NATIONAL BUREAU OF STANDARDS REPORT

3981

WEEP HOLES IN CONCRETE MASONRY PANEL WALLS

by

C. C. Fishburn and Edward J. McCamley, Jr.

Report to

Office of the Chief of Engineers
Department of the Army

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

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Abstract

Three small concrete masonry walls were subjected to exposure conditions simulating a wind-driven rain. Weep holes were provided in the vertical joints of the bottom course of each wall and their effect in reducing the leakage through the wall was studied. The walls were tested in painted and unpainted condition and with weep holes open and closed.

1. Introduction

A study of the function of weep holes in concrete masonry panel walls, as used in framed concrete buildings, was authorized by the Office of the Chief of Engineers, Department of the Army, in a letter dated February 24, 1954, signed by I. O. Thorley, Jr., Acting Chief, Engineering Division, Military Construction.

Three small concrete masonry test walls were subjected to exposure conditions simulating a wind-driven rain. Each wall was built on a cast concrete base of special shape. The base simulated the top of a concrete spandrel beam containing a recess in which the panel wall was supported at an elevation below that of the floor level.

Permeability tests were made on the wall specimens with the weep holes open (functioning) and with the weep holes closed. Variables which were studied included the effects of painting the walls with a cementitious paint, perforation of the top of the painted wall to simulate a horizontal shrinkage crack below the soffit of the spandrel beam above the panel, variation in the static air pressure (simulated wind pressure) applied to the exposed wall face and the effects of dropping mortar through the vertical cells in the block to the bottom of a wall.

2. Test Specimens

2.1 Walls

The three test walls were 8-in. thick, about 40-in. long and 50-in. high. Each wall was supported in a recess 1 1/2-in. deep formed in a poured concrete base resting on a steel channel section (see figure 1). The concrete base simulated the top of a spandrel beam on a concrete frame building in which the bottom of the concrete masonry panel wall is below the level of the concrete floor.

The concrete masonry units were of 8- by 8- by 16-in. nominal size. All of the units used in the first course of each wall were of half length. Walls A and B contained units of cinder aggregate concrete. Wall C contained sand and gravel aggregate concrete units. Some of the physical properties of the concrete masonry units are listed in table 1. All units were air dry when laid.

Mortar beds were placed under the face shells in all walls. The vertical joints were buttered with mortar to a depth equal to the thickness of the face shells. Care was taken to prevent the dropping of mortar into the interior of all walls during their construction. However, a half trowel of mortar was placed into the bottom of each cell in the first course of wall B, to simulate the careless dropping of excess mortar into a wall during its construction.

Weep holes were placed beneath each vertical joint in the first course (see figure 2). The holes were formed by placing a length of 3/8-in. dia rubber tubing in the mortar bed. One end of the tubing protruded from the wall; the other end was brought up vertically in the wall cells to a height above any mortar droppings. After the walls had been completed and the mortar had hardened, the rubber tubing was withdrawn.

2.2 Paint coatings for walls

The paints applied to the exposed faces of the walls were a base coat of a cement grout and a finish coat of white portland cement. The grout contained equal parts by weight of high-early strength portland cement and sand passing a No. 20 sieve. The amount of water used to temper the paints to a proper brushing consistency equaled 30 percent by weight of dry powder (cement and sand) for the grout and 40 percent by weight of powder (white cement) for the finish coat. The amounts of the dry powders applied to the walls are listed in table 2. The paints were applied to the dampened wall surfaces with a stiff fibered fender cleaning brush.

3. Water Permeability Test Apparatus

The test exposures and the test apparatus were similar to those described in NBS Reports BMS82 and BMS95. The exposed face of the test wall formed one side of a pressure chamber. Water at the rate of 40 gal/hr was applied to the top of the wall face from a tube containing a line of small perforations spaced 3/4 in. apart. The test chamber, without the wall, is illustrated in figure 3. The air pressure on the exposed wall face (inside the chamber) was maintained during the test at either 5-, 10- or 15-lb/ft^2 above atmospheric pressure; these pressures are equivalent to a hydrostatic head of about 1, 2, and 3 in., respectively. A wind velocity of 50 mph may produce a wind pressure of approximately 10 lb/ft^2. The tests were continued for a minimum of one day. Except for the requirements of a rating of Excellent, the water permeability test ratings of the walls were similar to those described in Report BMS95 and are listed below:

Excellent (E) - No leakage and no water or dampness visible on back of the wall (above the flashings) at the end of 1 day.

Good (G) - No water visible on the back of the wall at the end of 1 day. Less than 50 percent of the wall area damp at the end of 1 day. No leaks through the wall at the end of 1 day.

Fair (F) - No water visible on back of the wall during first 3 hours, but visible at end of 1 day. The rate of leakage through the wall less than 1 liter/hr at the end of 1 day.

Poor (P) - Water visible on back of the wall in 3 hr or less and at the end of 1 day. Rate of leakage less than 5 liters/hr at the end of 1 day.

Very Poor (VP) - Rate of leakage through the wall equal to or greater than 5 liters/hr at the end of 1 day.

Concrete masonry walls rated as Good or better should provide satisfactory protection against the leakage of wind-driven rain. Walls rated as Poor or Very Poor would not be likely to provide satisfactory protection against leakage.

4. Test Procedure

The walls were first tested in the plain, unpainted condition with the weep holes open and then with the weep holes closed. The static air pressure in the chamber was equivalent to a hydraulic head of 2- or of 3-in. The weep holes were plugged with corks but there was some evidence, particularly in the later tests on the painted walls, that air and water penetrated around the corks in plugged weep holes. After the completion of these tests the walls were painted on the exposed faces with a base coat of a portland cement-sand grout and a finish coat of white portland cement. The back of the painted walls were given a coating of white wash to accentuate the appearance of any dampness penetrating the masonry during subsequent permeability tests.

The painted walls were tested with weep holes open and then with weep holes closed, using air pressures equivalent to hydraulic heads of 1-, 2- or 3-in. After these tests were completed, five 3/16-in. dia holes were drilled through the exposed face of the top course in each wall; one hole being placed into each of the five cells in the course. These holes had a combined area of 0.18 sq in., approximately equivalent to the area of a horizontal crack about 0.005 in. wide and 35-in. long. Tests were made on the drilled walls with the weep holes open and then closed, using air pressures equivalent to hydraulic pressure heads of 1-, 2-, and 3 in.

After all of the above tests were completed, the weep holes and the drilled holes in the top courses of the walls were plugged and tightly sealed with mortar. A coating of cement paint was then placed over the mortar plugs and the walls were given a final test under a 3-in. hydraulic pressure head (15 lb/ft^2 static air pressure). The complete test schedule is listed below in table 3.

5. Test Data and Discussion of Results

5.1 Tests on the walls before painting

Data on the water permeability tests of the walls made before the walls were painted are listed in table 4. Water readily penetrated the exposed faces of the walls above the weep holes. Some of this water passed through the masonry and first appeared as damp spots on the back, unexposed faces, of the walls at points above the supporting base. This was most noticeable for walls A and C in which the first damp spots appeared well above the base. However, the first appearance of visible water on the backs of all the walls was at the bottom of the wall and at the elevation of the tops of the concrete bases.

With the weep holes open, all of the walls were rated as Poor when tested under hydraulic pressure heads of 2 and 3 in. The time for failure slightly decreased and the rate of leakage slightly increased as a result of increasing the pressure head from 2 to 3-in. Wall C containing the gravel aggregate block was significantly more permeable than the cinder aggregate block walls A and B. Wall B containing mortar in the bottom was slightly but consistently more permeable than was wall A.

When tested after closing the weep holes, the walls were much more permeable. Wall A was rated as Poor for pressure heads of 2 and 3 in. However, walls B and C were rated as Very Poor and leaked considerably. In general, the rate of leakage was doubled by increasing the pressure head from 2 to 3 in. Since much of the water penetrated the walls above the weep holes there was little difference between the appearance of the backs of the walls when tested with the weep holes open and when closed. Figure 4 shows the back of wall B after testing with the weep holes open under a 3-in. pressure head. The illustration is typical for both walls A and B when tested with the weep holes open or closed. Wall C was 100 percent damp.

The tests on the unpainted and permeable walls showed that the rate at which leakage water penetrated the wall and flowed over the top of the recess was greatly reduced by the use of the weep holes. An increase in the wind pressure (applied hydraulic pressure) had the same relative effect as a decrease in the depth of the recess. For similar exposure conditions, the wall B containing mortar droppings, was considerably more permeable than was wall A.

5.2 Tests on the painted walls

The data obtained from tests made after the walls were painted and before holes were drilled in the top courses are listed in table 5. As may be expected, there was no leakage through the painted wall faces. Water that penetrated the open weep holes was absorbed and carried up into the first and second courses of the masonry (see photographic figures 5, 6, and 7 for tests A-5 and A-6, and A-7, respectively). There was little difference between the performances of walls A, B, and C in these tests for like conditions of exposure. The height of capillary rise of moisture into the masonry from water that had penetrated the weep holes in the base was approximately the same for all three walls and the height of capillary rise was not much greater for a hydraulic pressure head of 2 or 3 in. than for a head of only 1 inch.

From table 5, it may be noted that the walls were rated as Good for pressure heads of 1 inch. For this pressure head, it is likely that water entering the weep holes did not rise to the top of the 1 1/2-in. deep recess except by capillarity. When the pressure heads were increased to 2 in. and to 3 in., visible water was noted on the backs of the walls. The time required for water to become visible decreased with increase in air pressure and, with one exception, rated as Fair, the walls were rated as Poor in all of the tests in which the hydraulic pressure was 2 in. or more.

Plugging of the weep holes with tightly fitting corks tended to reduce wall permeability (see table 5). However, it is likely that some moisture penetrated the weep holes around the periphery of the corks. The capillary rise of moisture on the backs of the walls was nearly as great and followed the same general pattern in tests made with weep holes closed as was the case for the tests made with the weep holes open.

In general, the painting of the walls made them highly resistant to water penetration and there was no water penetration except into the weep holes. This leakage water penetrated upward by capillarity and produced damp areas on the backs for a height of 8 or 10 in. above the recess. When the applied hydraulic pressure head exceeded the depth of the recess, visible water appeared on the inner faces of the walls just above the top of the recess. Dampness and visible water was noted in less time on the back of wall B than was the case for wall A. It is possible that the mortar placed in the bottom of wall B but not in the bottom of wall A had an effect on the time interval required for dampness to appear.

5.3 Tests on painted walls with drilled holes

Data obtained from tests made on the painted walls after 3/16-in. dia holes were drilled in the top course are listed in table 6. Water readily entered the drilled holes and penetrated to the backs of the walls. The backs of walls A and B were similar in appearance after all tests made with holes in the exposed faces, regardless of the applied pressure heads and whether the weep holes were open or closed. The back of wall C was nearly 100 percent damp in all tests made with holes in the exposed faces. The appearance of wall B in test B-12 (see figure 8), was not greatly different from its appearance in test B-2 made before painting. With the exception of wall A in test A-9 all of the walls leaked and were rated as Poor in tests made with the weep holes open and as Very Poor with the weep holes closed. As in previous tests, the wall B was slightly more permeable than was wall A.

The tests indicate that only a few small openings are needed in the exposed face of a wall to permit the leakage of a considerable amount of wind-driven rain. With the weep holes open the rate of leakage through the wall was greatly reduced from that observed when the weep holes were closed. Although permitting the entrance of some water and a resultant capillary rise, the weep holes may prevent excessive leakage through walls that contain shrinkage cracks.

5.4 Tests on painted walls with all openings tightly sealed with mortar

After the completion of the tests previously described, (section 5.3 and table 6) the weep holes and the drilled holes in the top courses of the walls were plugged with mortar and the mortar patches were painted with one coat of white cement. Since bases of the sealed walls contained some water which did not readily drain from the weep holes, it was necessary to dry the walls for two or three weeks before the final tests. After this drying period the walls were subjected to a test with a hydraulic pressure of 3 in. (as indicated in tests A-14, B-15, and C-14 in table 3).

After a test exposure of one day, there was no water or dampness on the backs of any of the walls all of which were arbitrarily rated as Excellent (see figure 9). It is probable that if the weep holes had been tightly closed during tests A-8, B-8, B-9, and C-8 (tables 3 and 5) there would have been no water penetration or dampness and the walls would have been rated as Excellent.

6. Summary of the Discussion

1. Before painting, the concrete masonry walls were highly permeable and leaked when subjected to conditions simulating a wind-driven rain. The rate of leakage was much greater when the weep holes were plugged and could not function.

2. The painted walls were highly resistant to water penetration. When the weep holes were tightly closed, there was no indication of dampness or leakage on the inside wall faces. When the weep holes in the painted walls were open, water penetrated them and tended to fill the bottom of the walls to a depth equal to the applied hydraulic pressure head. Some of this moisture rose in the masonry by capillarity producing damp areas and visible water on the inside faces of the walls to a height of 8 or 10 inches.

3. When tested with the weep holes open, the painted walls were much less permeable when the applied hydraulic pressure head was less than the depth of recess in which the walls rested. The walls were significantly more permeable when the applied pressure exceeded this depth.

4. There was no certain indication that the droppings of mortar into the bottoms of the walls had an important or significant effect on permeability. However, as formed by the use of long rubber tubing, the weep holes were not covered and sealed by the mortar droppings. Wall B, containing mortar droppings was consistently more permeable than was wall A containing no droppings. Since the weep holes were formed by the use of long pieces of rubber tubing it is unlikely that the holes were sealed and the effect of the mortar droppings was, therefore, not fully determined.

5. Cutting of holes in the upper faces of the painted walls greatly increased their permeability. As in the case of test on the unpainted walls, the rate of leakage was greatest with the weep holes closed.

6. Weep holes do provide an entrance for wind-driven rain into the masonry. This may possibly result in objectionable moisture and dampness at the bottom of the inside wall faces. If it is reasonably certain that no shrinkage cracking or other structural damage will occur, the weep holes may be eliminated. If severe shrinkage cracking does occur, the rate of leakage through the masonry may be greatly reduced through the use of weep holes. However, such shrinkage cracking will further increase the wet and damp areas on the wall face and such dampness may extend to greater than mid-height of the wall.

Where highly water resistant walls are desired, it may be advisable to reduce and control shrinkage cracking rather than to invite moisture penetration and dampness by the use of weep holes.

Table 1. Physical properties of concrete masonry units

Type of unit	Wall designation	Dimensions				Absorption 24 hr cold	Weight of concrete	Compressive strength gross area
		Thickness	Height	Length	Shell thickness			
		in.	in.	in.	in.	lb/cu ft	lb/cu ft	psi
Cinder 1	A & B	7.65	7.70	15.65	1.25	14.4	111.4	1570
Cinder 2	A & B	7.65	7.70	15.68	1.25	12.3	113.2	1550
Cinder 3	A & B	7.65	7.70	15.65	1.25	12.7	111.3	1540
Cinder 4	A & B	7.68	7.70	15.65	1.25			1500
Cinder 5	A & B	7.65	7.75	15.65	1.25			1680
Average		7.66	7.71	15.66	1.25	13.1	111.9	1570
Sand & Gravel 1	C	7.65	7.65	15.80	1.10	9.7	132.3	1670
Sand & Gravel 2	C	7.65	7.65	15.80	1.10	9.9	131.2	1590
Sand & Gravel 3	C	7.65	7.68	15.75	1.10	9.8	131.4	1310
Sand & Gravel 4	C	7.65	7.68	15.80	1.10			1520
Sand & Gravel 5	C	7.65	7.65	15.80	1.10			1520
Average		7.65	7.66	15.79	1.10	9.8	131.7	1520

Units tested under Federal Specification SS-C-621, type I.

Table 2

Cement Water Paint

Wall	Amount of dry powder used		
	Base coat per 100 ft^2	Finish coat per 100 ft^2	Both coats per 100 ft^2
	lb	lb	lb
A	22.8	11.4	34.2
B	17.1	12.1	29.2
C	9.1	7.2	16.3

Table 3. Test Schedule for Walls A, B, and C.

Condition of wall	Condition of weep holes a/	Wall designation, test number and applied hydraulic pressure head b/		
		1-inch	2-inch	3-inch
Before painting	Open	--	A-1,B-1,C-1	A-2,B-2,C-2
	Closed	--	A-3,B-3,C-3	A-4,B-4,C-4
After painting	Open	A-5,B-5,C-5	A-6,B-6,C-6	A-7,B-7,C-7
	Closed	--	B-8	A-8,B-9,C-8
Painted, with drilled holes c/	Open	A-9,B-10,C-9	A-10,B-11,C-10	A-11,B-12-C-11
	Closed a/	--	A-12,B-13,C-12	A-13,B-14,C-13
Painted, with all holes tightly closed	Closed a/	--	--	A-14,B-15,C-14

a/ The weep holes were tightly closed with mortar during the final tests only.

b/ The walls were designated as A, B, and C. Walls A and B were of cinder aggregate concrete block. Wall C was of gravel aggregate concrete block. Wall B contained extra mortar deposited in the bottoms of the cells in the first course to simulate the results of excessive mortar droppings during construction. The tests on each wall were numbered consecutively, for example, Test B-8 was the eighth test made on Wall B.

c/ A 3/16-in. dia hole was drilled into each of the five cells in the top course of each wall.

Table 4. Tests on the walls before painting

Test No.	Condition of weep holes	Hydraulic pressure head	Time for failure as indicated by: Damp on back	Visible water on back	Leak	Maximum rate of leakage	Area damp at end of 1 day	Rating
		in.	hr	hr	hr	L/hr	percent	
A-1	Open	2	0.13	0.13	1.54	0.1	75	Poor
B-1	Open	2	0.08	0.13	0.90	0.2	60	Poor
C-1	Open	2	0.05	0.13	0.17	2.0	100	Poor
Avg.	Open	2	0.09	0.13	0.87	0.8	75	Poor
A-2	Open	3	0.03	0.07	0.40	0.1	75	Poor
B-2	Open	3	0.07	0.10	0.17	0.2	70	Poor
C-2	Open	3	0.14	0.10	0.13	3.0	100	Poor
Avg.	Open	3	0.08	0.09	0.23	1.1	80	Poor
A-3	Closed	2	0.03	0.08	0.20	0.2	65	Poor
B-3	Closed	2	0.07	0.08	0.14	18.9	50	Very Poor
C-3	Closed	2	0.07	0.10	0.13	29.6	96	Very Poor
Avg.	Closed	2	0.06	0.08	0.16	16.2	70	Very Poor
A-4	Closed	3	0.05	0.09	0.13	4.2	73	Poor
B-4	Closed	3	0.05	0.07	0.08	22.2	63	Very Poor
C-4	Closed	3	0.03	0.07	0.07	78.0	100	Very Poor
Avg.	Closed	3	0.04	0.08	0.09	34.6	75	Very Poor

Table 5. Tests on walls after painting

Test No.	Condition of weep holes	Hydrostatic pressure head	Time for failure as indicated by:			Maximum rate of leakage	Area damp at end of 1 day	Rating
			Damp on back	Visible water on back	Leak			
		in.	hr	hr	hr	L/hr	percent	
A-5	Open	1	0.17	--	--	0	20	Good
B-5	Open	1	0.28	--	--	0	15	Good
C-5	Open	1	0.20	--	--	0	20	Good
Avg.	Open	1	0.22	--	--	0	15	Good
A-6	Open	2	0.10	4.00	--	0	20	Fair
B-6	Open	2	0.16	0.66	--	0	20	Poor
C-6	Open	2	0.22	0.63	--	0	20	Poor
Avg.	Open	2	0.16	1.76	--	0	20	Poor
A-7	Open	3	0.13	2.25	--	0	20	Poor
B-7	Open	3	0.09	0.12	0.17	0.05	20	Poor
C-7	Open	3	0.12	0.17	0.23	0.05	20	Poor
Avg.	Open	3	0.11	0.85			20	Poor
B-8	Closed	2	1.25	--	--	0	15	Good
A-8	Closed	3	0.04	--	--	0	15	Good
B-9	Closed	3	0.22	0.63	--	0	15	Poor
C-8	Closed	3	0.20	6.00	--	0	15	Fair
Avg.	Closed	3	0.15		--	0	15	Fair

Table 6. Tests of painted walls after drilling holes in top course [a/]

Test No.	Condition of weep holes	Hydrostatic pressure head	Time for failure as indicated by			Maximum rate of leakage	Area damp at end of 1 day	Rating
			Damp on back	Visible water on back	Leak			
		in.	hr	hr	hr	L/hr	percent	
A-9	Open	1	0.23	5.75	--	0	75	Fair
B-10	Open	1	0.03	0.12	0.37	0.1	80	Poor
C-9	Open	1	0.10	1.16	1.25	0.2	100	Poor
Avg.	Open	1	0.12	2.34		0.1	85	Poor
A-10	Open	2	0.13	1.50	1.75	0.05	75	Poor
B-11	Open	2	0.07	0.08	0.21	0.3	80	Poor
C-10	Open	2	0.09	0.25	0.66	0.6	100	Poor
Avg.	Open	2	0.10	0.61	0.87	0.3	85	Poor
A-11	Open	3	0.13	0.87	--	0	75	Poor
B-12	Open	3	0.10	0.23	0.29	0.6	75	Poor
C-11	Open	3	0.12	0.33	0.75	0.9	95	Poor
Avg.	Open	3	0.12	0.48		0.5	80	Poor
A-12	Closed	2	b/	b/	b/	5.1	75	Very Poor
B-13	Closed	2	0.02	0.03	0.58	6.7	75	Very Poor
C-12	Closed	2	0.11	0.19	0.83	9.8	100	Very Poor
Avg.	Closed	2				7.2	85	Very Poor
A-13	Closed	3	0.23	1.25	1.26	8.3	75	Very Poor
B-14	Closed	3	0.02	0.03	0.25	9.4	75	Very Poor
C-13	Closed	3	0.13	0.30	0.75	12.6	100	Very Poor
Avg.	Closed	3	0.13	0.53	0.75	10.3	85	Very Poor

a/ A 3/16-in. dia hole was drilled into each of the 5 cells in the top course of each wall.
b/ Wall in damp conditon when test was started.

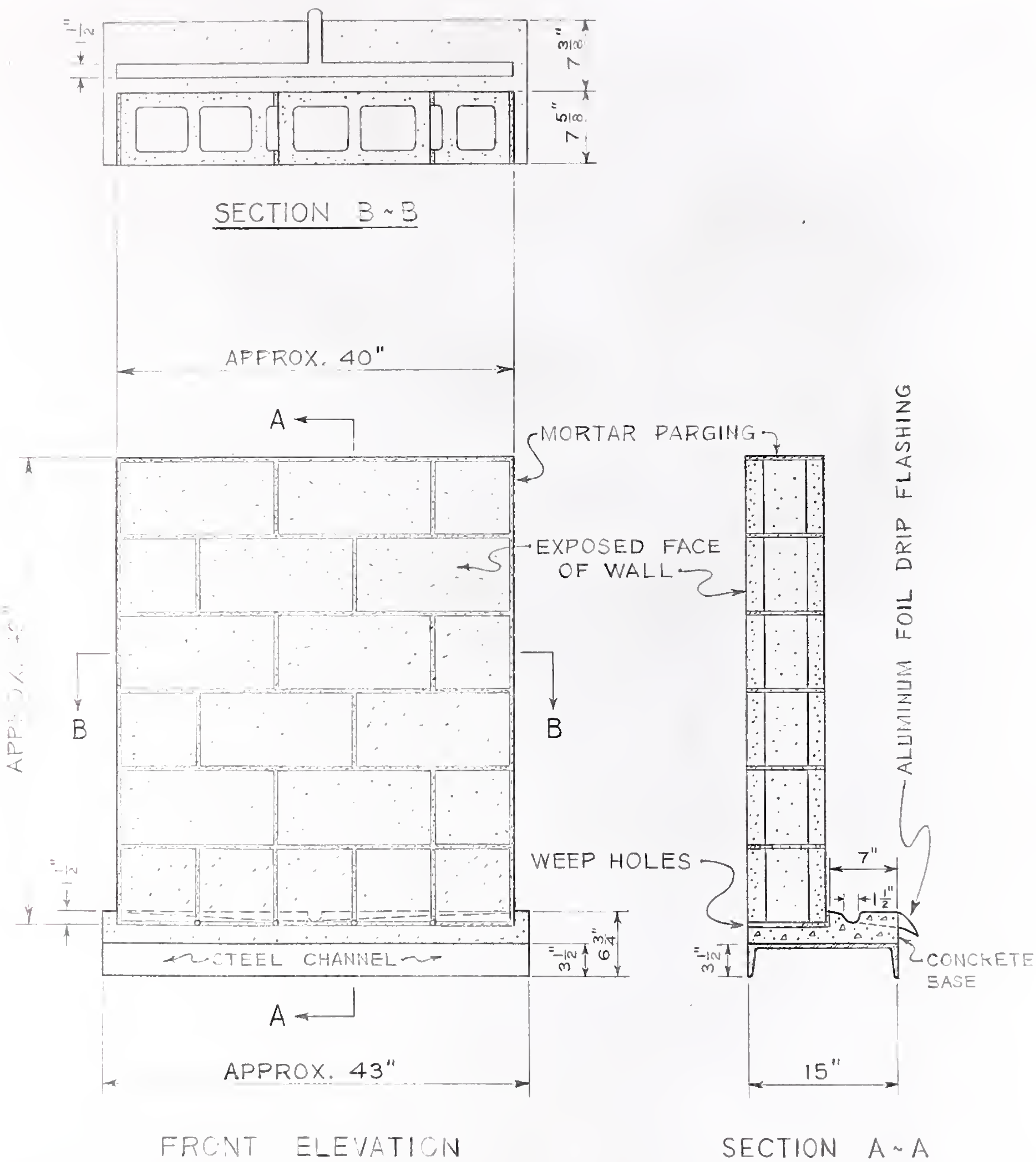

Fig. 1 - Details of a typical wall specimen.

Fig. 2 - Front elevation (exposed face) of wall A, showing weep holes.

Fig. 3 - Permeability test chamber, showing method of applying water to the wall face.

Fig. 4 - Back of wall B after test B-2; exposed face not painted, weep holes open, pressure head of 3-in.

Fig. 5 - Back of wall A after test A-5; face painted, back whitewashed, weep holes open and pressure head of 1-in.

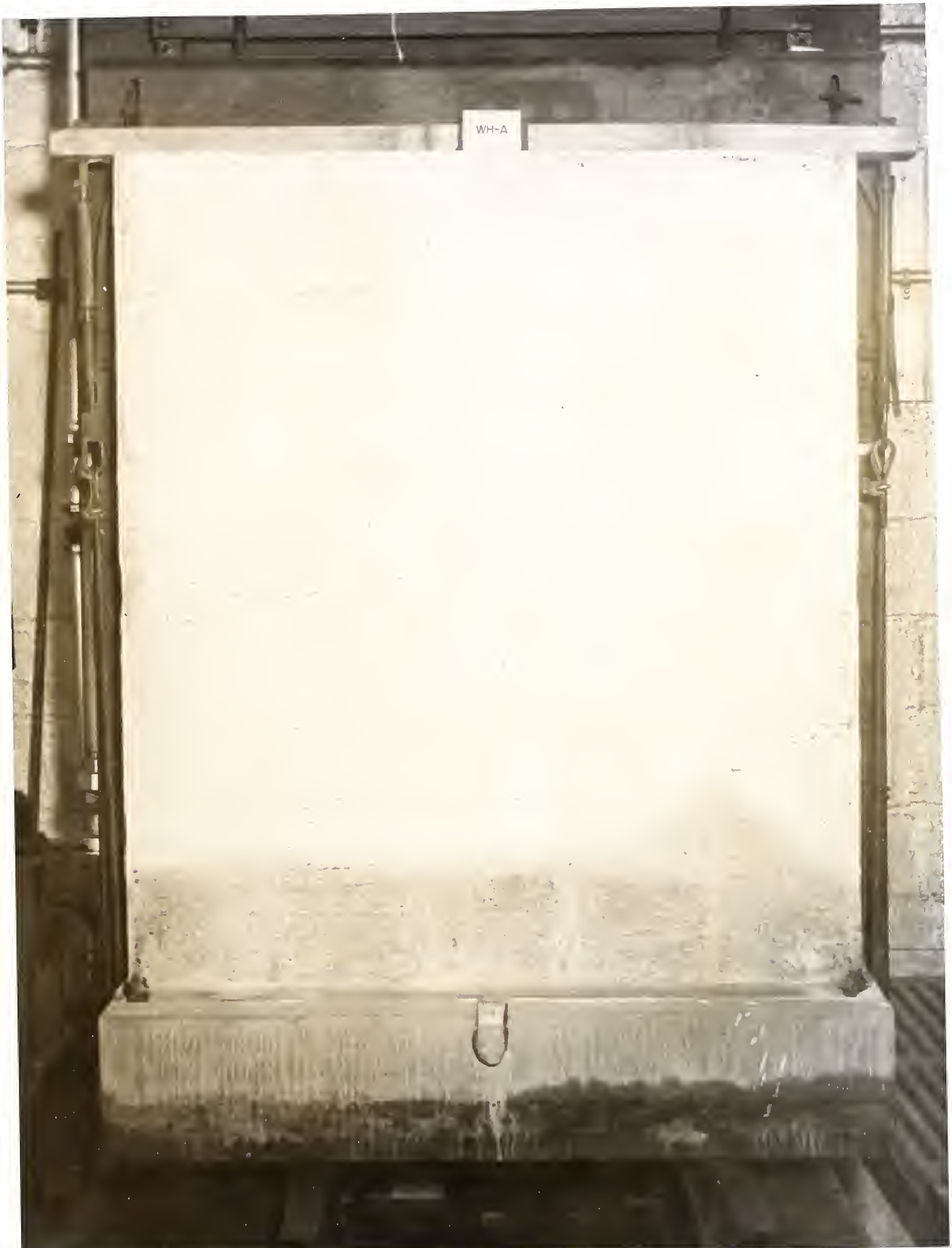

Fig. 6 - Wall A after test A-6; pressure head of 2-in.

Fig. 7 - Wall A after test A-7, pressure head of 3-in.

Fig. 8 - Back of wall B after test B-12. Holes drilled in top of exposed face, weep holes open, pressure head of 3-in.

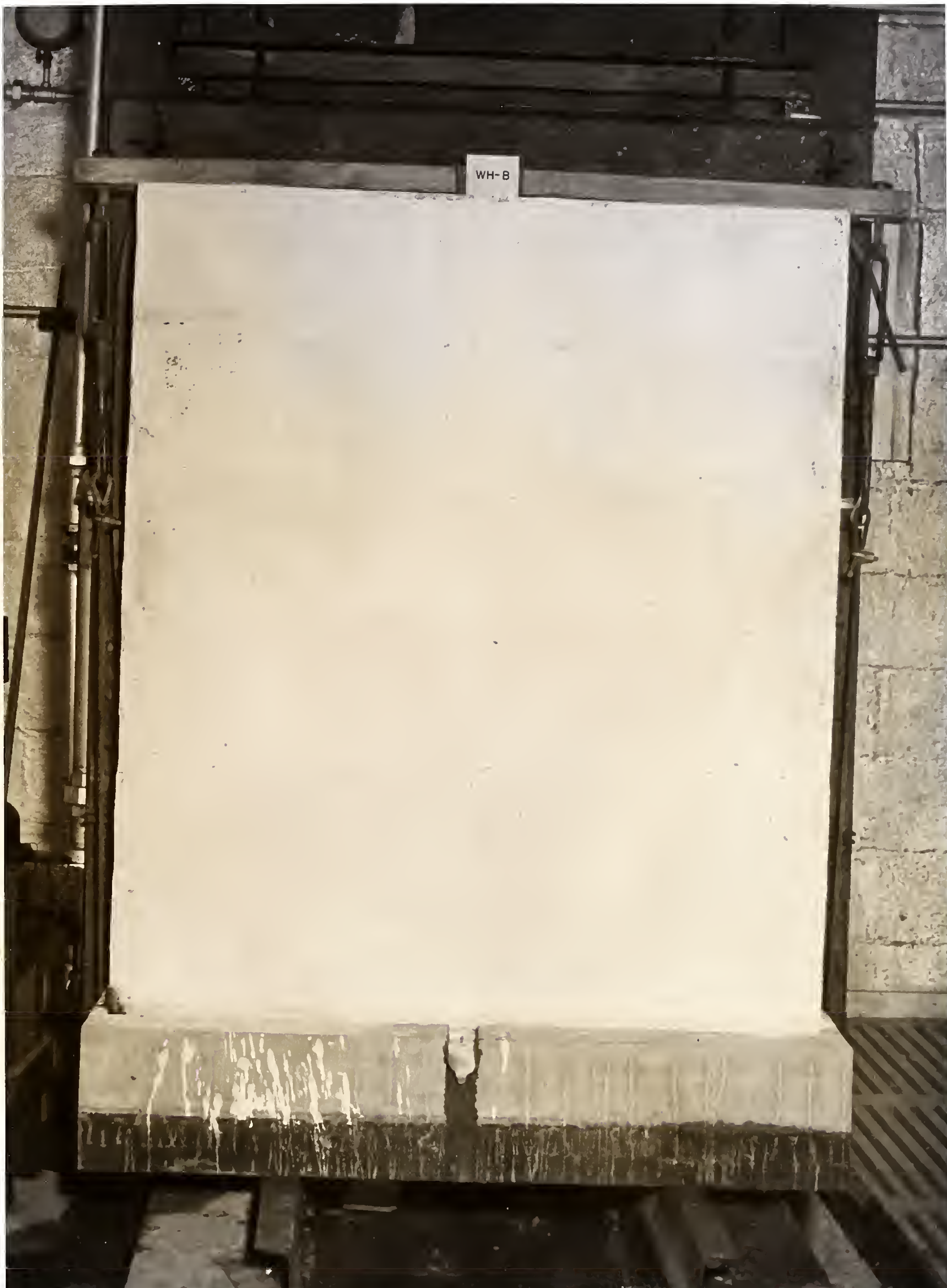

Fig. 9 - Wall B after test B-15. Test made after all openings in wall face had been sealed.

THE NATIONAL BUREAU OF STANDARDS

Functions and Activities

The functions of the National Bureau of Standards are set forth in the Act of Congress, March 3, 1901, as amended by Congress in Public Law 619, 1950. These include the development and maintenance of the national standards of measurement and the provision of means and methods for making measurements consistent with these standards; the determination of physical constants and properties of materials; the development of methods and instruments for testing materials, devices, and structures; advisory services to Government Agencies on scientific and technical problems; invention and development of devices to serve special needs of the Government; and the development of standard practices, codes, and speeifications. The work includes basic and applied research, development, engineering, instrumentation, testing, evaluation, calibration services, and various consultation and information services. A major portion of the Bureau's work is performed for other Government Agencies, particularly the Department of Defense and the Atomic Energy Commission. The scope of activities is suggested by the listing of divisions and sections on the inside of the front cover.

Reports and Publications

The results of the Bureau's work take the form of either actual equipment and devices or published papers and reports. Reports are issued to the sponsoring agency of a particular project or program. Published papers appear either in the Bureau's own series of publications or in the journals of professional and scientific societies. The Bureau itself publishes three monthly periodicals, available from the Government Printing Office: The Journal of Research, which presents complete papers reporting technical investigations; the Technical News Bulletin, which presents summary and preliminary reports on work in progress; and Basic Radio Propagation Predictions, which provides data for determining the best frequencies to use for radio communications throughout the world. There are also five series of nonperiodical publications: The Applied Mathematics Series, Circulars, Handbooks, Building Materials and Structures Reports, and Miscellaneous Publications.

Information on the Bureau's publications can be found in NBS Circular 460, Publications of the National Bureau of Standards ($1.25) and its Supplement ($0.75), available from the Superintendent of Documents, Government Printing Office. Inquiries regarding the Bureau's reports and publications should be addressed to the Office of Scientific Publications, National Bureau of Standards, Washington 25, D. C.

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