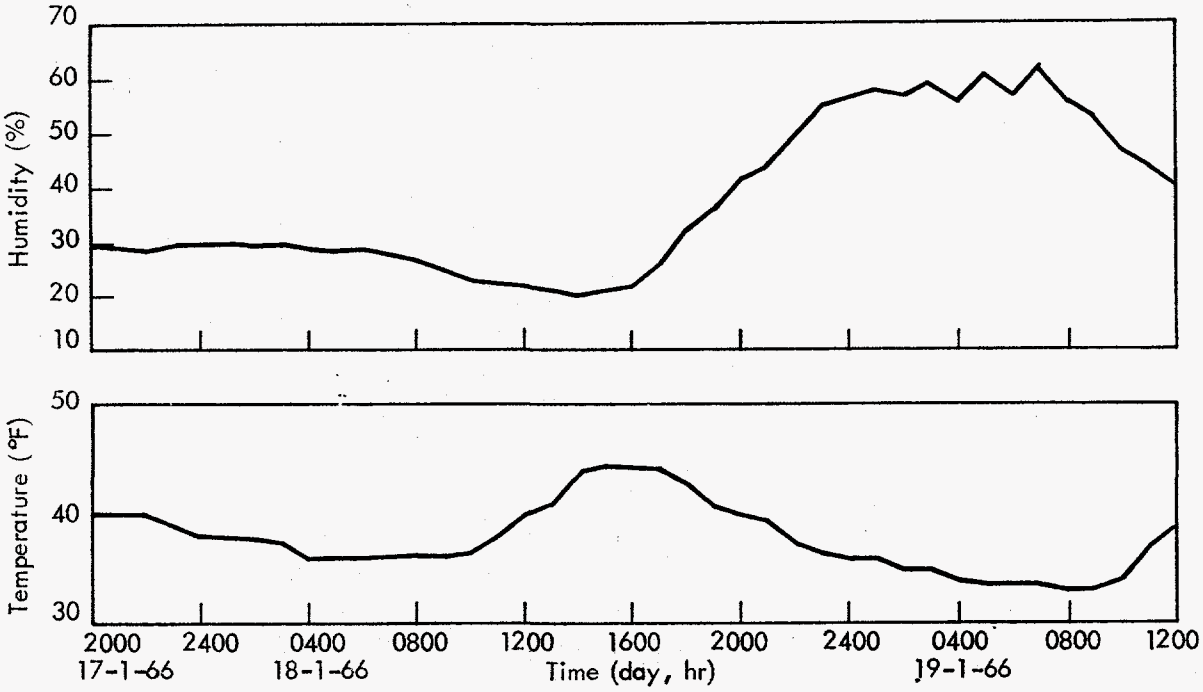

Fig. C-4. Temperature and humidity data as measured with a hydrograph outside Building 480.

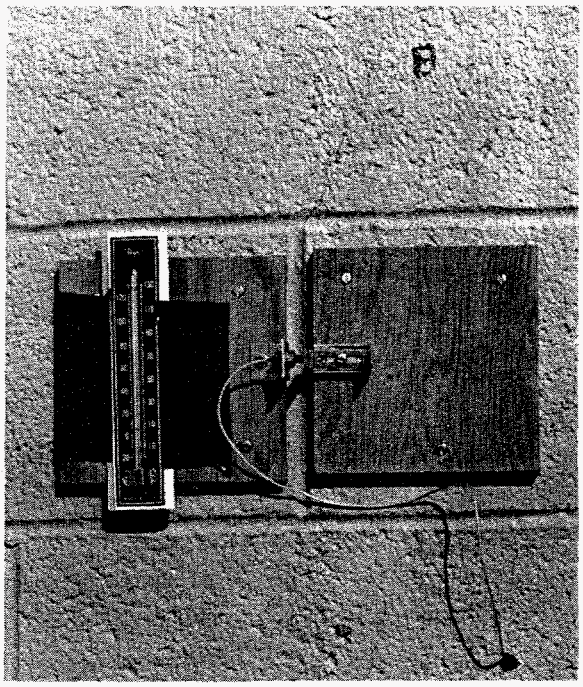

Fig. C-5. Bentley detector, south end of Building 700.

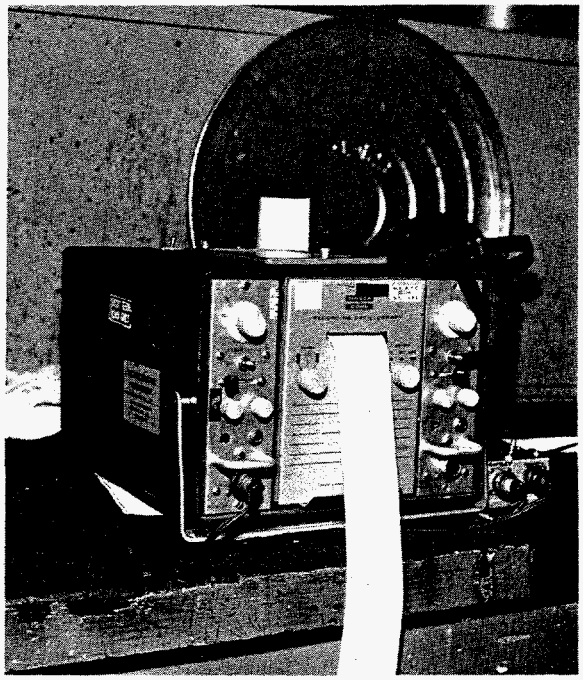

Fig. C-6. Massa-Cohu recorder, Building 700.

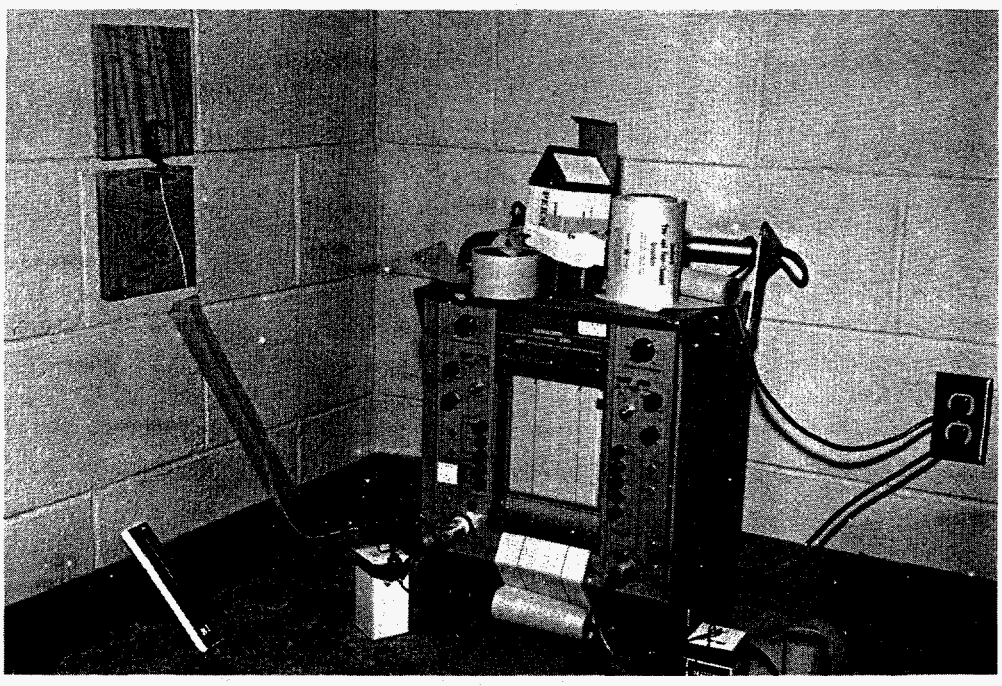

Fig. C-7. Bentley detector and Sanborn recorder inside Building 681.

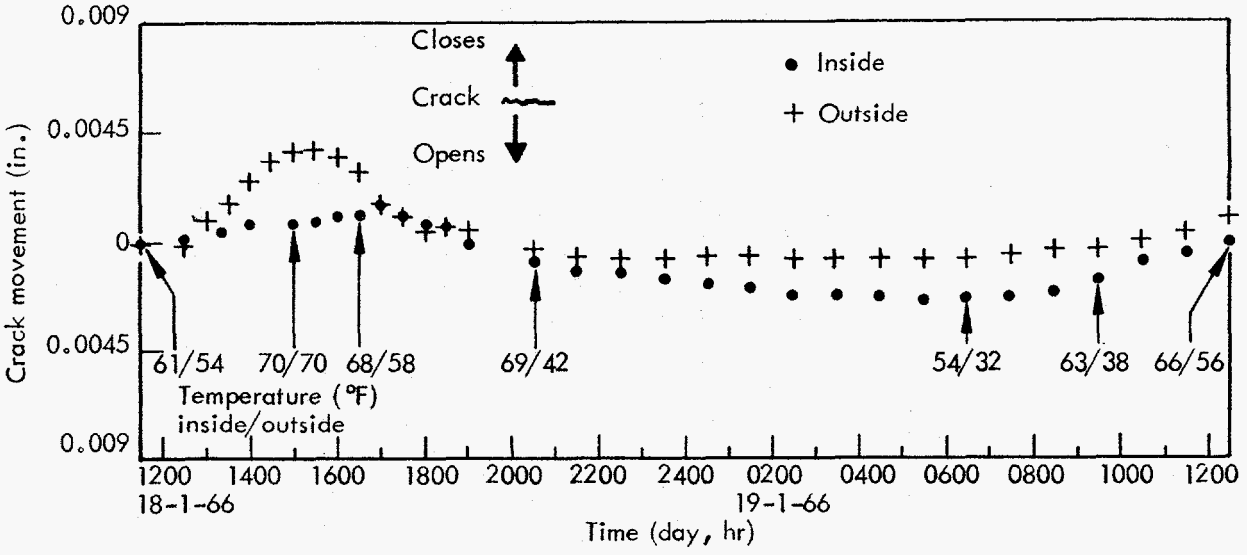

Fig. C-8. Movement of crack in Building 681 over a 24-hr period during Jan. 1966.

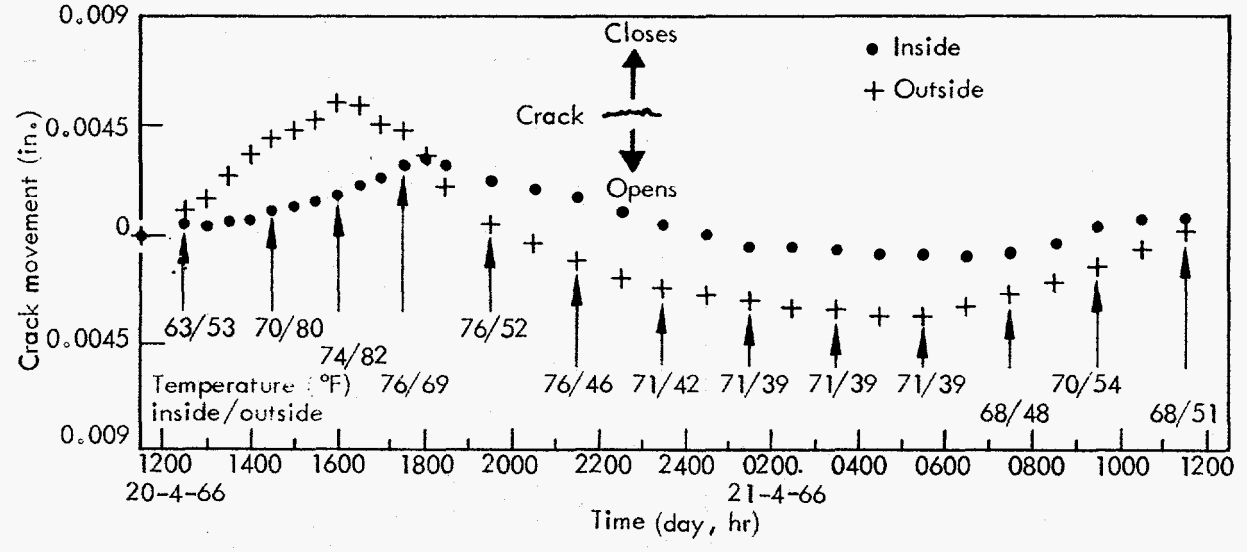

Fig. C-9. Movement of crack in Building 681 over a 24-hr period during Apr. 1966.

APPENDIX D
BUILDING 425

Building 425, the new Fire Station at Mercury, was completed about 18 Jan. 1966. It was in such an unblemished, relatively perfect condition that the proposed plan was to make weekly inspections to determine, if possible, some indication of normal cracking rates for this type of building at Mercury.

Weekly inspections showed many new hairline shrinkage cracks developing and extending. It is believed, however, that most all of these would not be objectionable to the so-called fastidious home owner. Those few cracks considered to be of a more serious size and extent are listed under the 23 Mar. inspection. None are deemed sufficiently prominent to warrant photographic coverage. Inspections will continue.

Based on the record of the 23 Mar. inspection, the crack rate may be about 2 to 3 cracks/month with 2 to 3 doubtful cracks.

Table III. Inspection record of Building 425.

Date of inspection	Condition observed
1 Dec. 1965	Under construction
3 Dec. 1965	Under construction
16 Dec. 1965	Under construction
5 Jan. 1966	Under construction
18 Jan. 1966	Fresh paint on finished building; no cracks
15 Feb. 1966	Cracks appearing in one vertical joint separation
23 Mar. 1966	North side center, vertical hairline crack top to bottom through foundation
	West side, south of door, vertical hairline crack top to bottom through foundation
	North side, west end, 6-block vertical hairline crack
	South side, west window, diagonal crack in right side of sill
	South side, near east corner, vertical hairline crack top to bottom with 1-block step over at 4th course up

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