Effect of Mortar on Shrinkage of Clay Masonry Wall Panels

by

Brian James Harris, B.S.E.

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APPROVED BY

SUPERVISING COMMITTEE:

Richard E. Klingner

Sharon L. Wood

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Austin, Texas Brian J. Harris

April 1996

ABSTRACT

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SUPERVISOR: Richard E. Klingner

The objectives of this study were to examine the effect of different mortar systems and mortar types on the shrinkage of clay masonry wall panels, and to predict the relationship between the shrinkage of the mortar and the shrinkage and cracking in the panels. To accomplish this, 8 running bond panels were constructed. Shrinkage of the panels was measured over time using Demec mechanical gage points. Cracking in the panels was visually identified, measured, and recorded over time as well. Additionally, mortar specimens were made and tested in accordance with ASTM C1448-92a using the same mortars used in the panels. Tensile and compressive strengths of the mortars were also measured in the laboratory. Finally, tests for air and water content were performed. The bar shrinkage results show that for each type of mortar, portland cement-lime mortars shrank as much or more than the masonry cement mortars. Panel shrinkage seems to obey the same rules as bar shrinkage. In fact, they are closely correlated. The results of the analytical model presented show it to be a fairly accurate predictor of panel shrinkage based on bar shrinkage. However, panel cracking does not follow the trend of bar and panel shrinkage. Therefore, bar shrinkage is a good predictor of panel shrinkage, but only within the portland cement-lime mortars did shrinkage predict the cracking in a panel. In other words, even though one panel shrinks more than another, it may not be more cracked. Additionally, the stresses in a panel due to external restraint are insignificant when compared to the stresses due to differential movement of the brick and mortar.

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1. Introduction

1.1 Objectives

The objective of this thesis is to examine the effect of different mortar systems and mortar types on the shrinkage of clay masonry wall panels. Results of testing and analytical studies are used to predict the relationship between the shrinkage of the mortar and the shrinkage and cracking in the panels, considering the restrained as well as unrestrained case.

1.2 Scope

The study reported in this thesis includes the following tasks:

1) Review available literature on mortar shrinkage;

2) Select materials for the experimental study;

3) Construct 8 running bond panels, each measuring 4 feet (1.22 m) square;

4) Measure shrinkage of mortar bars by ASTM C1148-92a;

5) Measure the tensile strength of mortar using modulus of rupture tests on mortar beams;

6) Measure the compressive strength of mortar using 2-inch (50.8 mm) cubes;

7) Measure shrinkage of the panels in both directions using Demec mechanical gage points;

8) Visually identify all mortar cracks and record their widths;

9) Using the measured values of mortar shrinkage, predict panel shrinkage; and

10) From the analytical and experimental results, predict the average mortar and unit stress in a completely restrained wall section for each mortar type.

2. Background

2.1 Previous Work on Mortar Shrinkage

Much of the research conducted in the area of mortar shrinkage is old, dating back as far as the 1920's, but the conclusions are still worth considering due to the unchanging nature of the materials involved.

Davis and Troxell (1929) tested mortars of many compositions for volumetric changes. Tests included mortar bars and brick piers. They concluded that in portland cement-lime mortars, lime had no significant effect on shrinkage, although the mortar without lime shrank least. Shrinkages at 12 months were all between 0.14% and 0.16%. After 7 months of air storage of the bars, some were put in water storage to determine the subsequent recovery of volume. This expansion was greatest for the mortar with the most lime and least for the mortar with no lime, but there was not a great difference. Volume recovery ceased after 3 months, at which time a net shrinkage of one-third to one-half of the original shrinkage (after 7 months of air storage) still existed in the bars.

The brick piers tested by Davis and Troxell expanded for the first one to two months, and then proceed to shrink. They note that this is in contrast to the behavior of the mortar bars, which shrank from the start, but explain this by reasoning that the brick "were not fully saturated when laid, and were doubtless capable of absorbing considerable quantities of water in a short period of time." They found that the pier with the plain cement mortar expanded the most (shrank least) and the pier with the highest lime content expanded least (shrank most); however they concluded that the difference was not great, and that lime does not affect the expansion. Based on the different volumetric changes of mortar bars compared to brick piers, they concluded "that the behavior of mortar cast in a non-absorbent mold is no criterion to the behavior of the same mortar when employed in brick work."

The second series of tests by Davis and Troxell involved mortars with different additives, including clay, hydrated lime, and a plastic cement, as well as a different ratio of cementitious materials to sand (1:5 as opposed to 1:3). They found that the plastic cement mortar shrank more than all the others. They also found that the richer mix of 1:3 (with 10% clay) shrank more than the 1:5 mix (also with 10% clay).

A third series of tests by Davis and Troxell tested straight portland cement mortars of 1:2 and 1:6.2 cement:sand mixes with varying amounts of water. For the 1:2 mortars, they found that the larger the water-cement ratio, the more the bars shrank. They found no relationship for the 1:6.2 mortars.

The final series of tests by Davis and Troxell investigated the effects of waterproofing additives. They found that all the waterproofed mortars shrank more than the normal portland cement mortar. For bars that were oven-dried some of the waterproofed mortars showed double the shrinkage of the normal portland cement mortar.

Palmer (1931) tested 45 different kinds of mortar, with various combinations of lime, portland cement, masonry cement, and calcium stearate (a water repellent) as well as different ratios of cementitious materials to sand. In tests of initial shrinkage during hardening (up to 10 days), he found that shrinkage was less in the 1:4 cementitious materials:sand mortars than in the 1:3 mortars. He also noted that shrinkage increased with lime content. His tests for volume changes during alternate wetting and drying (alternating cycles of 3 months in water, followed by drying until length changes were minimal) showed that the 1:3 lime:sand mortars (no portland cement) exhibited less volume change than the 1:3 portland cement:sand and 1:3 masonry cement:sand mortars. During these tests, he noticed that the lime mortars expanded even during drying conditions. Again, volume changes in the 1:4 mortars were less than in the 1:3 mortars; however, he noted that the difference was not enough to "...[warrant] a preference of the 1:4 mortars from this standpoint alone." During the alternate wetting and drying tests, he also found that both shrinkage and expansion were less for a 1:2:9 portland cement:lime:sand mortar than for a 1:3 portland cement:sand mortar. Additionally, he concludes from this testing series that "...from the standpoint of volume changes, there is no distinct advantage in a 1 lime:1 portland cement:6 sand mortar..."

Andregg (1940) tested mortars of proportion 1:1:6, 3:5:21, and 1:2:8 (portland cement:lime:sand), and found no significant differences in shrinkage between these mortars. He also found that varying the flow caused no significant differences in the shrinkage. Mortar fabricated in metal molds shrank less than mortar taken from between brick of very low absorption (0 to 1 grams in one minute). This led Andregg to follow the conclusions of Davis and Troxell (1929) in that it is important to measure volume changes of masonry mortars only in brick assemblages.

Watstein and Seese (1947) tested 4 masonry cement mortars, 2 slag cement mortars, and portland cement-lime mortars of different proportions. Three different proportions of portland cement lime mortars were used (proportions by volume of 1:0.2:3, 1:1:6, and 1:2:9 cement:lime:sand), and five different limes were used with these 3 proportions, giving 15 different portland-cement lime mortars. They found "no consistent relation between the shrinkage of the various mortars and any of their other properties." They did find that shrinkage increased with the amount of mixing water required within the portland cement-lime mortars. Shrinkages of the 1:1:6 and 1:2:9 mixes were notably greater that of 1:0.2:3 mix. They report that this mix had the least shrinkage of all mortars tested. Resistance to cracking increased as shrinkage decreased. Additionally, resistance to cracking increased as strength of the mortar increased, within a group of mortars of "comparable composition."

Evans et al (1953) tested masonry cement mortars using 17 different brands of masonry cement. All mortars were mixed to the same proportions. They found shrinkages in the range of 0.073 to 0.0155 percent in 60 days, with three-fourths of the shrinkage occurring in the first week.

Kalousek (1955) performed tests on shrinkage and cracking in concrete block walls using mortars in proportions of cement:lime:sand of 1:¼:3, 1:½:4½, 1:1:6, and 1:2:6 by weight. He found that varying the mortar had minor effects on the shrinkage of the non-restrained walls. The restrained walls showed no difference in shrinkage among the various mortars used. He added that all walls cracked regardless of the mortar strength. In considering the shrinkage of the concrete block alone, he determined that cracking is not proportional to shrinkage, but rather extensibility, "..the strain (shrinkage) a block can withstand in tension before cracking." He concludes, however, by stating that shrinkage, tensile strength, and modulus of elasticity of the block are all factors to be considered in determining the "cracking tendency" of a type of block.

Using mortars prepared in accordance with the Standard Specifications for Masonry Cement (ASTM C91), Bloem (1963) found that finer sands increased the mixing water requirement, increasing the drying shrinkage. He also reported that high air content increased drying shrinkage.

Monk (1963) reported numerical data on shrinkage of mortars in the course of his structural testing of high-bond clay masonry assemblages. He used mortars with polymer additives, portland cement-lime mortars, masonry cement mortars, and mortars with varied gradations of sand. He did not analyze the shrinkage data, but the raw data seem to indicate that as lime content of the portland cement-lime mortars increased, the shrinkage increased. The range of 180-day shrinkage for the portland-cement lime mortars is from 0.1387% to 0.2522% and for the masonry cement mortars, 0.1135% to 0.1335%. Other conclusions are difficult to draw from the raw data.

Ritchie (1966) studied the effect of restraint on mortar shrinkage. He tested portland cement-lime mortars of proportions 1:½:4½, 1:1:6 and 1:2:9 cement:lime:sand, and a masonry cement mortar of proportion 1:3 masonry cement:sand by volume. Unrestrained bars shrank more than restrained bars. Within the portland cement-lime mortars, shrinkage of the unrestrained bars increased as the proportion of lime increased. The effect of restraint reduced shrinkage to different extents in different mortars. He postulated that the strength of the mortar influenced the mortars' response to restraint. The masonry cement mortar had the least unrestrained and restrained shrinkage of all mortars tested.

Hansen (1966) performed an experiment to determine the effects of wind on the drying shrinkage and creep of cement mortar and concrete. He found "little difference in weight change, shrinkage, and creep of cement mortar specimens exposed to wind, and specimens stored in dry air."

In testing the effect of mortar shrinkage (straight portland cement mortar) on ceramic tile installations, Bernett (1968) determined that there were three types of mortar shrinkage that could be considered separately. The first is the shrinkage gradient, which occurs when one side of the mortar dries faster than the other. The second is the ordinary linear shrinkage. The third is a "second shrinkage" then occurs upon rewetting and subsequent drying of the mortar. He reported that upon drying for the second time, the shrinkage can be 100 percent greater than the original shrinkage.

Hedstrom et al (1968) investigated cracking due to drying shrinkage in restrained concrete block walls. They found that weaker mortars provided less restraint to block shrinkage, and also led to larger joint openings. Also, block in the "unrestrained" wall were in fact restrained by some amount because they exhibited less shrinkage than free block. They found that masonry cement mortars tolerated a larger block shrinkage and thus led to larger joint openings than portland cement-lime mortars. Finally, they note that wall behavior is dictated by the "in-place" properties of the mortar, rather than the properties of mortars prepared and cured in accordance with ASTM test methods.

Brooks and Abdullah (1990) tested the effect of different geometries on the shrinkage of brick walls and piers. They found that ultimate shrinkage in both the horizontal and vertical directions decreased as the volume / surface area (v/s) ratio increased. They note that the relationship is influenced by the type of brick. Clay brick showed an expansion in the horizontal direction that was independent of v/s ratio. They postulate that inconsistencies in their results when compared to other published data suggest the influence of other factors, requiring further research.

Dubovoy (1990) tested Types S and M portland cement-lime mortars and Types S and M masonry cement mortars for drying shrinkage. Mixing all mortars to a flow of 110±5, he found that the portland cement-lime mortars showed nearly twice the shrinkage of the corresponding masonry cement mortars at 25 days.

Bessey (1933) found that the rate of carbonation in lime-sand and portland cement-sand mortars is effectively zero at 100 percent relative humidity, and increases as humidity decreases down to 50 percent. He determined that strength increases as carbonation increases.

Verbeck (1958) tested cement-sand mortars to learn more about the process and effects of carbonation. In general, he determined that carbonation causes irreversible shrinkage and weight gains, and may lead to better volume stability in masonry exposed to subsequent moisture changes. At 100 percent and 25 percent relative humidity, he observed slow carbonation and little shrinkage associated with carbonation. He observed maximum carbonation shrinkage at 50 percent relative humidity. When comparing different size specimens, he noted a large difference in carbonation shrinkage at 25 percent relative humidity, where the size of the specimen was directly related to the carbonation shrinkage. Also in this test, he noted that size seemed to be irrelevant for drying shrinkage alone. He also found that highest concentrations of carbon dioxide that the specimens were exposed to produce more rapid shrinkage, and a greater magnitude of shrinkage for the time period studied (~130 days). It seems worthwhile to consider the applicability of these tests to field conditions, as the specimen stored in air had a carbonation shrinkage of around 0.025 percent at 80 days, while the specimen in 100 percent carbon dioxide had about a 0.10 percent shrinkage.

Kroone and Blakey (1959) studied the reaction between carbon dioxide gas and the portland cement in mortar. All mortars had a sand-cement ratio of 4 and a water-cement ratio of 0.6, but were subject to different curing conditions. First, they established that carbon dioxide is absorbed by the mortar in many ways, leading them to classify the absorbed carbon dioxide as stable, unstable, or alkali. They found a direct relationship between stable carbon dioxide absorbed by the mortar and the compressive strength of the mortar. Based on shrinkage tests in dry carbon dioxide and in plain air, they found that the absorption of unstable carbon dioxide affects shrinkage to nearly the same degree as drying shrinkage.

Powers (1962) hypothesized on the mechanisms of carbonation and shrinkage of portland cement pastes. The conclusion that he reaches that is relevant for this discussion is that if carbonation of a specimen takes place while it is completely or nearly saturated, little or no carbonation shrinkage will occur. Also, drying shrinkage will be reduced, because the calcium carbonate formed during carbonation "...offers more resistance to shrinkage force than did the calcium hydroxide it replaced."

Kamimura et al (1965) tested plain portland cement mortars to compare the amount of shrinkage due to carbonation, the amount of shrinkage due to drying alone, and various combinations of the two phenomena. In the CO_2-free drying test (no carbonation), the shrinkage decreased as relative humidity increased. The slopes of these curves, they explain, are influenced by the compressibility of the mortar, which itself is influenced by the aggregate, water cement-ratio, and cement content. These slopes seem to be higher with a higher cement:sand ratio, and higher with perlite than with natural sand.

The next test by Kamimura et al was drying with subsequent carbonation, where they found that the greatest total shrinkage took place between 50 and 75% relative humidity (R.H.), with the maxima near 50%. The shrinkage at 25% R.H. was almost equal to the drying shrinkage, as was shrinkage below 25% R.H and at 100% R.H., indicating that no carbonation shrinkage occurred in this range. The maximum shrinkage due to carbonation alone was from 1½ to 2 times as great as the drying shrinkage in this test. They explain that maximum carbonation occurred near 75% R.H., as evidenced by weight gain of the specimens, but this did not coincide with the maximum carbonation shrinkage. The maximum carbonation shrinkage appeared more closely tied to "..minimum non-evaporable water content, maximum capacity for water on resaturation, and maximum reduction in total shrinkage on subsequent drying."

The test involving drying with simultaneous carbonation gave higher values of weight gain, but lower carbonation shrinkage than the test involving drying with subsequent carbonation. From this test they conclude that carbonation leads to shrinkage only when the paste is at a moisture content corresponding to a relative humidity less than 100%. They conclude by stating that current test methods for shrinkage and creep should include procedures for eliminating or controlling carbonation.

In reviewing the above research, it is not difficult to see many contradictory findings and need for clarification through additional research, even to this day. This highlights the importance of this study in adding to the accumulated knowledge in the area of mortar shrinkage and its effects. Additionally, many of the authors note that testing of mortar is of questionable value when the laboratory conditions are unlike the field conditions. This conclusion supports study under field-approximated conditions, as in the experimental design outlined in Chapter 3.

2.2 Significance of Mortar Shrinkage for Mortar Cracking

Few of the papers discussed above directly address the issue of cracking in mortar, nor relate it to the shrinkage. This is interesting, as it implies that perhaps this relationship was often assumed based on intuition or analytical reasoning, the assumption being that mortar that shrinks more will crack more. One of the above papers does specifically support this hypothesis: Watstein and Seese (1947) found that decreased shrinkage led to decreased cracking. The others that refer to cracking find correlation between cracking and strength of the mortar (or other portland cement product), rather than with shrinkage: Watstein and Seese (1947), Kalousek (1955), and Hedstrom et al (1968). They all conclude that stronger mortars lead to less cracking. Additionally, Hedstrom et al found that masonry cement mortars lead to larger joint openings than portland cement-lime mortars when tested in concrete block walls.

2.3 Analytical Prediction of Effects of Mortar Shrinkage

It should be possible to predict the panel shrinkage (or expansion) if the properties of the individual components of the panel are known. The strain in the mortar can be measured using mortar bars, the strain in a clay unit can be measured, and any conditions of exterior restraint can be evaluated. A compatibility equation can be set up to compute the net strain in a panel in the horizontal and vertical directions.

2.3.1 Time-Dependent Deformations of Mortar and Clay Brick

Under normal environmental conditions, both mortar and clay brick undergo volumetric changes over time. Mortar will generally shrink over time, from water loss due to drying, and from carbonation. Clay brick will expand over time, due to absorption of water from the mortar and from the atmosphere. The rates of these volumetric changes decrease and eventually taper off over time, but leave the materials in a permanent state of deformation. Both materials also undergo such changes as temperature expansion and contraction, but these changes will be insignificant compared with the aforementioned behavior, and are ignored in the following analysis.

2.3.2 Analytical Prediction of Shrinkage of Unrestrained Panels

For unrestrained panels, such as those tested in the experimental phase of this project, there are theoretically no external forces acting on the panel. This means that there are two types

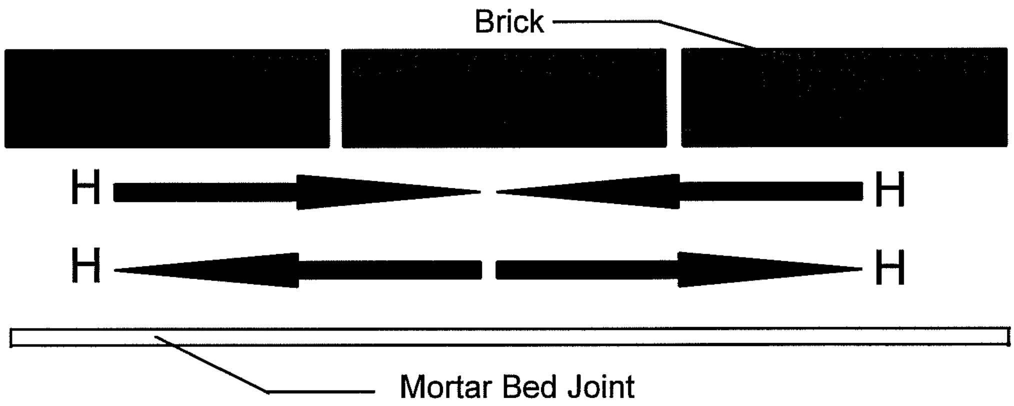


Figure 2-1 *Horizontal Self-Equilibrating Forces in a Panel*

of self-equilibrating forces acting in the panel, both internal (see Figure 2-1). For the horizontal direction, one is the force of the mortar bed joint restraining expansion of the adjacent course of brick. The other force is the force of the course restraining the mortar bed joint from shrinking. These forces must be equal and opposite in order to satisfy equilibrium. Each force can be translated into a strain using the cross-sectional area and modulus of elasticity of the given material. The compatibility equation is then established by realizing that because there is no slip at the joint-course interface, the net strain in each brick course must equal the net strain in the corresponding bed joint:

$$\varepsilon_{\text{net (course)}} = \varepsilon_{\text{net (mortar bed)}} \qquad (2.1)$$

$$\varepsilon_{hc} - \frac{H}{A_{vc} \cdot E_c} = \varepsilon_m + \frac{H}{A_{vb} \cdot E_m} \quad (2.2)$$

where:

ε_{hc} = horizontal strain in an unrestrained course (see below)

ε_m = strain in mortar (unrestrained)

H = force of course on bed joint = force of bed joint on course, pounds (N)

A_{vc} = vertical cross-sectional area of the course, in^2 (mm^2)

E_c = modulus of elasticity of the course (brick and mortar combined), pounds / in^2 (kPa)

A_{vb} = vertical cross-sectional area of the mortar bed joint, in^2 (mm^2)

E_m = modulus of elasticity of the mortar, pounds / in^2 (kPa)

The force, H, is the only unknown in Equation 2.2. The equation is solved for H, which is substituted back into either side of the Equation 2.2 to get the total horizontal strain in the panel, ε_h. The horizontal strain in a course, ε_{hc}, needed for Equation 2.2, is calculated via the following equation:

$$\varepsilon_{hc} = \frac{(\varepsilon_m \cdot L_m + \varepsilon_b \cdot L_b)}{L_c} \quad (2.3)$$

where:

ε_m = strain in mortar (unrestrained)

ε_b = strain in clay brick

L_m = total length of mortar in one course (summation of widths of head joints), inches (mm)

L_b = total length of brick in one course (summation of lengths of brick), inches (mm)

L_c = length of one course ($L_b + L_m$), inches (mm)

In the vertical direction, the units are restrained from expanding by the head joints and vice-versa within a course. An equation similar to Equation 2.2 can be set up to find this restraining force:

$$\varepsilon_b - \frac{V}{A_{hb} \cdot E_b} = \varepsilon_m + \frac{V}{A_{hh} \cdot E_m} \qquad (2.4)$$

where:

ε_b = strain in clay brick

ε_m = strain in mortar

V = force of brick on head joint = force of head joint on brick, pounds (N)

A_{hb} = horizontal cross-sectional area of a brick, in^2 (mm^2)

E_b = modulus of elasticity of the brick, pounds / in^2 (kPa)

A_{hh} = horizontal cross-sectional area of a head joint, in^2 (mm^2)

E_m = modulus of elasticity of the mortar, pounds / in^2 (kPa)

The equation is solved for V, and this force is substituted back into either side of Equation 2.4 to find the vertical strain in a course, ε_{vc}. The total vertical strain in the panel ε_v then calculated by an equation similar to Equation 2.3:

$$\varepsilon_v = \frac{\left(\varepsilon_{vc} \cdot H_b + \varepsilon_m \cdot H_m\right)}{H_p} \tag{2.5}$$

where:

ε_{vc} = vertical strain in a course

ε_b = strain in mortar

H_b = total height brick in the panel (summation of heights of brick), inches (mm)

H_m = total height of mortar in the panel (summation of heights of bed joints), inches (mm)

H_p = height of the panel ($H_b + H_m$), inches (mm)

The values used in these equations are all estimates, except the values used for strain in the mortar, which come from measurements of the ASTM C1148 shrinkage bars in the experimental phase of the project. The cross-sectional areas, lengths, and heights are all based on the nominal dimensions of the brick and mortar joints [modular brick, 3/8" (9.53 mm) joints]. The modulus of elasticity of the course is estimated using the MSJC code (ACI 530/ ASCE5/ TMS 402-92, 1992), using the appropriate type of mortar and a known unit strength of 14000 psi (97000 kPa). For the Type O and N mortars, this value is 2.8×10^6 psi (1.9×10^7 kPa); for the

Type M and S mortars, it is 3.0 x 10^6 psi (2.1 x 10^7 kPa). Modulus of elasticity of the mortar is calculated using the following formula:

$$E_m = 57000\sqrt{f_m} \qquad (\text{SI}: E_c = 158\sqrt{f_m}) \tag{2.6}$$

where f_m is the cylinder compressive strength (cube strength / 1.2) of the mortar in psi (kPa). The strain in the clay brick is estimated at 200 με (expansion), while the modulus of elasticity of the brick is estimated as equal to the modulus of elasticity of the course.

The analytical results are presented in Section 5.2.2, where they are compared to the experimental results.

2.3.3 Analytical Prediction of Shrinkage of Restrained Panels

The case of panels with external restraint involves an external restraining force in each direction that prevents the panel from overall expansion or contraction. The stress in a panel due to external restraint is calculated by setting the net strain in the panel equal to zero:

$$\varepsilon_{\text{h (net)}} = \varepsilon_{\text{h (unrestrained)}} + \sigma_{eh}\left(\frac{1}{E_c}\right) - \sigma_{ev}\left(\frac{\nu}{E_c}\right) = 0$$

$$\varepsilon_{\text{v (net)}} = \varepsilon_{\text{v (unrestrained)}} + \sigma_{ev}\left(\frac{1}{E_c}\right) - \sigma_{eh}\left(\frac{\nu}{E_c}\right) = 0$$

where:

$\varepsilon_{\text{h (net)}}$ = net horizontal strain in a restrained panel = 0

$\varepsilon_{\text{v (net)}}$ = net vertical strain in a restrained panel = 0

ε_h = horizontal strain in an unrestrained panel, from Section 2.3.2 above

ε_v = vertical strain in an unrestrained panel, from Section 2.3.2 above

σ_{eh} = horizontal stress in panel caused by external restraint, pounds / in^2 (kPa)

σ_{ev} = vertical stress in panel caused by external restraint, pounds / in^2 (kPa)

E_c = modulus of elasticity of the course, brick and mortar combined (from Section 2.3.2 above), pounds / in^2 (kPa)

These two equations are then solved simultaneously for the stresses. These stresses, of course, act on both the mortar and the brick in the panel. They will be added to the stresses due to internal restraint to find the total stresses on a restrained panel. For simplicity, panel stresses due to external restraint are calculated reflecting the small difference between the moduli of mortar and units. The panels are therefore approximated as isotropic.

The stresses on the brick are of little interest. Of more interest are the stresses on the mortar due to internal restraint. Assuming isotropy, these stresses are calculated from values found in Section 2.3.2 above using the following equations:

$$\sigma_{ih} = \frac{H}{A_{vb}}$$

$$\sigma_{iv} = \frac{V}{A_{hh}}$$

σ_{ih} = horizontal stress in a mortar bed joint caused by internal restraint, pounds / in^2 (kPa)

σ_{iv} = vertical stress in a mortar head joint caused by internal restraint, pounds / in^2 (kPa)

H = internal horizontal restraining force (from Section 2.3.2 above), pounds (N)

V = internal vertical restraining force (from Section 2.3.2 above), pounds (N)

A_{vb} = vertical cross-sectional area of the mortar bed joint, in^2 (mm^2)

A_{hh} = horizontal cross-sectional area of a head joint, in^2 (mm^2)

The total stress in the mortar of a restrained panel, then, is the sum of the stresses from differential movement of mortar and units, plus the stresses from external restraint.

$$\sigma_h = \sigma_{ih} + \sigma_{eh}$$

$$\sigma_v = \sigma_{iv} + \sigma_{ev}$$

The analytical results are presented in Section 5.2.2.

2.3.4 Analytical Prediction of Mortar Cracking in Unrestrained and Restrained Panels

Mortar in an unrestrained panel will crack when the tensile stresses caused by the differential movement of the brick and mortar exceed the tensile strength of the mortar. If the panels show net shrinkage, the tensile stresses in the mortar of a restrained panel are increased by external restraining force as shown in Section 2.3.3. This should result in more cracking in a restrained panel than in an unrestrained, yet otherwise identical panel. This should apply to all panels, regardless of mortar type and system. If the panels are restrained in both directions, the vertical direction should experience a greater increase in cracking over the unrestrained panel, because there is little internal restraint in the vertical direction of the unrestrained panel. This implies that complete restraint would lead to a greater increase in bed joint cracking, as opposed to head joint cracking.

3. Experimental Testing Program

3.1 Overview of Testing Program

The main thrust of the testing program is the measurement of shrinkage and cracking in 8 brick panels. Each panel is constructed with a different mortar, but with the same type of units. Simultaneously, shrinkage is measured for the ASTM C1148 shrinkage bars formed from the same mortars as the panel. The measurements and observations are continued at increasing time intervals until no significant changes occur. Compressive and tensile strength tests are run on each mortar in order to gather as much data on the mortars' properties as possible.

3.2 Materials

3.2.1 Mortar

The mortars used in the experiment were chosen in cooperation with the sponsor. All mortars conformed to ASTM C270 by proportion. Single-bag masonry cements, Type M and Type N, were obtained through the sponsor, and are referred to here as MC1M and MC1N. A second Type N and a Type S were obtained locally, and are referred to here as MC2N and MC2S.

The portland cement-lime mortars (Types M, S, N, and O) were mixed by proportion from local materials, and are referred to here as PCLM through PCLO. All mortars used Type S hydrated lime and Type I white portland cement. Sand for all mortars was obtained locally (known as "Mason's sand"), and met ASTM C144 by use (see Section 3.4.2 for results of a sieve analysis).

Mortar	Portland Cement (Parts)	Lime (Parts)	Sand (Parts)
PCLM	1	0	3
PCLS	2	1	9
PCLN	1	1	6
PCLO	1	2	9

Table 3-1 *Portland Cement-Lime Mortars' Proportions by Volume*

All mortar was proportioned by volume, not weight equivalents. For the masonry cement mortars, the proportions were 1 part masonry cement to 3 parts of sand. The proportions of the portland cement-lime mortars are shown in Table 3-1. Later, an analysis was made in an effort to determine the weight equivalent proportions; the results were inconsistent, and are not presented here.

3.2.2 Brick

A standard modular brick, obtained locally, was known to have an IRA near 5 grams / 30 sq. in. See Section 3.4.1 for IRA test results.

3.3 Panel Construction

The panels were built by an experienced mason and helper in an enclosed and heated space, separated from the concrete floor by a bond breaker (drop cloth). A Graduate Research Assistant batched all dry materials by volume, and the mason and helper adjusted the amount of water as they saw fit, mixing the mortar in a paddle-type mixer. Immediately after mixing, mortar was removed from the mixer for materials testing (see Section 3.4.2). Construction of each panel took approximately 2 hours from the time the mortar was removed from the mixer. During that time, the mason and helper retempered the mortar to maintain desired workability. The first two specimens (MC1N and MC1M) were concave tooled on the south side only. The remaining panels were concave tooled on both sides. After each panel was completed, a prefabricated wooden frame was placed around the panel to prevent it from falling over. Table 3-3 below shows the dates of construction of the panels. This date is taken as Day Zero (0) for data collection.

3.4 Material Properties

3.4.1 Brick

The brick was a blend with 4 distinct brick variant (red vs. brown, 10-core vs. 3-core). Initial rate of absorption testing was performed on 12 brick, 3 samples of each variant used. The average IRA from all 12 brick was 4.7 gm/(30 in^2-min). See Table 3-2 for a complete summary.

BRICK #	LENGTH (in)	WIDTH (in)	# Holes	Core Dim (in)	1 Core Area (in^2)	Net Area (in^2)	Init. Wt. (g)	Wet Wt. (g)	H_2O Wt. (g)	IRA (g/30 in^2)	Avg IRA (by type)	Avg IRA (overall)
1	7.625	3.625	10	0.9375	0.690	20.738	1616.7	1620.8	4.1	5.931	4.499	4.724
2	7.6875	3.625	10	0.9375	0.690	20.964	1616.7	1620.0	3.3	4.722		
3	7.5625	3.5625	10	0.9375	0.690	20.038	1620.9	1622.8	1.9	2.845		
4	8	3.625	3	1.625	2.074	22.778	1833.5	1836.0	2.5	3.293	3.746	
5	7.9375	3.625	3	1.625	2.074	22.552	1816.6	1819.8	3.2	4.257		
6	8	3.625	3	1.625	2.074	22.778	1831.5	1834.3	2.8	3.688		
7	7.5625	3.625	3	1.625	2.074	21.192	1731.5	1733.2	1.7	2.407	2.092	
8	7.625	3.6875	3	1.625	2.074	21.895	1740.0	1741.7	1.7	2.329		
9	7.625	3.625	3	1.625	2.074	21.419	1728.6	1729.7	1.1	1.541		
10	7.75	3.75	10	0.875	0.766	21.406	1634.6	1643.2	8.6	12.05	8.560	
11	7.6875	3.6875	10	0.875	0.766	20.691	1649.2	1652.8	3.6	5.229		
12	7.6875	3.6875	10	0.875	0.766	20.691	1627.7	1633.5	5.8	8.409		

Table 3-2 Initial Rate of Absorption Data and Calculations for Clay Brick Used for Panels

The 4 distinct types were used randomly in the panel construction, and blending of types appeared to be nearly even.

3.4.2 Mortar

As explained in Section 3.3 above, for each panel the mortar used for materials testing was sampled directly after mixing was completed. First, mason's flow was measured using a

Mortar	Panel Construction Date	Bar Molding Date	Flow Type	Flow	Bars
MC1N	12/10/94	12/10/94	Mason	98	1, 2, 3
	12/10/94	12/10/94	Lab	115	6
MC1M	12/10/94	12/10/94	Mason	98.5	11-15
	12/10/94	12/10/94	Lab	108	16-20
MC2S	1/14/95	1/14/95	Mason	98	21-23, 25
	1/14/95	1/14/95	Lab	105	26-30
MC2N	1/14/95	1/14/95	Mason	99.5	31-35
	1/14/95	1/14/95	Lab	114	36-40
PCLM	1/21/95	1/21/95	Mason	121	41-45
	1/21/95	1/21/95	Lab	111	46-50
PCLS	1/21/95	1/21/95	Mason	120.5	51-55
	1/21/95	1/21/95	Lab	108.5	56-60
PCLN	1/28/95	1/28/95	Mason	105	61-65
	1/28/95	1/28/95	Lab	105*	66-70
PCLO	1/28/95	1/28/95	Mason	107.5	-none-
	1/28/95	1/28/95	Lab	107.5*	-none-
MC1N	n/a	2/4/95	Mason	102	81-85
	n/a	2/4/95	Lab	111	86-90
PCLO	n/a	2/4/95	Mason	109.5	91-94
	n/a	2/4/95	Lab	109.5*	99

*Mason's flow did not need to be adjusted in order to meet lab flow requirements

Table 3-3 *Specimen Construction and Mortar Flow Data* manual flow table. Five ASTM 1148 shrinkage bars were molded using this flow. The flow was then adjusted to the ASTM 1148-prescribed laboratory flow of 110 ± 5. Five more bars were molded from that lab-flow mortar. See Table 3-3 for a summary of flows and the numerical labeling system used for the shrinkage bars.

In spite of precautions taken to handle the shrinkage bars carefully, some of them broke upon de-molding. From MC1N, Bars 4,5,7,8,9, and 10 broke. A new batch of MC1N was made later, approximating the correct flows, resulting in Bars 81-90. Similarly, PCLO Bars 71-80 broke initially, but a new batch was later made, resulting in Bars 91, 92, 93, 94, and 99. Ten bars were initially fabricated in this second batch, but some again broke. However, since the mason's and the lab flow were the same for PCLO, the remaining quantity of 5 bars was deemed sufficient. Finally, Bar 24 from mortar MC2S broke, but a new batch was never made.

Cube #	Mortar Type	Cube Area		Max. Load		Strength		Avg. Strength		C.O.V.
		in²	(mm²)	lbs	(N)	psi	(kPa)	psi	(kPa)	
1	MC1N	4	(2581)	3180	(14145)	795	(5482)			
2	MC1N	4	(2581)	3190	(14189)	798	(5499)	793	(5470)	0.0066
3	MC1N	4	(2581)	3150	(14011)	788	(5430)			
4	MC1M	4	(2581)	14300	(63606)	3575	(24650)			
5	MC1M	4	(2581)	15800	(70278)	3950	(27235)	3833	(26431)	0.0585
6	MC1M	4	(2581)	15900	(70723)	3975	(27408)			
7	MC2S	4	(2581)	7580	(33716)	1895	(13066)			
8	MC2S	4	(2581)	7940	(35317)	1985	(13687)	2007	(13836)	0.0618
9	MC2S	4	(2581)	8560	(38075)	2140	(14755)			
10	MC2N	4	(2581)	6260[1]	(27844)	1565	(10791)			
11	MC2N	4	(2581)	9080	(40388)	2270	(15652)	2271	(15660)	0.0008
12	MC2N	4	(2581)	9090	(40432)	2273	(15669)			
13	PCLM	4	(2581)	18550	(82510)	4638	(31976)			
14	PCLM	4	(2581)	18850	(83845)	4713	(32493)	4471	(30826)	0.0795
15	PCLM	4	(2581)	16250	(72280)	4063	(28011)			
16	PCLS	4	(2581)	8080	(35940)	2020	(13928)			
17	PCLS	4	(2581)	8030	(35717)	2008	(13842)	2031	(14003)	0.0149
18	PCLS	4	(2581)	8260	(36740)	2065	(14238)			
19	PCLN	4	(2581)	4130	(18370)	1033	(7119)			
20	PCLN	4	(2581)	4120	(18326)	1030	(7102)	1038	(7159)	0.0119
21	PCLN	4	(2581)	4210	(18726)	1053	(7257)			
22	PCLO	4	(2581)	1700	(7562)	425	(2930)			
23	PCLO	4	(2581)	1700	(7562)	425	(2930)	429	(2959)	0.0168
24	PCLO	4	(2581)	1750	(7784)	438	(3017)			
25	MC1N-BATCH 2	4	(2581)	3510	(15612)	878	(6050)			
26	MC1N-BATCH 2	4	(2581)	3680	(16369)	920	(6343)	903	(6223)	0.0246
27	MC1N-BATCH 2	4	(2581)	3640	(16191)	910	(6274)			
28	PCLO-BATCH 2	4	(2581)	1090	(4848)	273	(1879)			
29	PCLO-BATCH 2	4	(2581)	1200	(5338)	300	(2069)	283	(1948)	0.0538
30	PCLO-BATCH 2	4	(2581)	1100	(4893)	275	(1896)			

[1] This data point is in question and is not included in the average strength and c.o.v. calculations for mortar MC2N

Table 3-4 Mortar Compressive Strength Data and Calculations

Additionally, three 2-inch cubes were fabricated from the lab-flow mortar for compressive strength tests. The cubes were cured in precisely the same manner as the shrinkage bars. Table 3-4 shows the numerical labeling system used for the cubes, and the results from the compressive strength testing carried out on March 30, 1995.

Tests for air and water content were conducted after the experiment was complete, using completely new batches of mortar. The flows calculated during panel construction were approximated, and gravimetric air content tests in accordance with ASTM C91-93 (ASTM, 1993)

Mortar	Water Added (g)	Air Content (%)
MC1M	400	16.7
MC1N	460	15.3
MC2S	400	11.3
MC2N	400	11.4
PCLM	520	1.4
PCLS	520	1.0
PCLN	500	1.9
PCLO	580	0.3

Table 3-5 *Results of Water and Air Content Testing*

were carried out for each mortar. See Appendix F for the data. Results are summarized in Table 3-5.

Results of the sieve analysis of the sand carried out in accordance with ASTM C136-93 (ASTM, 1993) used in all batches are shown in Figure 3-1. The sand comes close to meeting ASTM 144-93 (ASTM, 1993a) by gradation, differing from that standard only in that too much sand passes the No. 30 sieve.

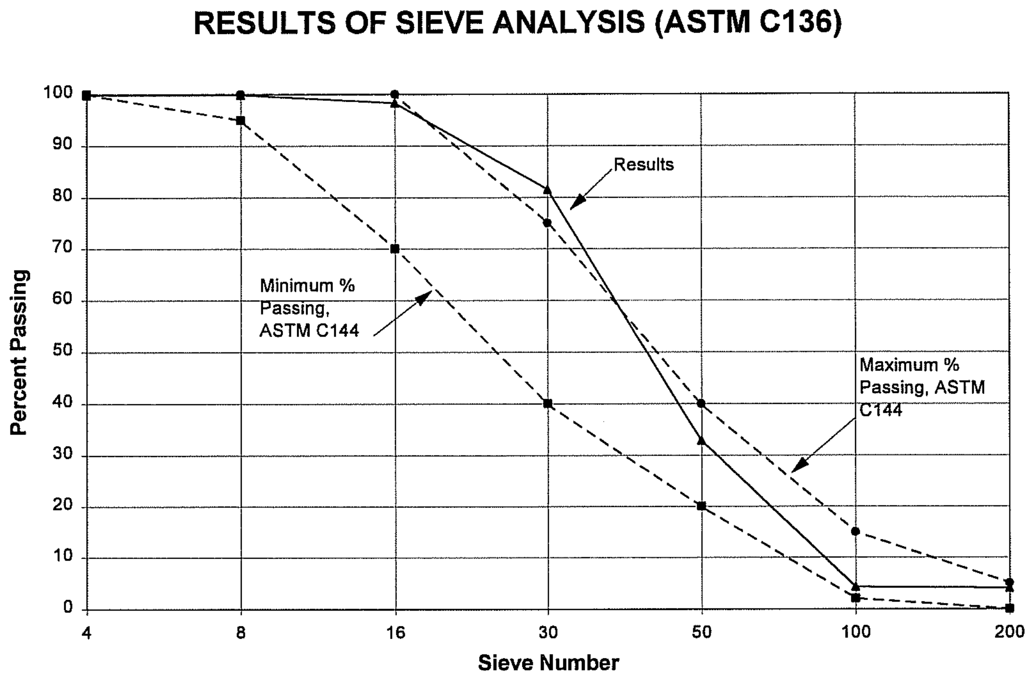


Figure 3-1 *Results of Sieve Analysis (ASTM C136)*

3.5 Test procedures and instrumentation

3.5.1 Demec Gage Points Used to Measure Panel Strains

A grid of 25 Demec mechanical gage points was placed on the south side of each specimen the day after construction (Figure 3-2). A digital Demec gage with an 0.0005-inch precision was used to measure the distance between each set of 2 adjacent points horizontally and vertically. These distances were initially measured at one-day intervals. The measurement interval was increased as the specimen aged. A small number of Demec points on the first 3 walls

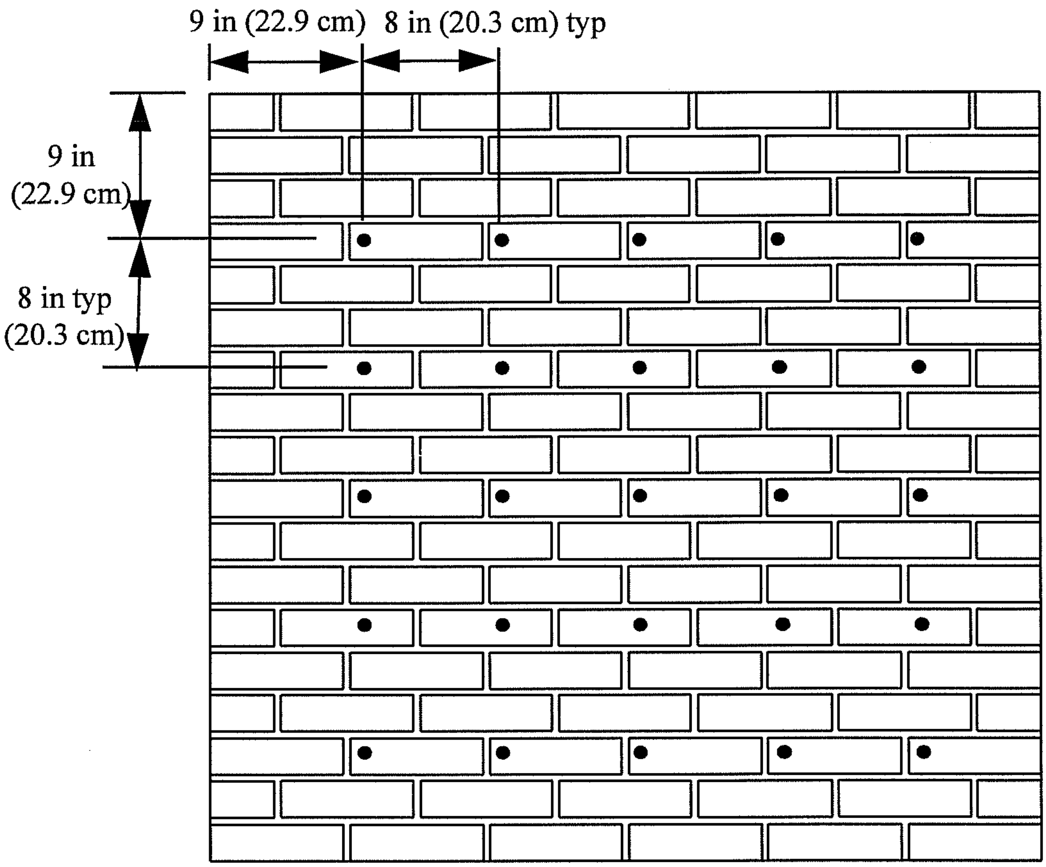


Figure 3-2 *Demec Point Locations for a Typical Panel*

(MC1N, MC1M, MC2S) came loose and had to be reattached, nullifying previous data involving those gage points (see Appendix C for more details).

3.5.2 Crack Recording

The south side of each specimen was carefully observed for mortar joint cracking, beginning the day after construction. A Construction Technology Laboratories (CTL) crack comparator was used to measure the width of each crack, with the average width being used if the crack's width varied over its length. The length of each crack was approximated to the nearest joint width. Each crack's location, approximate shape, and orientation were also recorded. If cracking was concentrated in too small an area for this to be practical, only the widths and lengths were recorded for that small area. All data were entered on computer-generated plots of the panel areas (see Appendix D for the data). Cracking was observed beginning at one-day intervals, with the interval increasing in length as the specimen aged.

3.5.3 Shrinkage Bars

The shrinkage bars were tested in accordance with ASTM C1148-92a. The gage used for measurement was digital with a 0.0001-inch precision. The gage setup often had to be reassembled before measurements were to be taken (every 7 days), due to sharing of equipment among projects. So even though the gage was zeroed with the same reference bar each time, the setup may have had a slight difference in alignment each time, resulting in errors in the ten-thousands place. Measurements were carried out beyond the time recommended by ASTM C1148, collecting bar shrinkage data as long as panel shrinkage and cracking were being measured.

3.5.4 Modulus of Rupture Testing

Well after the experimentation phase was complete, it was decided that tensile strength measurements for each type of mortar would be desirable. Modulus of rupture testing was then carried out on the ASTM C1148 shrinkage bars.

Two tests were carried out on each bar, using a span length of 4 inches. Each bar was loaded in a test machine as a simply supported beam with a point load at midspan. The load was increased until failure, and the failure load was recorded.

4. Experimental Results

4.1 Meteorological Data

Daily weather data were obtained beginning at the time that the specimens were fabricated. Daily highs, lows and averages are presented in graphical form in Appendix A (NOAA, 1994 and 1995). An example is shown in Figure 4-1. The arrow labeled by mortar types at the top of the graph denotes the construction date for the panels with those mortar types.

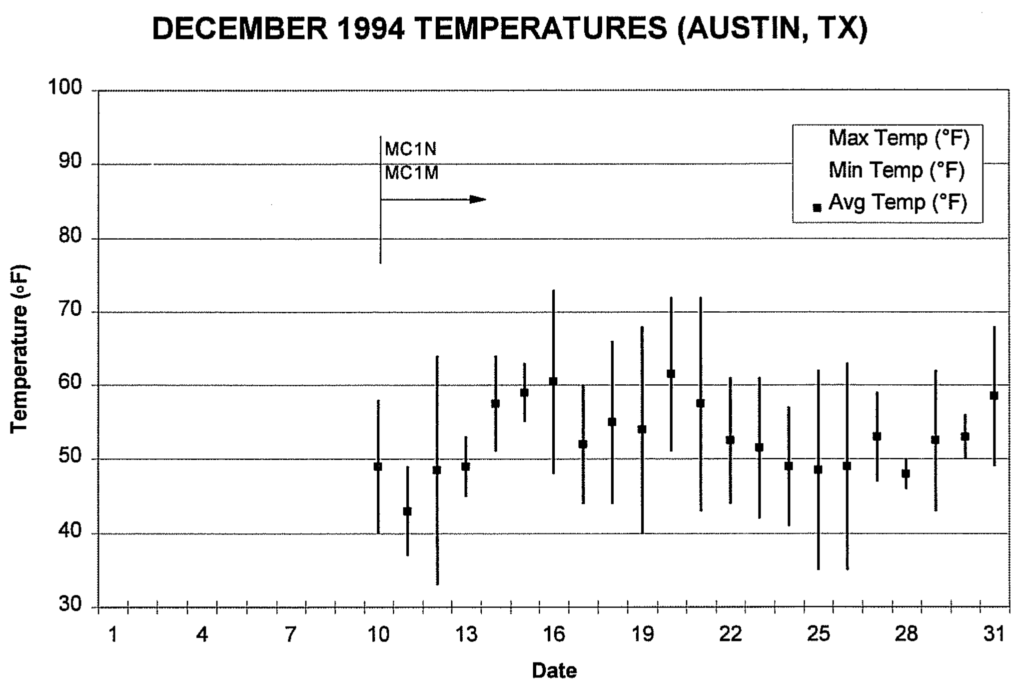


Figure 4-1 December 1994 Temperatures (Austin, TX) (NOAA, 1994 and 1995)

4.2 Bar Strain Data

The strain readings collected for each bar were the differences over time in its length, compared to the length of the reference bar. If the mortar bar was longer than the reference bar, the strain value was taken as positive in sign. If the mortar bar was shorter than the reference bar, the strain value was taken as negative in sign.

Data were reduced as per ASTM C1148-92a. Percent strains, S, were calculated via the following formula:

$$S = \left[\frac{L_1 - L}{L_0} \right] \times 100 \qquad (4.1)$$

where:

L_0 = effective gage length, (10 inches / 254 mm)

L_1 = initial measurement after removal from moist cure, inches (mm)

L = measurement during or after drying, inches (mm)

A mean value was then calculated for each set of mortar bars (usually 5 bars), and these values were converted to microstrain for ease of use. An example of the bar strain data plotted against time for one type of mortar is shown in Section 4.3 below. In such plots, positive shrinkage values denote negative strains. Refer to Appendix B for a complete record of the bar shrinkage data. For purposes of comparison, all MC1N bars' shrinkage values were averaged together (Bars 1, 2, 3, and 81-85 for mason's flow; Bars 6 and 86-90 for lab flow).

4.3 Panel Strain Data

The strain data collected from each panel consisted of 40 readings of the Demec gage (20 horizontal and 20 vertical) for each day data were collected. Each reading was the difference between the distance between two Demec points and the length of the reference bar (7.915 inches, 201.0 mm). If the distance between the two Demec points was greater than the length of the reference bar, the reading was taken as positive. If the distance between the two Demec points was less than the length of the reference bar, the reading was taken as negative.

Panel strain data were reduced like the bar strain data. For one pair of Demec points, the strain on day n was calculated via the following formula (in microstrain):

$$\varepsilon_n = \left(\frac{L_n - L_1}{7.915} \right) \times 10^6 \qquad (4.2)$$

where:

L_n = distance between the Demec points on day n, inches (mm)

L_1 = initial distance between the Demec points (day 1), inches (mm)

A mean value of all the vertical strains was then calculated, along with a mean value of all the horizontal strains. These strains were also converted to shrinkage strains in the same step (units of -με). As before, shrinkage denotes negative strains. An example of the panel shrinkage data plotted against time for one type of mortar is shown in Figure 4-2. Quadratic curves are fitted to both the vertical and horizontal shrinkage data. Bar shrinkage (mason's flow) is plotted against time on the same graph. A logarithmic curve is fitted to the bar shrinkage data. For a complete record of panel shrinkage data, see Appendix C.

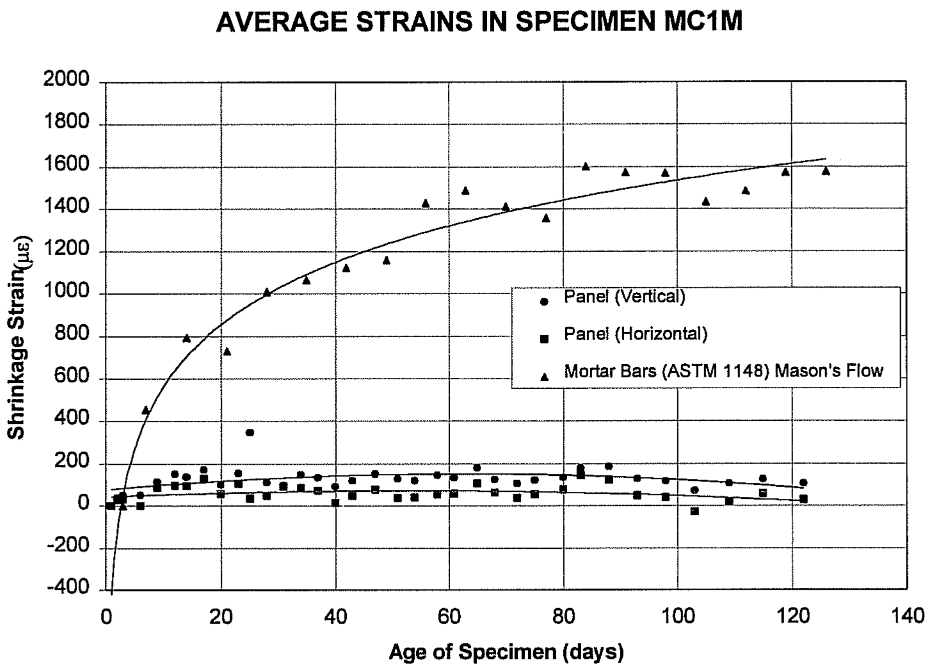


Figure 4-2 *Average Strains vs. Time in Specimen MC1M*

4.4 Panel Cracking Data

4.4.1 Qualitative presentation

An example of the computer-generated drawing of the cracking for one panel (MC2S) is shown in Figure 4-3. Table 4-1 shows the raw data that makes up this drawing, along with the calculated cracking index (Section 4.4.2).

WALL: MC2S DATE: 2/5/95

SIDE: south

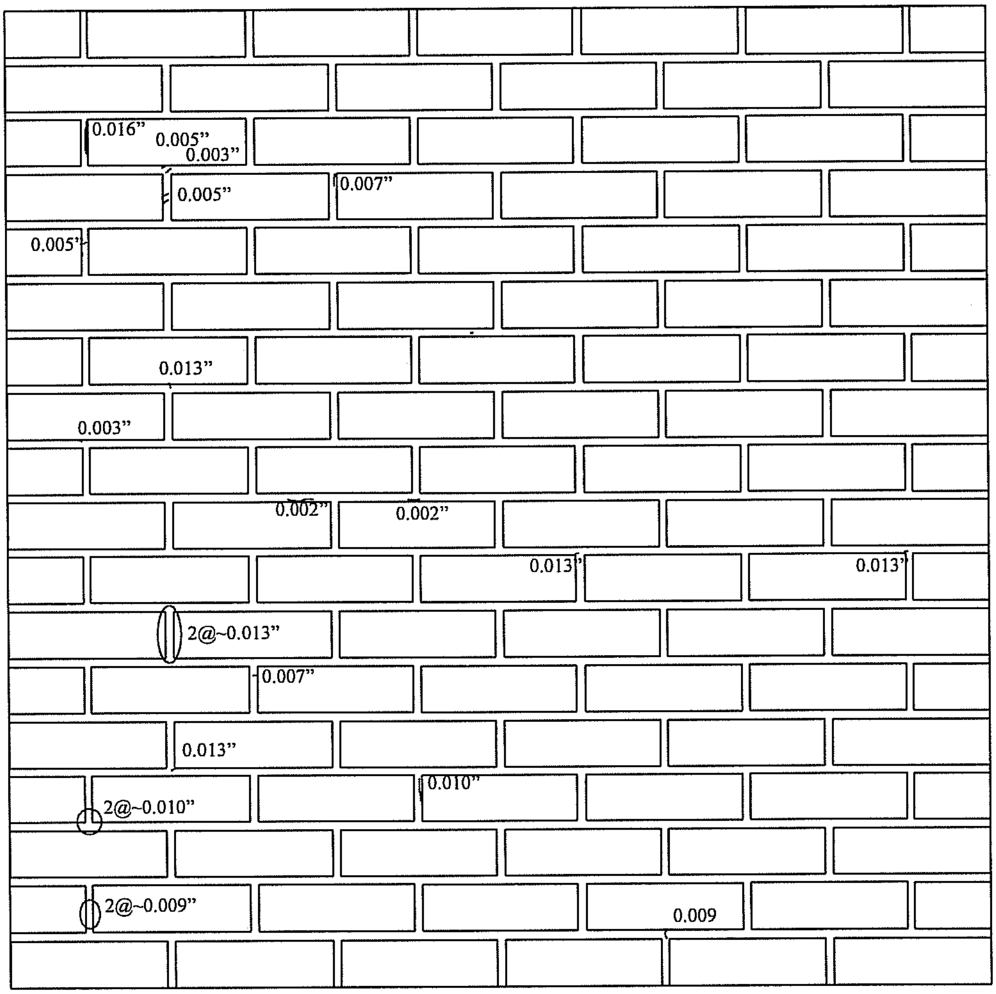


Figure 4-3 Drawing of Cracking in Specimen MC2S for February 5, 1995

2/5/95 #	Crack Width (1/1000 in)	Crack Length (joint widths)	$w^2\ell$
1	13	1	169
2	10	1	200
1	10	2	200
1	9	1	81
1	16	2	512
1	2	2	8
1	5	1	25
1	3	1	9
2	5	1	50
1	5	3	75
1	2	1	4
1	13	1	169
1	13	1	169
1	3	1	9
2	13	1	338
1	13	1	169
2	9	1	162
1	7	1	49
1	7	1	49
SUM			2447

Table 4-1 *Cracking Data for Specimen MC2S for February 5, 1995*

Note that each line in the table represents one crack if that individual crack is shown on the figure. If there is an area too densely cracked for each individual crack to be shown, the figure shows a circle around that area with the number of cracks there and their average width. In such a situation, the table has only one line representing that area of cracking. For example, Line 3 in Table 4-1 represents an area of cracking seen in the lower left corner of Figure 4-3. However, there are also single lines in the tables that represent multiple cracks in one area, all drawn discretely on the picture of the wall. Line 9 in Table 4-1 represents 2 closely spaced cracks that are both seen in the upper left corner of Figure 4-3. See Appendix D for a complete record of panel cracking data and drawings, as well as histograms of crack widths for each wall.

4.4.2 Cracking Indices

Using cracking data for each panel, several numerical indices of cracking severity were developed. One such index was obtained by taking, for all cracks in the mortar joints on a wall, the sum of the product of the crack width squared, times the crack length:

$$Cracking\ Index = \sum w^2 \ell \tag{4.3}$$

This index gives a single numerical value for each panel that represents the severity of cracking. This particular cracking index was selected because it tends to emphasize the presence of wide cracks (the squared term), which were deemed more likely to result in water penetration. For purposes of this evaluation, the crack width was expressed in thousandths of an inch, and the crack length was expressed in joint widths. These units made it possible to obtain the index quickly using the electronic drawing of the wall. Figure 4-4 shows a plot of the cracking index against time for one of the panels. The curve fit to the data is logarithmic. See Appendix D for complete plots of the cracking index vs. time.

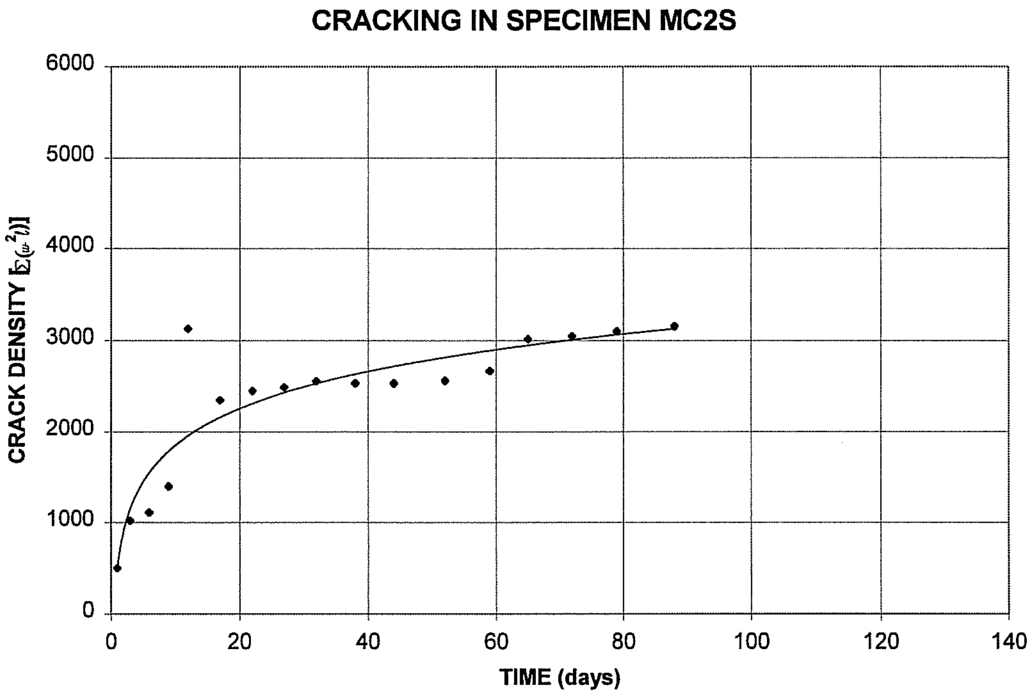


Figure 4-4 *Cracking vs. Time for Specimen MC2S*

In addition to calculating the cracking index, the frequency distribution of crack widths was tabulated for each wall. Figure 4-5 shows one of the histograms of crack widths that was assembled from this data. This is a discrete distribution because the CTL crack comparitor measures width only in the discrete intervals shown in Figure 4-5. The mean crack width and its coefficient of variation, along with the number of cracks, are also shown on the graph. Histograms for all panels are in Appendix D.

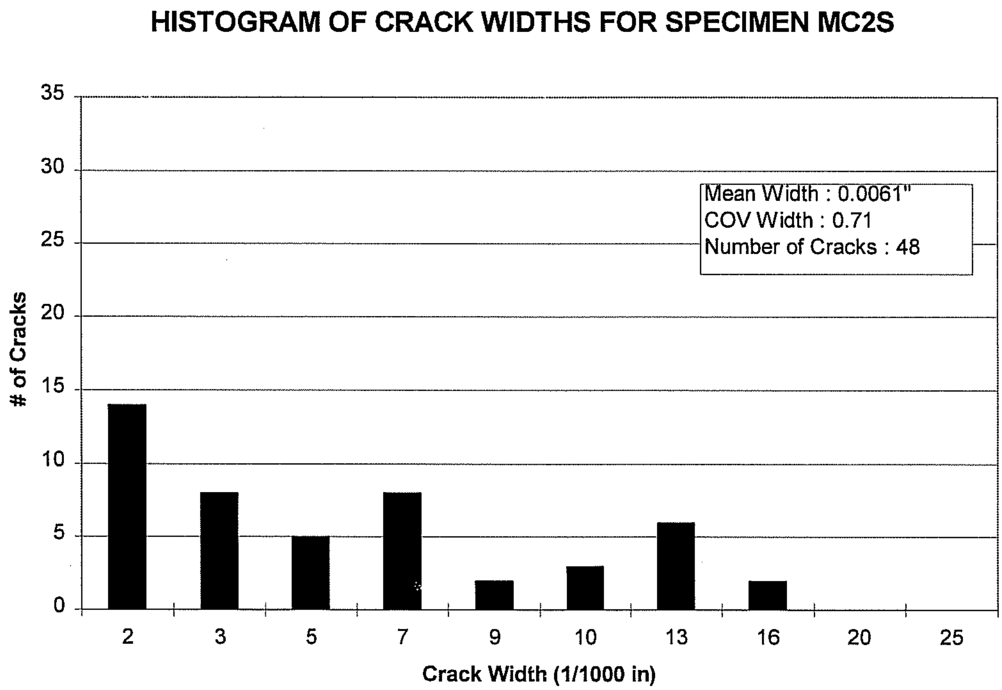


Figure 4-5 *Histogram of Crack Widths for Specimen MC2S*

4.5 Modulus of Rupture Data for Mortar Bars

4.5.1 Quantitative Presentation

Table 4-2 shows the results of the modulus of rupture testing, grouped by mortar type

Mortar	Flow	Mean Tensile Strength (psi)	COV
MC1N	Mason	291.7	0.3342
	Lab	210.3	0.2906
MC1M	Mason	1076.4	0.2300
	Lab	1096.2	0.1803
MC2S	Mason	657.8	0.1207
	Lab	576.3	0.2295
MC2N	Mason	444.2	0.4238
	Lab	383.0	0.5215
PCLM	Mason	964.0	0.4139
	Lab	1050.6	0.1250
PCLS	Mason	684.6	0.0637
	Lab	643.2	0.0672
PCLN	Mason	339.6	0.2606
	Lab	255.7	0.5095
PCLO	Mason	113.5	0.1097
	Lab	113.5	0.1097

Table 4-2 Modulus of Rupture Test Results

and flow. The value for tensile stress at failure was computed by first finding the failure moment,

$$M = \frac{P \times L}{4} \tag{4.4}$$

where:

P = load at failure, pounds (N)

L = span, (4 inches / 10.16 mm)

Then the tensile stress at failure was computed,

$$\sigma_T = \frac{M \times c}{I} \tag{4.5}$$

where:

M = moment at failure, pound-inches (Newton-meters)

c = depth to neutral axis, inches (mm)

I = moment of inertia, in^4 (mm^4)

See Appendix E for complete modulus of rupture data and calculation records.

4.5.2 Tensile Strengths of Mortar

Modulus of rupture tests are affected by strain gradient and specimen size, and are therefore not completely accurate measure of the probable concentric tensile strength of a mortar joint. However, the relative strengths should not differ, allowing these data to be used as an acceptable approximation to tensile strength for analysis purposes.

5. Discussion of Experimental Results

5.1 Discussion of Bar Shrinkage Results

5.1.1 Methodology and Results of Comparison Between Mortar Bar Shrinkages

To compare the bar shrinkages of the different mortars, a single value of maximum bar shrinkage had to be obtained for each mortar. The absolute maximum value ever recorded would not have been appropriate because of scatter in the data. The bar shrinkage vs. time graphs, as

Mortar	Flow	Mean Max Bar Shrinkage (με)	COV
MC1N	Mason	1250	0.0440
	Lab	1308	0.0505
MC1M	Mason	1545	0.0396
	Lab	1533	0.0414
MC2S	Mason	1186	0.0507
	Lab	1229	0.0490
MC2N	Mason	1155	0.0482
	Lab	1256	0.0469
PCLM	Mason	1494	0.0417
	Lab	1503	0.0445
PCLS	Mason	1768	0.0339
	Lab	1714	0.0345
PCLN	Mason	1628	0.0334
	Lab	1628	0.0334
PCLO	Mason	1316	0.0530
	Lab	1316	0.0530

Note: For PCLN and PCLO Mason's flow was equal to Lab flow

Table 5-1 *Maximum Bar Shrinkages*

exemplified by Figure 4-2 and given in Appendix C, show that the data become nearly constant near the end of the data-gathering period. To reduce the effects of the scatter of individual data points, an effective maximum value of bar shrinkage was calculated by computing the mean of

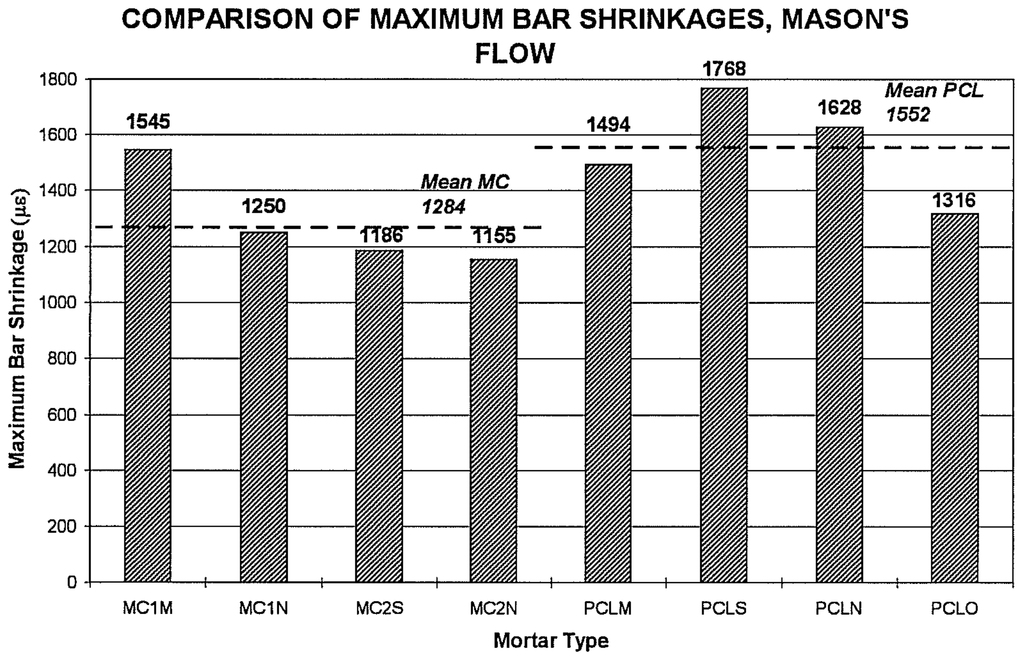


Figure 5-1 *Comparison of Maximum Bar Shrinkages, Mason's Flow*

the data points on this final asymptote. The last 7 points were used for each mortar type, because this seemed to represent that final asymptote quite well. Table 5-1 shows the calculated maxima with their corresponding coefficients of variation.

Figure 5-1 compares these maximum bar shrinkages, showing the shrinkage strain in the ASTM C1148 bars with the Mason's flow for each mortar type. Note the two dashed lines, indicating mean values of bar shrinkage for the 4 masonry cement mortars and for the 4 portland cement-lime mortars.

Figure 5-2 is similar to Figure 5-1, but shows the shrinkage strain in the ASTM C1148

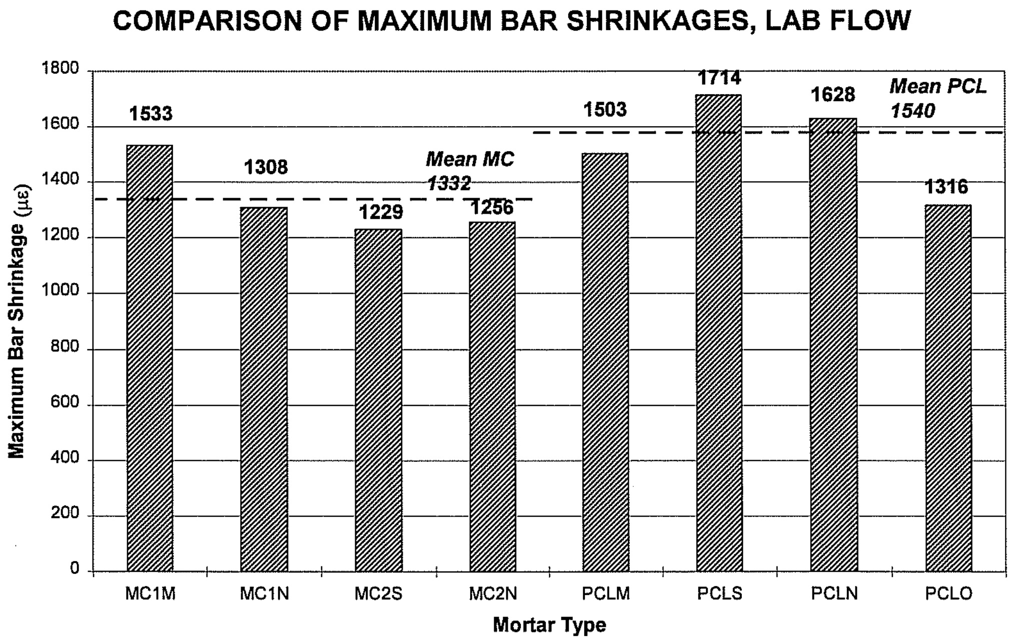


Figure 5-2 *Comparison of Maximum Bar Shrinkages, Lab Flow*

bars with the laboratory-prescribed flow of 110±5. It is worth noting that this second graph shows the same sort of results as the first. In other words, within the Mason's flow mortars, PCLS shrank the most, PCLN the second most, and so forth. With the lab-flow mortar, this relative ranking of most to least shrinkage does not change; only the maximum shrinkage values change.

Mortars	Bars (Mason's Flow) (%)
MC vs. PCL	99.999886
MC1M vs. PCLM	99.9
MC2S vs. PCLS	99.99999987
MC1N vs. MC2N	99.999876
MC1N vs. PCLN	99.99999973
MC2N vs. PCLN	99.99999975
MC1N vs. PCLO	99.978

Table 5-2 *Confidence Level of Inequality for Various Comparisons of Maximum Bar Shrinkages*

Both graphs seem to indicate that the portland cement-lime mortars shrink more overall than the masonry cement mortars. To support this assertion, a two-tailed, paired, two-sample t-test was performed. The purpose of this test was to determine if there is a statistical difference between the bar shrinkage of the masonry cement mortars as a whole and the bar shrinkage of the portland-cement lime mortars as a whole. One sample for the test was the 28 points used to calculate the maximum bar shrinkages for the masonry cement mortars (final 7 points from each of 4 masonry cement mortars). The other sample was the 28 points used to calculate the maximum bar shrinkages for the portland cement-lime mortars (final 7 points from each of 4 masonry cement mortars). The test was two-tailed to test the hypothesis that the mean of the masonry cement mortar bar shrinkages was equal to the mean of the portland cement-lime mortar bar shrinkages. The result of this test are in the first row of Table 5-2. The result indicates that the two means are not statistically equivalent, with 99.999886 % certainty. In other words, the portland cement-lime mortar bars shrink more than the masonry cement mortar bars, with a certainty approaching 100%.

Similar statistical testing was done to compare mortars of the same type (for example, MC2S vs. PCLS). Results of these tests are also shown in Table 5-2. In each case, the means were found to be not equivalent with very high confidence. In other words, a significant difference in means was found for each pair tested, for reasonable significance levels (significance level = 1 - confidence). The high level of confidence for all comparisons can be attributed to the low coefficients of variation in the data, as shown in the last column of Table 5-1.

5.1.2 Possible Explanations of Bar Shrinkage Results

Within the masonry cement mortars, it appears that shrinkage is directly proportional to compressive strength, with MC1N not fitting this relationship exactly. The same seems to be true for the portland-cement lime mortars, with PCLM not fitting the trend. Cement contents were not available for the masonry cement mortars tested. However, the compressive strength of masonry cement mortars usually correlates positively with cement content. The trend implies that for masonry cement mortars, a higher cement content results in more shrinkage.

Another possible explanation for the bar shrinkage data is shown in Figure 5-3. Bar

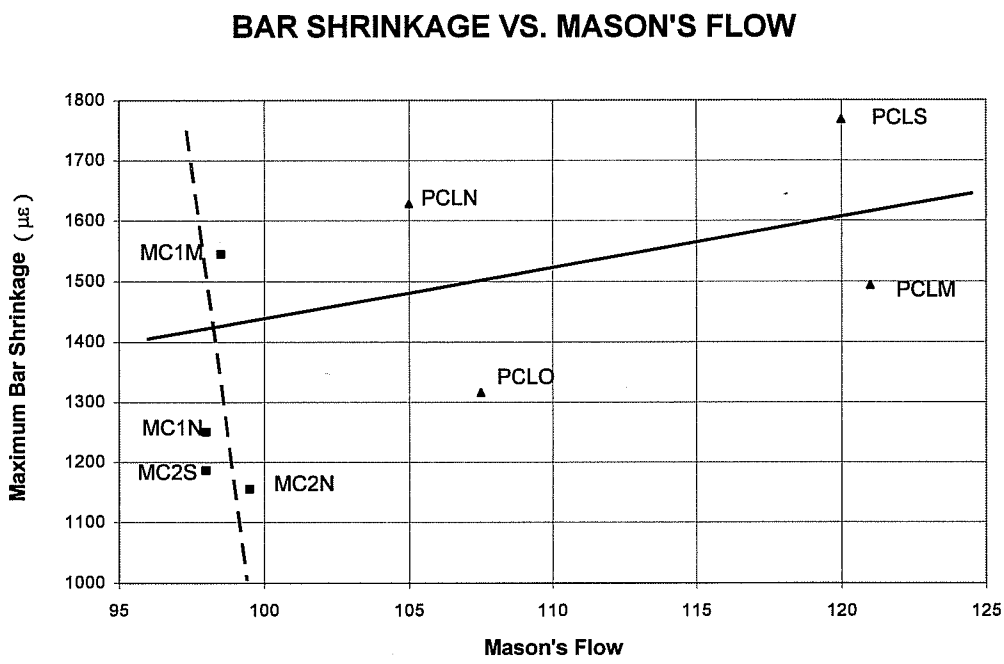


Figure 5-3 *Bar Shrinkage vs. Mason's Flow*

shrinkage is plotted against Mason's flow for all 8 mortars. For the portland cement-lime mortars, bar shrinkage is proportional to flow. This is a logical correlation, since a higher flow requires more water, and more water leads to more drying shrinkage. However, this trend does not hold for the masonry cement mortars, as there is effectively no correlation between shrinkage and flow. Looking at the data, it is likely that no correlation is observed because the masonry cement mortars had effectively the same flow. This could also be due to the role of entrained air in the masonry cement mortars. As presented in Section 3.4.2, the masonry cement mortars had air contents ranging from 11.3% to 16.7 % (as compared with 0.3% to 1.9% for the portland cement-lime mortars). This high amount of air reduces the amount of water necessary to achieve a given flow (or workability), as the entrained air itself increases the flow. Section 3.4.2 also shows that the amount of water added to the masonry cement mortars is less than the amount added to the portland cement mortars, supporting this hypothesis.

5.1.3 Comparison with Data from Previous Studies

As explained in Chapter 2 above, some previous data exist on shrinkage of mortar bars of various types. Davis and Troxell (1929) found no effect of lime content on shrinkage in portland cement-lime mortars, except that the mortar without lime shrank least. Data here support that conclusion in that the PCLM mortar (no lime) shrank less than two of the portland cement-lime mortars with lime, PCLS and PCLN. Andregg (1940) and Kalousek (1955) also found no significant effect of lime content on shrinkage.

Palmer (1931), Monk (1963), and Ritchie (1966) found that shrinkage increases with lime content. These findings are in direct opposition to the data presented here. Monk, Ritchie, and Dubovoy (1990) also found that masonry cement mortars shrink less than portland cement-lime mortars, which agrees with the bar shrinkage results presented above.

Watstein and Seese (1947) reported that shrinkage increased with the amount of mixing water required, which generally implies that shrinkage increases with the amount of lime present. Again, the data above do not support the conclusion that more lime leads to more shrinkage, and the conclusion that more water leads to more shrinkage was not directly addressed by this study. The most probable reason for the differences in the results of this study when compared to the above research involves the way the mortar was mixed. In this study, the water was added as needed by the mason, instead of added to achieve the same flow for all mortars. The mortar was mixed in this way by this study in order to simulate more accurately the actual mixing process in the field.

5.2 Discussion of Panel Shrinkage Results

5.2.1 Methodology and Comparisons among Panel Shrinkages

As was the case for the bar shrinkage data, a maximum value was needed for the vertical and horizontal shrinkage for each panel over the life of the experiment. In this case, the first step was to find the maximum value of each fitted quadratic curve (seen in Appendix C), and its location in time. This was done through simple differentiation of the quadratic function (a sample calculation is shown in Section 9.1 of Appendix C). The mean of the 7 points centered around

Panel	Direction	Mean Max Panel Shrinkage ($\mu\varepsilon$)	COV
MC1N	Vert	68.1	0.4949
	Horiz	35.9	2.8060
MC1M	Vert	134.0	0.1779
	Horiz	59.6	0.3914
MC2S	Vert	34.7	1.3090
	Horiz	30.6	1.8657
MC2N	Vert	14.4	3.3363
	Horiz	-7.2	-5.6465
PCLM	Vert	62.3	0.6885
	Horiz	76.7	0.4859
PCLS	Vert	225.6	0.1973
	Horiz	204.4	0.1984
PCLN	Vert	136.3	0.2868
	Horiz	121.4	0.3655
PCLO	Vert	47.4	0.9491
	Horiz	45.6	0.7643

Table 5-3 *Maximum Panel Shrinkages*

this maximum was then taken as the maximum panel shrinkage. Table 5-3 shows the calculated maximum panel shrinkages with their corresponding coefficients of variation.

Figure 5-4 shows these maximum unrestrained shrinkages for each panel. One set of bars in this graph shows the vertical strains; the other shows the horizontal strains. A negative value for shrinkage indicates expansion. Statistical analyses similar to those performed on the mean maximum bar shrinkages were performed for the panel shrinkages as well, and results are

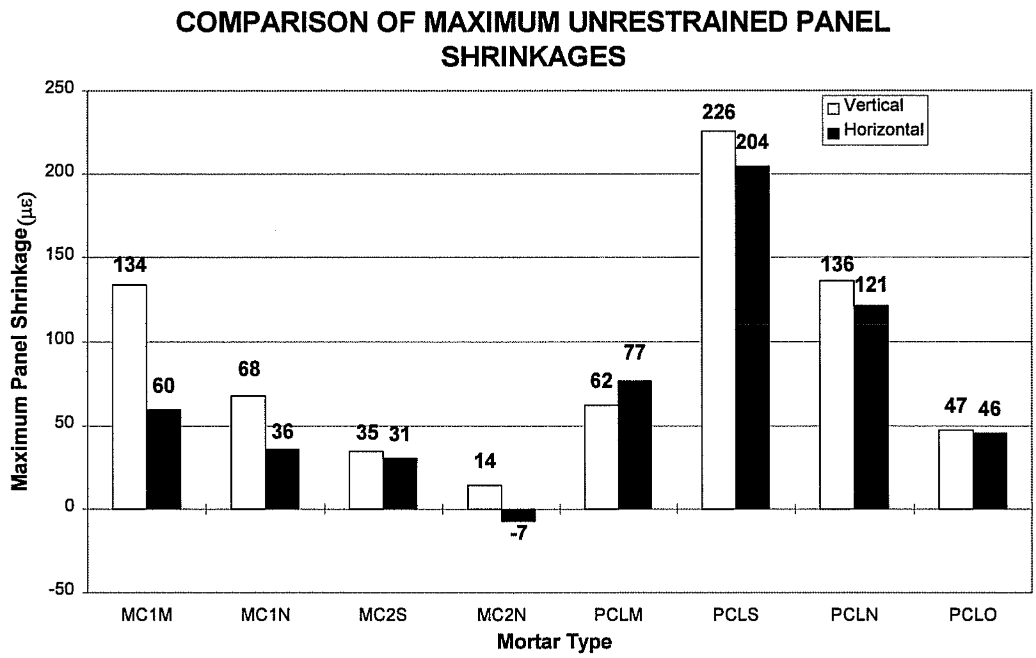


Figure 5-4 Comparison of Maximum Unrestrained Panel Shrinkages

shown in Table 5-4. These results vary more than those of the bar shrinkages. However, in looking at the overall differences between the two mortar systems, it is still reasonable to conclude with up to 99.8 % confidence that there is a statistically significant difference between the shrinkage values of portland cement-lime versus masonry cement panels. When comparing

Mortars	Panel (Vertical) (%)	Panel (Horizontal) (%)
MC vs. PCL	98.83	99.913
MC1M vs. PCLM	97.46	56.4
MC2S vs. PCLS	99.99272	99.711
MC1N vs. MC2N	98.32	75.1
MC1N vs. PCLN	96.31	84.6
MC2N vs. PCLN	99.9285	99.412
MC1N vs. PCLO	60.3	15.6

Table 5-4 *Confidence Level of Inequality for Various Comparisons of Maximum Panel Shrinkages*

within types of mortar (for example, MC1M vs. PCLM), there are many pairs with no statistical difference, even at a 90% confidence level. Despite this, it appears that the panel shrinkages follow the same trends seen in the bar shrinkages: higher strength (cement content) leads to more shrinkage, with the exceptions noted above. If these trends are indeed the same, it would follow that bar shrinkage is closely correlated with panel shrinkage.

Figure 5-5 shows that this is indeed the case. The best fit lines through the data indicate a strong correlation between unrestrained panel shrinkage and bar shrinkage. Therefore it may be possible to predict panel shrinkage from bar shrinkage. This hypothesis leads directly to the next section.

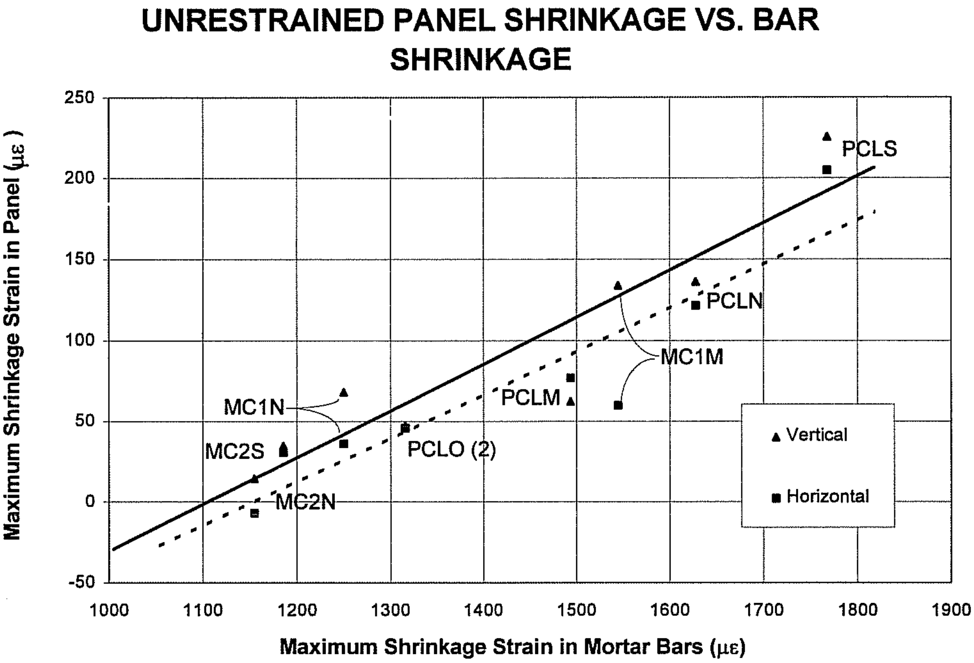


Figure 5-5 *Unrestrained Panel Shrinkage vs. Bar Shrinkage*

5.2.2 Comparison of Experimental Results and Analytical Predictions

A method for predicting panel shrinkages based on the bar shrinkages was presented in Section 2.3. Using the maximum values of shrinkage in the Mason's flow bars as the mortar strain in the Section 2.3 equations, expected panel shrinkages were calculated and are shown in Table 5-5 alongside the actual maximum panel shrinkages found in Section 5.2.1 above. Again, a positive value indicates shrinkage, while a negative value indicates expansion.

Figure 5-6 and Figure 5-7 show the correlation between the calculated and actual values of panel shrinkage. Note the dashed line labeled "theoretical line", which indicates the line along which all points should lie if the predicted values perfectly matched the actual observations. The

Mortar	Calculated ε_{vert} ($\mu\varepsilon$)	Measured ε_{vert} ($\mu\varepsilon$)	Calculated ε_{horiz} ($\mu\varepsilon$)	Measured ε_{horiz} ($\mu\varepsilon$)
MC1M	147	134	134	59.6
MC1N	58.3	68.1	-17.7	35.9
MC2S	59.6	34.7	16.4	30.6
MC2N	59.5	14.4	29.6	-7.22
PCLM	142	62.3	141	76.7
PCLS	169	226	108	204
PCLN	130	136	43.8	121
PCLO	58.6	47.4	-49.2	45.6

Table 5-5 Calculated (Predicted) and Actual Panel Shrinkages

correlation for both the vertical shrinkage and the horizontal shrinkage is relatively good. In any case, both best-fit lines trend up and to the right (positive slope), showing again that panel shrinkage increases with increasing bar shrinkage.

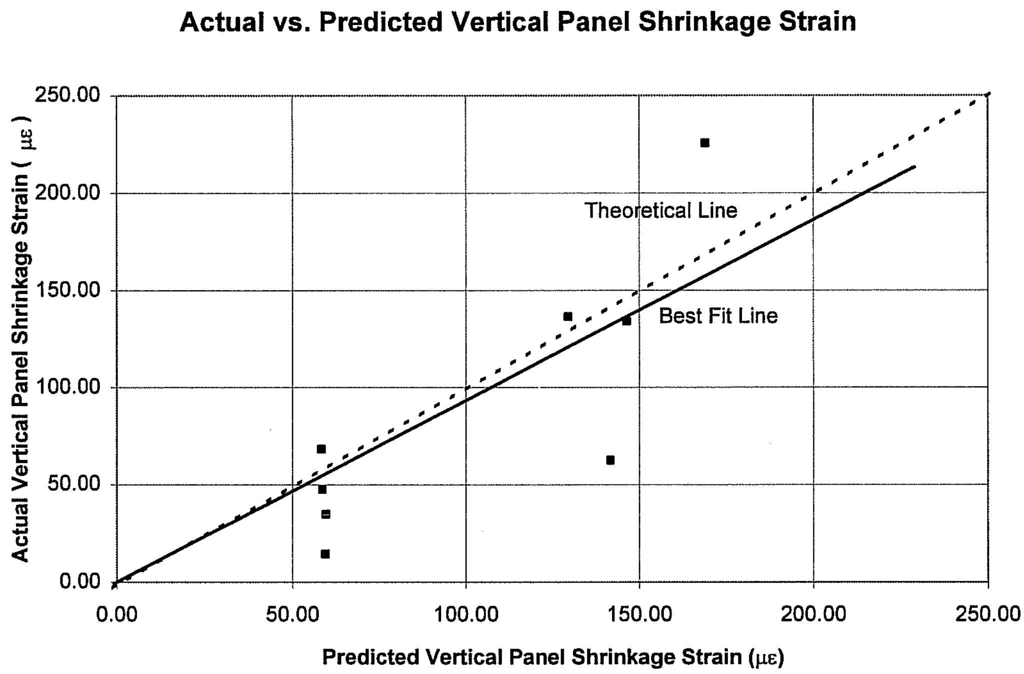


Figure 5-6 *Actual vs. Predicted Vertical Panel Shrinkage Strain*

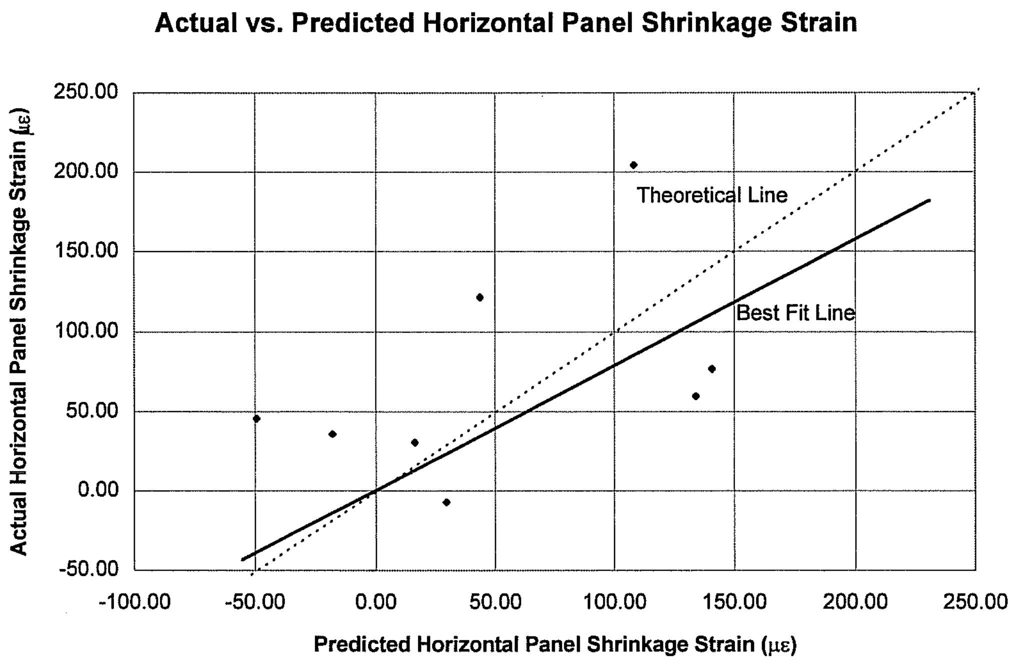


Figure 5-7 Actual vs. Predicted Horizontal Panel Shrinkage Strain

Mortar	σ_i psi	σ_e psi	σ_{tot} psi	Increase %
MC1M	4544.6	491.8	5036.4	10.8
MC1N	1920.9	-22.4	1898.4	-1.2
MC2S	2726.4	82.1	2808.4	3.0
MC2N	2790.6	114.5	2905.1	4.1
PCLM	4707.6	509.9	5217.5	10.8
PCLS	3891.6	423.8	4315.4	10.9
PCLN	2655.8	189.8	2845.6	7.1
PCLO	1340.3	-113.0	1227.2	-8.4

Table 5-6 Horizontal Stresses on the Mortar in a Restrained Panel

The results of the analysis for restrained panels is seen in Table 5-6 and Table 5-7. The last column in each table shows the percent change in stress between the unrestrained ($\sigma_{internal}$ only) and the restrained case ($\sigma_{internal} + \sigma_{external}$). A negative change indicates that the unrestrained panel was predicted to expand (see Table 5-5), leading the restraint to impose a compressive stress on the panel.

Mortar	σ_I psi	σ_e psi	σ_{tot} psi	Increase %
MC1M	5339.4	523.2	5862.6	9.8
MC1N	2140.1	159.4	2299.5	7.4
MC2S	3111.9	192.8	3304.7	6.2
MC2N	3219.7	185.9	3405.6	5.8
PCLM	5575.7	512.2	6087.9	9.2
PCLS	4444.0	579.0	5023.0	13.0
PCLN	2976.8	395.6	3372.4	13.3
PCLO	1463.1	144.8	1607.9	9.9

Table 5-7 Vertical Stresses on the Mortar in a Restrained Panel (Tension Positive)

5.3 Discussion of Panel Cracking Results

5.3.1 Implications of Observed Panel Cracking

As described in Section 4.4.2 above, for each panel a numerical index was calculated that would represent the severity of cracking. The maximum value of this cracking index for a given panel was taken as the maximum value ever calculated for that panel, which in this case is also the value for the last day data were taken. Figure 5-8 compares the maximum cracking indices for each panel. Once again, the mean values for the masonry cements and for the portland cement-lime mortars are shown with dashed lines.

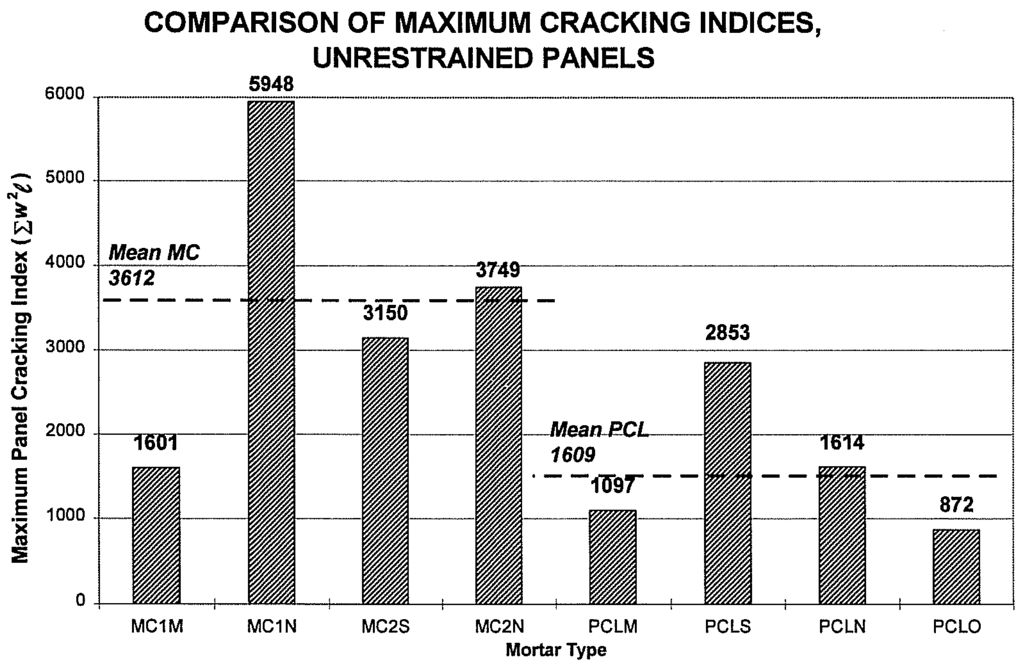


Figure 5-8 Comparison of Maximum Cracking Indices, Unrestrained Panels

In order to statistically compare the amount of cracking of each wall, there must be an error range, or standard deviation, for each wall's cracking index. For example, it must be decided if the cracking index of 2853 for PCLS is significantly different from the cracking index of 3150 for MC2S, taking into account the errors in measuring the cracks. Each maximum value shown in Figure 5-8 is a kind of mean value for that mortar type, and the standard deviation about this "mean" is calculated using the errors introduced when measuring the length and width of each crack. The following formula (Bannister et al, 1992) calculates the standard deviation of an expression (in this case, one $w^2\ell$ term in the summation of the cracking index, or one crack) using the standard deviation of each individual variable in the expression (in this case, width and length):

$$\sigma_{w^2\ell}^2 = \left(\frac{\partial f}{\partial w}\right)^2 \sigma_w^2 + \left(\frac{\partial f}{\partial \ell}\right)^2 \sigma_\ell^2 \qquad (5.1)$$

where:

$$f(w,\ell) = w^2\ell$$

σ_w = measurement error in the crack width

σ_1 = measurement error in the crack length

Then the standard deviation of the cracking index can be calculated using the same formula, except the expression is now $\Sigma(w^2\ell)$, and the variables are each $w^2\ell$ term. This is the square root of the sum of the squares of the standard deviations of each crack. The total variance is simply the sum of the individual variances.

$$\sigma^2_{\Sigma w^2 l} = \sigma^2_{(w^2 l)_1} + \sigma^2_{(w^2 l)_2} + \sigma^2_{(w^2 l)_3} + \ldots \qquad (5.2)$$

Therefore, for each wall, there is a "mean" value of the cracking index (above each bar in Figure 5-8) and a standard deviation about that mean. Sample calculations appear in Appendix D. The values are as shown in Table 5-8. The measurement errors used in this analysis were estimated as ±1/1000 inch for the crack width, and ±0.25 joint widths for the crack length.

Mortar	Cracking Index $\Sigma w^2 \ell$	Std. Deviation σ
MC1M	1601	155
MC1N	5948	191
MC2S	3150	206
MC2N	3749	204
PCLM	1097	113
PCLS	2853	249
PCLN	1614	114
PCLO	872	119

Table 5-8 Cracking Indices and Their Standard Deviations

The masonry cement mortars seem to have had more cracking (using this formulation of the cracking index) than the portland cement-lime mortars. The overall mean cracking index of the masonry cement mortars was 3612 (as denoted by the horizontal dashed line in Figure 5-8) with a standard deviation of 380. The overall mean cracking index of the portland cement-lime mortars was 1609, with a standard deviation of 319. Again, a two-tailed, paired, two-sample t-test was performed to compare these mean values. This test showed that the two means are not statistically equivalent, with more than 99.98% certainty, meaning that the masonry cement panels are more cracked overall than the portland cement-lime panels. However, the exact same 4 mortar types were not used with each mortar system, so this is not a perfect side-by-side comparison.

T-tests involving the cracking index of one specific mortar versus another (MC1M vs. PCLM, for example) were not possible because the number of samples is, in effect, one. Only one panel was built using each mortar, giving one value for the cracking index for each panel, or one data point per panel. The t-test requires more than one data point for comparison. A qualitative judgment is possible by looking at the values in Table 5-8.

Finally, these results are not sensitive to the definition of the cracking index. For example, changing the squared term to a linear term in the formula does not change the ordering of the panels from least cracked to most cracked.

Within the masonry cements, it appears that the cracking index is inversely proportional to tensile strength. This trend does not hold for the portland cement-lime mortars. Figure 5-9

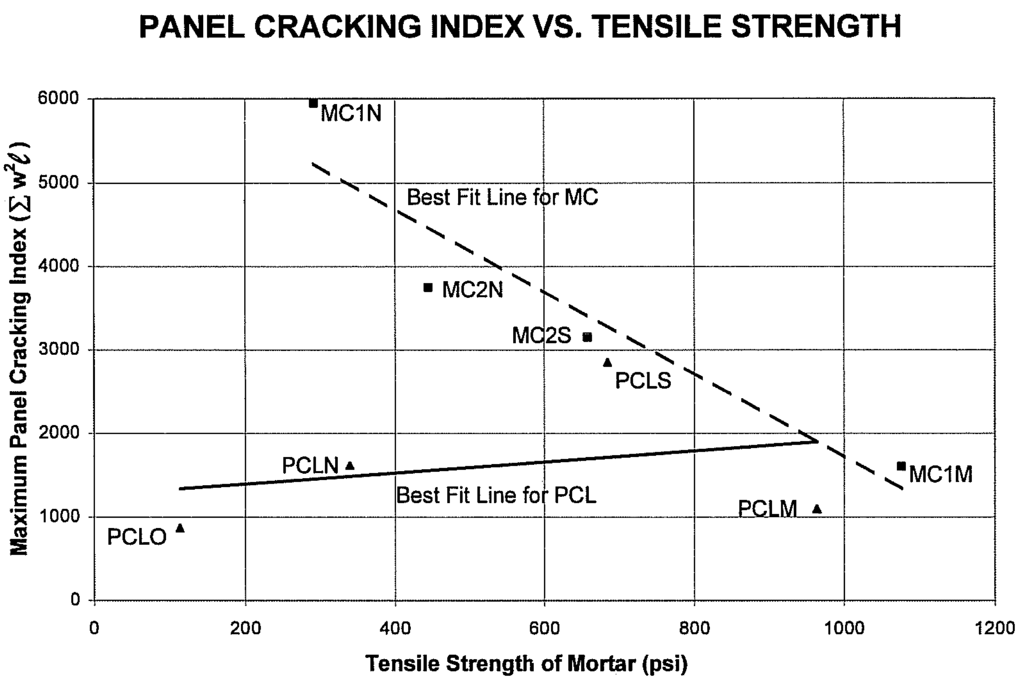


Figure 5-9 *Panel Cracking Index vs. Tensile Strength*

shows the cracking vs. tensile strength relationships. The graph shows a strong correlation for the masonry cement mortars. However, the correlation is very poor for the portland cement-lime mortars.

A trend that does hold for the portland cement-lime mortars is cracking in direct proportion to bar (or panel) shrinkage. Figure 5-10 shows this trend. The correlation here between cracking and bar shrinkage is excellent. It is not known why the PCLM mortar does not fit into any strength trend within the portland cement-lime mortars. For the masonry cement mortars, the correlation seems to be negative, but it is weak at best.

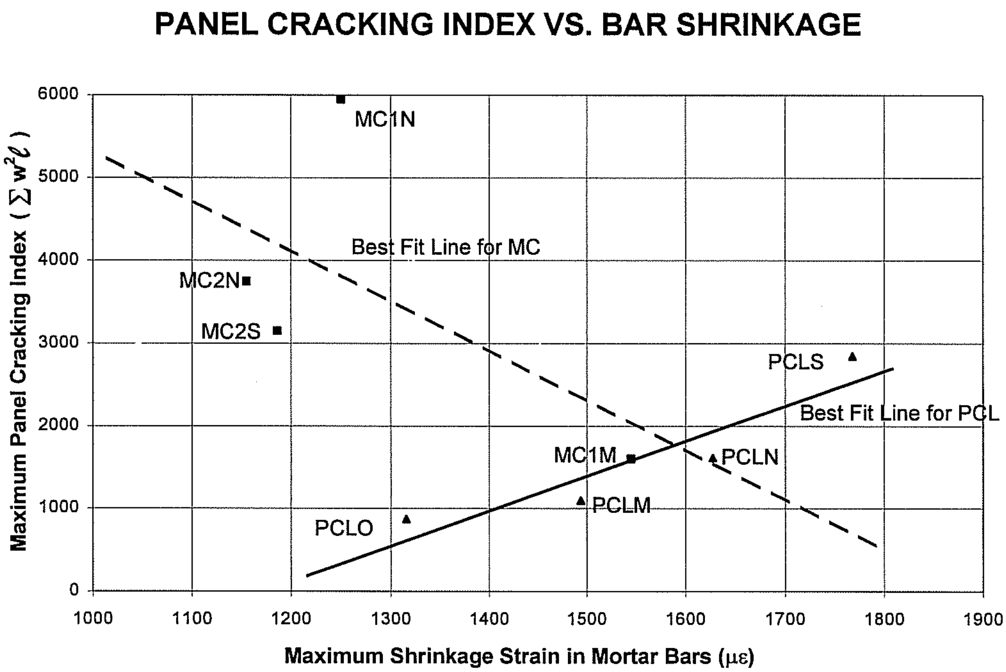


Figure 5-10 *Panel Cracking Index vs. Bar Shrinkage*

Water permeability tests were not performed in this study, so the link between the magnitude of the cracking index and a panel's performance in such a test is not known. However, for all panels, the amount of cracking was relatively small in general. Therefore the cracking documented in this study would probably not lead to excessive water permeance in any case.

5.3.2 Possible Explanations for Differences in Cracking Between Mortar Systems

In looking at the overall difference between masonry cement mortars and portland cement lime mortars, the implication that more shrinkage leads to more cracking does not appear to apply. The masonry cement panels shrank less than the portland cement lime panels, yet had more cracking than the portland cement-lime panels. The other implication mentioned above, that higher tensile strength leads to less cracking, also does not apply between the two groups, as there is no significant difference in tensile strengths between masonry cement mortars and portland cement-lime mortars of the same type. Therefore one possible explanation is that different variables affect cracking in masonry cement mortars than affect cracking in portland cement-lime mortars.

Another possible explanation for the lower level of cracking in portland-cement lime mortars is that autogenous healing occurs in the portland cement-lime mortars. The lime in the mortar is recarbonated and deposited in the cracks, effectively closing them. One problem here is that in observing the cracking in the portland cement-lime mortars, very rarely did cracks ever close or disappear after they had been observed. Unless this process of cracking and subsequent autogenous healing occurred between observations, this possible explanation may not be adequate. It is also unlikely, since panels were not exposed to water during the observation period.

A third explanation is that tensile creep in the portland cement-lime mortars is greater than in the masonry cement mortars. This tensile creep would tend to relieve tensile stresses caused by restrained mortar joint shrinkage. At this point, there is no way to verify this possible explanation.

5.3.3 Probable Levels of Cracking for Restrained Panels

As seen in Chapter 2, restraint leads to higher tensile stresses in the mortar, assuming the panel shrinks overall. This should result in more cracking in a restrained panel than in an unrestrained, yet otherwise identical panel. This should apply to all panels, regardless of mortar type and system. The results of the analysis for restrained panels were presented in Section 5.2.2. The panels whose mortar tensile stresses increased should see more cracking, while those whose stresses decreased should see a decrease in cracking.

The results show that the stresses in each panel increase (or decrease) differently when restraint is added. This is because of the different overall panel strains that are resisted by the restraint. The panels that shrink more in the unrestrained case will experience a greater increase in tensile stress in the restrained case. So it follows that those panels should experience a greater increase in cracking as well. It is doubtful, though, that the small magnitude of these stress increases would cause a significant increase in cracking. If they would, the panels made with portland cement-lime mortars may see a greater increase in cracking than the panels made with masonry cement mortars when the panels are restrained, because they generally experience greater increases in tensile stress. Again, it is unknown if this would be the case, since the portland cement-lime panels had higher stresses than the masonry cement panels for the unrestrained case, yet cracked less (tensile strengths of the masonry cement mortars and portland cement-lime mortars are comparable - see Table 4-2). In any case, the magnitude of the stresses caused by external restraint are small and not very significant when compared to the stresses caused by differential movement of the brick and mortar.

5.4 Summary of Implications of Experimental Results

5.4.1 Bar Shrinkage Implications

For each type of mortar, portland cement-lime mortars shrank as much or more than the masonry cement mortars. For the portland cement-lime mortars, bar shrinkage is proportional to flow, presumably because higher flow indicates more water in the mix, and thus more potential for drying shrinkage. Water content data shown in Table 3-5 do not support this conclusion, but those tests were not performed on the mortar tested for shrinkage. Since the mason retempered the mortars during construction, the water content data does not necessarily reflect the true water content of the mortars used in construction. For masonry cement mortars, bar shrinkage is not proportional to flow, because entrained air in the mortar helps the workability without the need for water. Based on statistical analysis, portland cement-lime bars shrank more than masonry cement bars, with a certainty approaching 100%.

5.4.2 Panel Shrinkage Implications

Panel shrinkage seems to obey the same rules as bar shrinkage. In fact, they are closely correlated, as was shown in Figure 5-5. Furthermore, the analytical model was able to predict fairly accurately the panel shrinkage based on the bar shrinkage (Figure 5-6 and Figure 5-7). From these results, bar shrinkage appears to be a rough indicator of panel shrinkage. As was the case for bar shrinkage, statistical analysis indicates that portland cement-lime panels shrink more than masonry cement panels.

5.4.3 Panel Cracking Implications

Panel cracking does not follow the trend of bar and panel shrinkage, so no conclusion or correlation is immediately apparent. However, within the masonry cement mortars, cracking seems to depend on tensile strength of the mortar. The stronger the mortar, the less cracked the panel. Within the portland cement-lime mortars, it appears that cracking depends on the amount of shrinkage in the mortar. The more shrinkage in the mortar, the more cracking in the panel.

Overall, regardless of which quantitative index is used to describe cracking, the panels made with masonry cement mortars exhibited higher cracking indices than the panels made with portland cement-lime mortars. This is backed up by the statistical analysis presented in Section 5.3.1.

6. Summary, Conclusions, and Recommendations

6.1 Summary

The objectives of this study were to examine the effect of different mortar systems and mortar types on the shrinkage of clay masonry wall panels, and to predict the relationship between the shrinkage of the mortar and the shrinkage and cracking in the panels. To accomplish this, 8 running bond panels were constructed, each measuring 4 feet (1.22 m) square. The first four panels were constructed with single-bag masonry cement mortar, using two brands of Type N, a Type S, and a Type M. The other four panels were made using portland cement-lime mortars, Types M, S, N, and O.

Shrinkage of the panels was measured over time using Demec mechanical gage points. Cracking in the panels was visually identified, measured, and recorded over time as well.

Additionally, mortar specimens were made and tested in accordance with ASTM C1448-92a using the same mortars used in the panels. Tensile and compressive strengths of the mortars were also measured in the laboratory. Finally, tests for air and water content were performed.

For each mortar tested, test results included vertical shrinkage of the panel over time, horizontal shrinkage of the panel over time, shrinkage of the ASTM C1148 mortar bars over time, cracking in the panel over time, compressive strength, tensile strength, air content, and water content.

6.2 Conclusions

The conclusions of this study are as follows:

1) The bar shrinkage results show that for each type of mortar, portland cement-lime mortars shrank as much or more than the masonry cement mortars.

2) Panel shrinkage seems to obey the same rules as bar shrinkage. In fact, they are closely correlated, as was shown in Figure 5-5.

3) The results of the analytical model show it to be a fairly accurate predictor of panel shrinkage based on bar shrinkage (Figure 5-6 and Figure 5-7).

4) Panel cracking does not follow the trend of bar and panel shrinkage. The masonry cement mortar panels had higher cracking indices than the portland cement-lime mortar panels. Therefore, bar shrinkage is a good predictor of panel shrinkage, but only within the portland cement-lime mortars can shrinkage predict the cracking in a panel. In other words, even though one panel shrinks more than another, it may not have a higher cracking index.

5) Within the masonry cement mortars, cracking seems to depend on tensile strength of the mortar. The stronger the mortar, the less cracked the panel. Why cracking in masonry cement panels does not correlate with shrinkage, and why cracking in portland cement-lime panels does correlate with tensile strength, were not determined by this study.

6) The stresses in a panel due to external restraint are insignificant when compared to the stresses due to differential movement of the brick and mortar.

6.3 Recommendations

6.3.1 Recommendations for Implementation

1) Shrinkage of mortar should not be taken as an index of the probable severity of cracking in clay masonry walls.

6.3.2 Recommendations for Further Research

In undertaking further research similar to this study, the following steps should be taken in order to better satisfy the objectives:

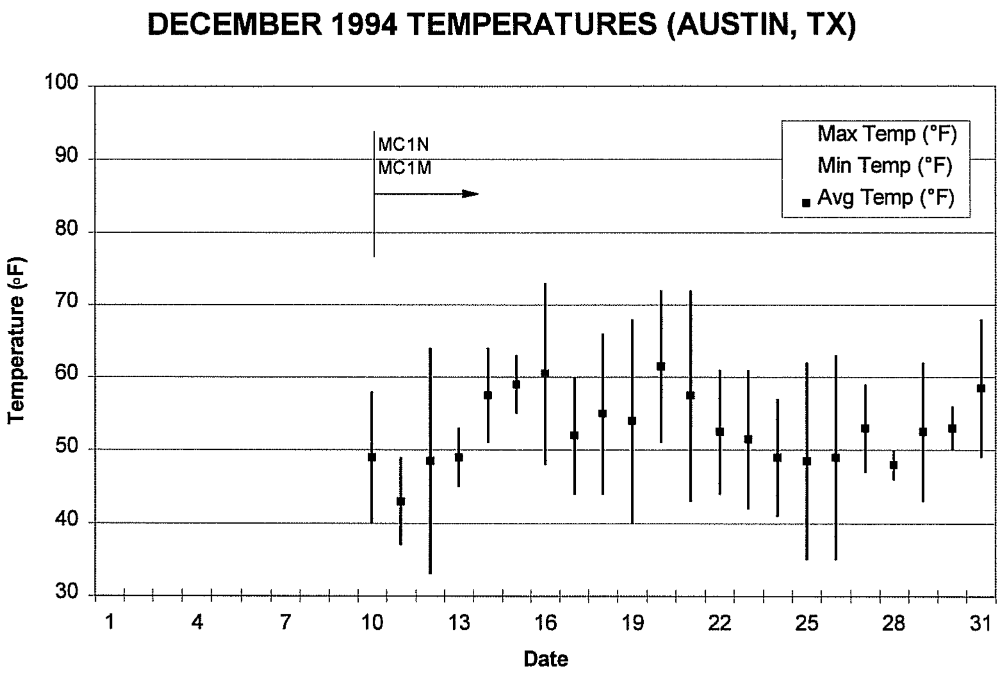
1) The expansion of the clay brick should be measured, in order to perform a more accurate analytical prediction of panel shrinkage.

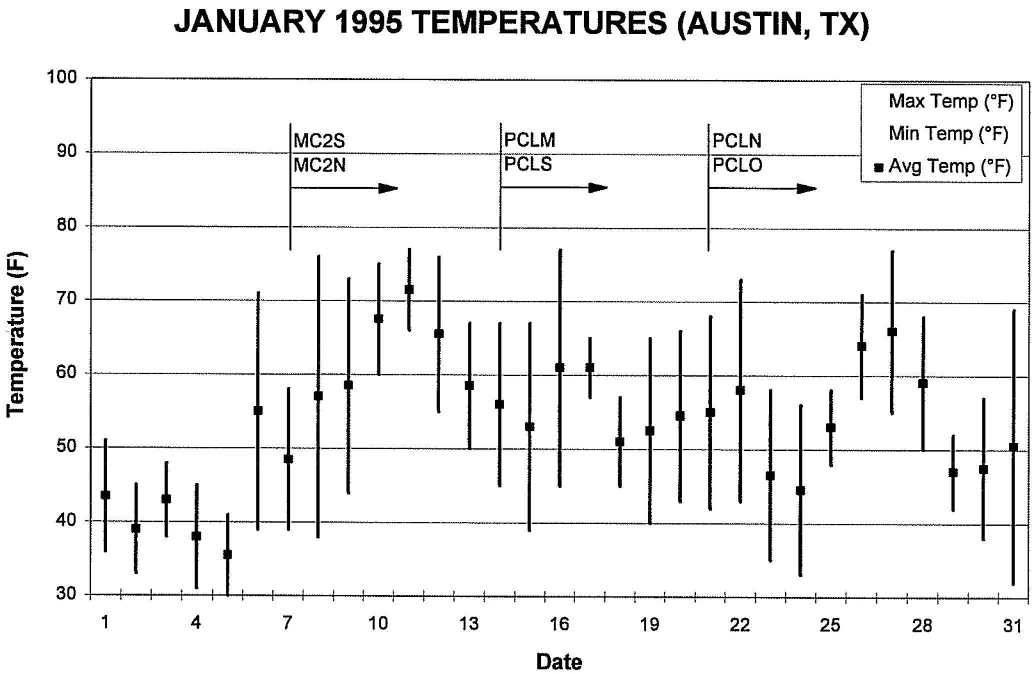
2) The mortar should be batched by weight equivalent, instead of by volume. This method accounts for the different densities of the materials, and therefore helps to standardize makeup of the mortars for comparison purposes.

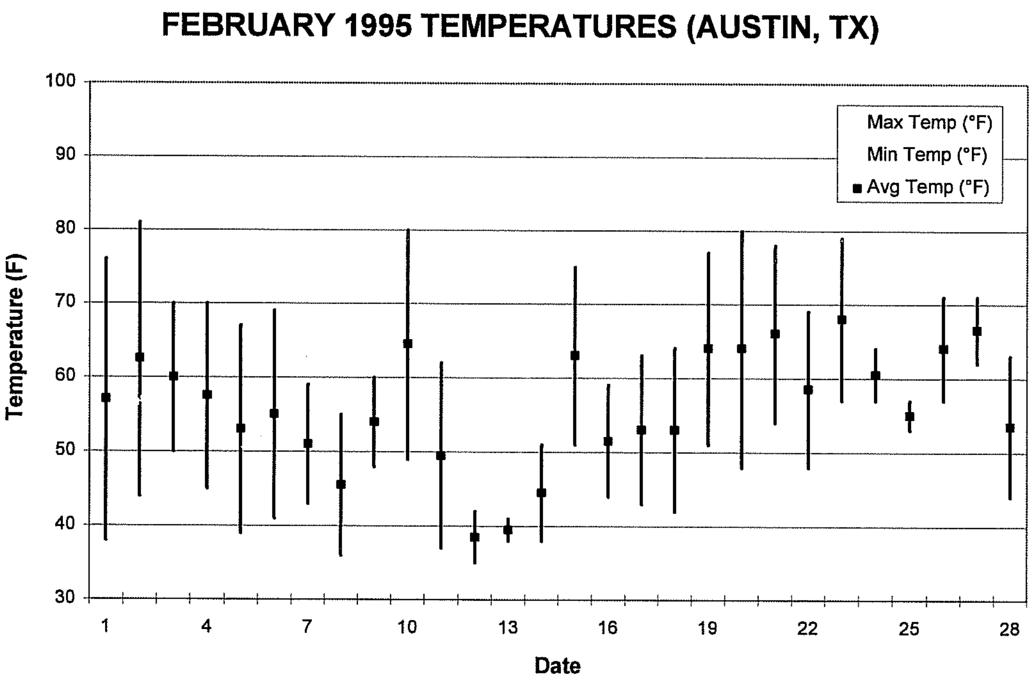
3) The effects of tensile creep should be investigated in the experimental phase.

4) The tests for water and air content of the mortars should be performed at the time of construction of the panels, as opposed to afterwards with new batches.

7. Appendix A - Weather Data




JANUARY 1995 TEMPERATURES (AUSTIN, TX)
Max Temp (°F)
Min Temp (°F)
Avg Temp (°F)
MC2S
MC2N
PCLM
PCLS
PCLN
PCLO
Temperature (F)
100
90
80
70
60
50
40
30
1
4
7
10
13
16
19
22
25
28
31
Date


FEBRUARY 1995 TEMPERATURES (AUSTIN, TX)
Max Temp (°F)
Min Temp (°F)
Avg Temp (°F)
Temperature (F)
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90
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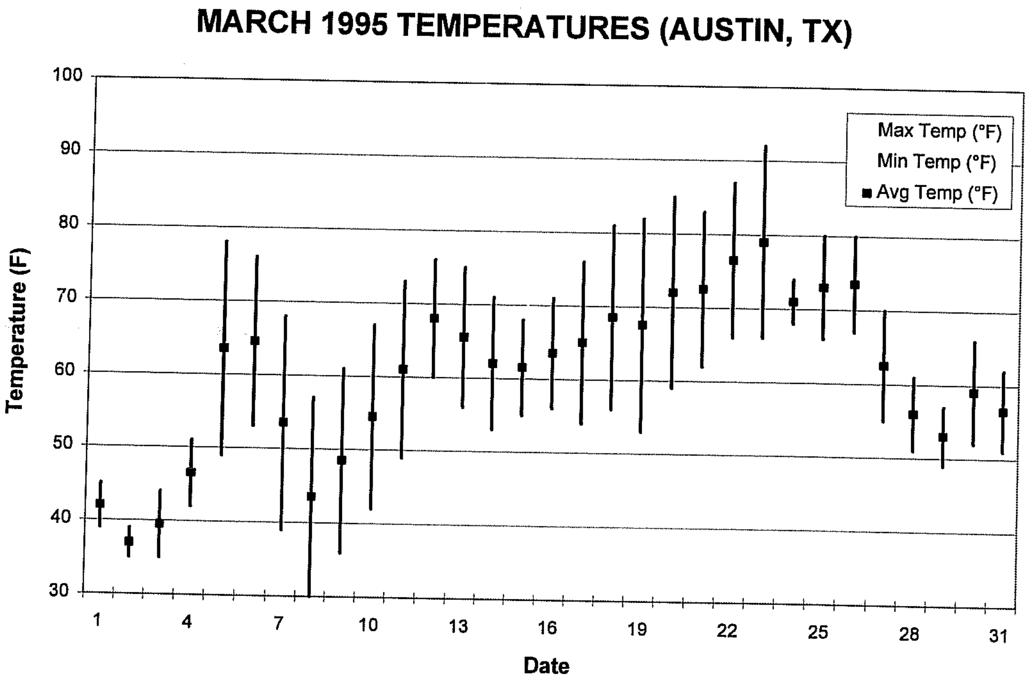
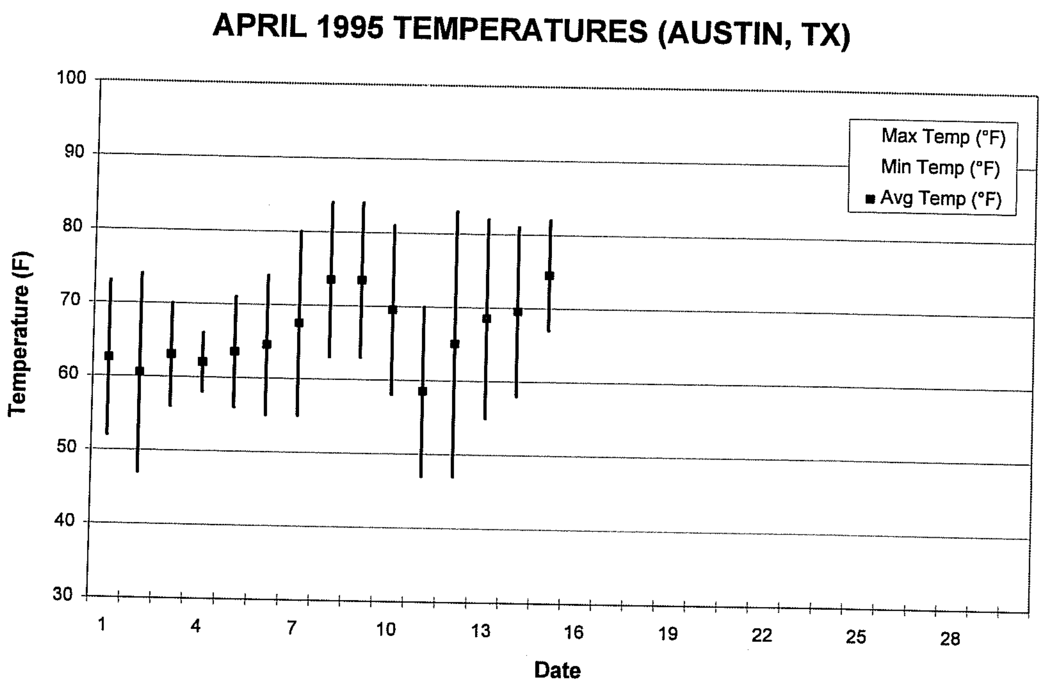
70
60
50
40
30
1
4
7
10
13
16
19
22
25
28
Date


MARCH 1995 TEMPERATURES (AUSTIN, TX)
Temperature (F)
100
90
80
70
60
50
40
30
Max Temp (°F)
Min Temp (°F)
Avg Temp (°F)
1
4
7
10
13
16
19
22
25
28
31
Date


APRIL 1995 TEMPERATURES (AUSTIN, TX)
Temperature (F)
100
90
80
70
60
50
40
30
Max Temp (°F)
Min Temp (°F)
Avg Temp (°F)
1
4
7
10
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22
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28
Date

8. Appendix B - Bar Shrinkage Data

8.1 Shrinkage in MC1M Bars

	Bar #									
DATE	11	12	13	14	15	16	17	18	19	20
12/10/94	LENGTH MEASUREMENTS (in)									
12/13/94	0.0385	0.0389	0.0224	0.0268	0.0047	0.0148	0.0435	0.0462	0.0302	0.0233
12/17/94	0.0336	0.0343	0.0179	0.0224	0.0004	0.0107	0.0391	0.0419	0.0259	0.0192
12/24/94	0.0304	0.0310	0.0145	0.0188	-0.0030	0.0070	0.0353	0.0381	0.0222	0.0154
12/31/94	0.0312	0.0318	0.0153	0.0190	-0.0025	0.0077	0.0361	0.0388	0.0229	0.0162
1/7/95	0.0282	0.0289	0.0124	0.0166	-0.0052	0.0049	0.0332	0.0360	0.0201	0.0134
1/14/95	0.0277	0.0283	0.0118	0.0161	-0.0059	0.0042	0.0325	0.0353	0.0195	0.0127
1/21/95	0.0272	0.0278	0.0113	0.0153	-0.0064	0.0037	0.0320	0.0348	0.0189	0.0122
1/28/95	0.0268	0.0273	0.0108	0.0152	-0.0068	0.0033	0.0316	0.0345	0.0186	0.0120
2/4/95	0.0243	0.0247	0.0082	0.0119	-0.0093	0.0009	0.0290	0.0317	0.0159	0.0094
2/11/95	0.0234	0.0241	0.0076	0.0118	-0.0100	0.0002	0.0285	0.0311	0.0152	0.0086
2/18/95	0.0241	0.0249	0.0083	0.0127	-0.0093	0.0009	0.0293	0.0318	0.0160	0.0093
2/25/95	0.0249	0.0253	0.0089	0.0130	-0.0087	0.0014	0.0297	0.0322	0.0164	0.0096
3/4/95	0.0223	0.0232	0.0064	0.0105	-0.0112	-0.0007	0.0279	0.0301	0.0139	0.0070
3/11/95	0.0226	0.0235	0.0067	0.0108	-0.0110	-0.0004	0.0280	0.0304	0.0145	0.0076
3/18/95	0.0227	0.0235	0.0068	0.0107	-0.0109	-0.0004	0.0279	0.0295	0.0144	0.0077
3/25/95	0.0241	0.0248	0.0082	0.0120	-0.0095	0.0010	0.0294	0.0319	0.0156	0.0093
4/1/95	0.0237	0.0243	0.0075	0.0115	-0.0100	0.0004	0.0288	0.0312	0.0152	0.0084
4/8/95	0.0226	0.0232	0.0068	0.0107	-0.0107	-0.0002	0.0282	0.0304	0.0147	0.0078
4/15/95	0.0226	0.0234	0.0066	0.0107	-0.0109	-0.0004	0.0279	0.0303	0.0144	0.0076

8.2 Shrinkage in MC1N Bars - Batch 1

	Bar #			
DATE	1	2	3	6
12/10/94	LENGTH MEASUREMENTS (in)			
12/13/94	0.0183	0.0168	0.0072	0.0212
12/17/94	0.0128	0.0144	0.0018	0.0158
12/24/94	0.0109	0.0096	0.0001	0.0140
12/31/94	0.0112	0.0099	0.0003	0.0144
1/7/95	0.0097	0.0084	-0.0011	0.0128
1/14/95	0.0091	0.0077	-0.0018	0.0122
1/21/95	0.0089	0.0076	-0.0020	0.0120
1/28/95	0.0087	0.0073	-0.0023	0.0118
2/4/95	0.0069	0.0056	-0.0040	0.0100
2/11/95	0.0059	0.0045	-0.0049	0.0089
2/18/95	0.0066	0.0051	-0.0042	0.0097
2/25/95	0.0072	0.0056	-0.0040	0.0098
3/4/95	0.0051	0.0032	-0.0059	0.0079
3/11/95	0.0059	0.0038	-0.0053	0.0076
3/18/95	0.0060	0.0036	-0.0053	0.0084
3/25/95	0.0067	0.0047	-0.0042	0.0095
4/1/95	0.0066	0.0047	-0.0041	0.0095
4/8/95	0.0059	0.0037	-0.0053	0.0086
4/15/95	0.0060	0.0039	-0.0051	0.0086

8.3 Shrinkage in MC1N Bars - Batch 2

	Bar #									
DATE	81	82	83	84	85	86	87	88	89	90
2/4/95	LENGTH MEASUREMENTS (in)									
2/7/95	-0.0064	0.0107	0.0156	0.0158	-0.0103	0.0179	0.0260	0.0247	0.0134	0.0141
2/11/95	-0.0158	0.0016	0.0065	0.0068	-0.0192	0.0084	0.0165	0.0153	0.0039	0.0047
2/18/95	-0.0162	0.0011	0.0056	0.0061	-0.0196	0.0074	0.0155	0.0144	0.0029	0.0036
2/25/95	-0.0170	0.0004	0.0053	0.0055	-0.0206	0.0068	0.0149	0.0136	0.0022	0.0030
3/4/95	-0.0197	-0.0023	0.0024	0.0030	-0.0236	0.0040	0.0121	0.0111	-0.0005	0.0004
3/11/95	-0.0193	-0.0020	0.0028	0.0035	-0.0232	0.0045	0.0123	0.0108	0.0000	0.0000
3/18/95	-0.0195	-0.0021	0.0023	0.0034	-0.0235	0.0041	0.0124	0.0113	-0.0003	0.0005
3/25/95	-0.0182	-0.0007	0.0031	0.0045	-0.0220	0.0055	0.0138	0.0128	0.0012	0.0020
4/1/95	-0.0183	-0.0011	0.0036	0.0042	-0.0221	0.0053	0.0136	0.0125	0.0008	0.0020
4/8/95	-0.0195	-0.0020	0.0028	0.0034	-0.0231	0.0044	0.0126	0.0113	0.0001	0.0007
4/15/95	-0.0193	-0.0019	0.0029	0.0037	-0.0231	0.0046	0.0128	0.0118	0.0001	0.0009

8.4 Shrinkage in MC2S Bars

	Bar #								
DATE	21	22	23	25	26	27	28	29	30
1/14/95	LENGTH MEASUREMENTS (in)								
1/17/95	0.0201	0.0131	0.0176	0.0292	0.0138	0.0201	0.0229	0.0271	0.0341
1/21/95	0.0151	0.0082	0.0127	0.0244	0.0089	0.0153	0.0175	0.0220	0.0289
1/28/95	0.0130	0.0061	0.0104	0.0223	0.0063	0.0129	0.0152	0.0197	0.0266
2/4/95	0.0103	0.0034	0.0078	0.0197	0.0036	0.0103	0.0124	0.0169	0.0239
2/11/95	0.0092	0.0024	0.0065	0.0185	0.0024	0.0093	0.0115	0.0157	0.0226
2/18/95	0.0097	0.0030	0.0072	0.0193	0.0031	0.0099	0.0121	0.0163	0.0232
2/25/95	0.0098	0.0030	0.0072	0.0193	0.0030	0.0097	0.0122	0.0162	0.0231
3/4/95	0.0072	0.0007	0.0047	0.0171	0.0006	0.0079	0.0099	0.0140	0.0207
3/11/95	0.0078	0.0014	0.0054	0.0177	0.0012	0.0084	0.0105	0.0147	0.0213
3/18/95	0.0077	0.0013	0.0051	0.0174	0.0011	0.0082	0.0103	0.0144	0.0211
3/25/95	0.0091	0.0024	0.0063	0.0186	0.0024	0.0097	0.0117	0.0156	0.0224
4/1/95	0.0086	0.0022	0.0061	0.0184	0.0020	0.0091	0.0112	0.0152	0.0220
4/8/95	0.0075	0.0012	0.0053	0.0173	0.0012	0.0081	0.0103	0.0144	0.0212
4/15/95	0.0076	0.0011	0.0051	0.0175	0.0012	0.0081	0.0103	0.0144	0.0211

8.5 Shrinkage in MC2N Bars

	Bar #									
DATE	31	32	33	34	35	36	37	38	39	40
1/14/95	LENGTH MEASUREMENTS (in)									
1/17/95	0.0264	0.0266	0.0155	0.0159	0.0171	0.0171	-0.0191	0.0160	0.0007	0.0192
1/21/95	0.0218	0.0220	0.0108	0.0113	0.0125	0.0122	-0.0241	0.0111	-0.0040	-0.0146
1/28/95	0.0197	0.0199	0.0087	0.0091	0.0104	0.0097	-0.0268	0.0086	-0.0068	0.0119
2/4/95	0.0169	0.0173	0.0061	0.0064	0.0077	0.0070	-0.0295	0.0059	-0.0095	0.0091
2/11/95	0.0158	0.0161	0.0049	0.0054	0.0065	0.0061	-0.0306	0.0047	-0.0107	0.0080
2/18/95	0.0164	0.0167	0.0055	0.0061	0.0073	0.0067	-0.0301	0.0055	-0.0101	0.0086
2/25/95	0.0168	0.0168	0.0057	0.0059	0.0073	0.0060	-0.0300	0.0053	-0.0101	0.0085
3/4/95	0.0139	0.0143	0.0034	0.0041	0.0049	0.0045	-0.0323	0.0028	-0.0130	0.0059
3/11/95	0.0137	0.0149	0.0039	0.0045	0.0055	0.0049	-0.0320	0.0034	-0.0121	0.0066
3/18/95	0.0143	0.0148	0.0040	0.0042	0.0055	0.0049	-0.0323	0.0032	-0.0125	0.0062
3/25/95	0.0155	0.0159	0.0050	0.0055	0.0066	0.0061	-0.0309	0.0047	-0.0111	0.0075
4/1/95	0.0153	0.0156	0.0046	0.0051	0.0061	0.0055	-0.0314	0.0039	-0.0114	0.0073
4/8/95	0.0143	0.0147	0.0038	0.0043	0.0053	0.0046	-0.0322	0.0032	-0.0123	0.0064
4/15/95	0.0144	0.0149	0.0038	0.0043	0.0053	0.0048	-0.0322	0.0032	-0.0125	0.0063

8.6 Shrinkage in PCLM Bars

	Bar #									
DATE	41	42	43	44	45	46	47	48	49	50
1/21/95	LENGTH MEASUREMENTS (in)									
1/24/95	0.0196	0.0164	0.0133	0.0155	0.0135	0.0229	0.0109	-0.0063	0.0076	0.0015
1/28/95	0.0134	0.0100	0.0067	0.0089	0.0068	0.0160	0.0039	-0.0134	0.0006	-0.0056
2/4/95	0.0074	0.0041	0.0007	0.0030	0.0011	0.0103	-0.0020	-0.0191	-0.0053	-0.0116
2/11/95	0.0059	0.0027	-0.0007	0.0019	-0.0003	0.0091	-0.0032	-0.0203	-0.0066	-0.0130
2/18/95	0.0067	0.0034	0.0000	0.0027	0.0006	0.0099	-0.0024	-0.0195	-0.0059	-0.0120
2/25/95	0.0065	0.0034	-0.0002	0.0028	0.0005	0.0100	-0.0024	-0.0195	-0.0059	-0.0119
3/4/95	0.0043	0.0009	-0.0026	0.0007	-0.0016	0.0080	-0.0045	-0.0218	-0.0086	-0.0145
3/11/95	0.0038	0.0012	-0.0024	0.0007	-0.0015	0.0080	-0.0044	-0.0210	-0.0082	-0.0141
3/18/95	0.0047	0.0014	-0.0022	0.0007	-0.0015	0.0082	-0.0041	-0.0209	-0.0081	-0.0140
3/25/95	0.0061	0.0027	-0.0009	0.0022	-0.0001	0.0097	-0.0030	-0.0193	-0.0066	-0.0125
4/1/95	0.0051	0.0016	-0.0019	0.0011	-0.0011	0.0086	-0.0039	-0.0206	-0.0076	-0.0136
4/8/95	0.0045	0.0012	-0.0022	0.0009	-0.0013	0.0080	-0.0046	-0.0209	-0.0082	-0.0141
4/15/95	0.0041	0.0007	-0.0026	0.0004	-0.0019	0.0078	-0.0049	-0.0213	-0.0085	-0.0143

8.7 Shrinkage in PCLS Bars

	Bar #									
DATE	51	52	53	54	55	56	57	58	59	60
1/21/95	LENGTH MEASUREMENTS (in)									
1/24/95	0.0351	0.0391	0.0188	-0.0047	0.0259	0.0217	0.0155	0.0252	0.0215	0.0244
1/28/95	0.0268	0.0309	0.0101	-0.0130	0.0177	0.0136	0.0072	0.0168	0.0133	0.0161
2/4/95	0.0204	0.0243	0.0037	-0.0193	0.0115	0.0074	0.0010	0.0107	0.0072	0.0097
2/11/95	0.0191	0.0231	0.0027	-0.0206	0.0101	0.0060	-0.0005	0.0093	0.0059	0.0084
2/18/95	0.0198	0.0239	0.0032	-0.0198	0.0109	0.0068	0.0004	0.0101	0.0070	0.0095
2/25/95	0.0200	0.0237	0.0031	-0.0199	0.0107	0.0068	0.0003	0.0100	0.0066	0.0093
3/4/95	0.0168	0.0209	0.0005	-0.0225	0.0081	0.0042	-0.0024	0.0075	0.0047	0.0069
3/11/95	0.0172	0.0212	0.0007	-0.0222	0.0084	0.0045	-0.0022	0.0077	0.0049	0.0074
3/18/95	0.0171	0.0212	0.0006	-0.0223	0.0082	0.0045	-0.0032	0.0075	0.0050	0.0068
3/25/95	0.0185	0.0226	0.0019	-0.0207	0.0097	0.0059	-0.0007	0.0090	0.0062	0.0083
4/1/95	0.0175	0.0216	0.0010	-0.0217	0.0087	0.0049	-0.0017	0.0080	0.0055	0.0074
4/8/95	0.0169	0.0209	0.0007	-0.0225	0.0080	0.0043	-0.0025	0.0074	0.0047	0.0070
4/15/95	0.0168	0.0209	0.0003	-0.0226	0.0081	0.0043	-0.0024	0.0075	0.0046	0.0068

8.8 Shrinkage in PCLN Bars

	Bar #									
DATE	61	62	63	64	65	66	67	68	69	70
1/28/95	LENGTH MEASUREMENTS (in)									
1/31/95	0.0197	0.0187	-0.0096	0.0132	0.0160	-0.0078	0.0176	0.0203	0.0202	0.0166
2/4/95	0.0086	0.0072	-0.0209	0.0018	0.0045	-0.0195	0.0064	0.0088	0.0096	0.0050
2/11/95	0.0056	0.0043	-0.0237	-0.0011	0.0014	-0.0227	0.0036	0.0059	0.0069	0.0023
2/18/95	0.0061	0.0047	-0.0232	-0.0006	0.0019	-0.0222	0.0053	0.0075	0.0075	0.0029
2/25/95	0.0059	0.0045	-0.0234	-0.0008	0.0016	-0.0224	0.0039	0.0060	0.0070	0.0024
3/4/95	0.0033	0.0020	-0.0257	-0.0029	-0.0009	-0.0251	0.0015	0.0034	0.0050	-0.0001
3/11/95	0.0035	0.0020	-0.0257	-0.0037	-0.0009	-0.0251	0.0016	0.0036	0.0051	0.0000
3/18/95	0.0028	0.0021	-0.0259	-0.0029	-0.0011	-0.0252	0.0006	0.0033	0.0050	0.0002
3/25/95	0.0045	0.0033	-0.0247	-0.0017	0.0003	-0.0240	0.0029	0.0048	0.0062	0.0012
4/1/95	0.0038	0.0025	-0.0250	-0.0025	-0.0004	-0.0246	0.0020	0.0041	0.0057	0.0005
4/8/95	0.0031	0.0019	-0.0260	-0.0034	-0.0013	-0.0255	0.0012	0.0032	0.0049	-0.0004
4/15/95	0.0033	0.0018	-0.0260	-0.0032	-0.0011	-0.0255	0.0014	0.0033	0.0049	-0.0003

8.9 Shrinkage in PCLO Bars

	Bar #				
DATE	**91**	**92**	**93**	**94**	**99**
2/4/95	**LENGTH MEASUREMENTS (in)**				
2/7/95	0.0363	0.0138	0.0348	0.0274	0.0090
2/11/95	0.0265	0.0037	0.0248	0.0173	-0.0014
2/18/95	0.0257	0.0030	0.0238	0.0164	-0.0020
2/25/95	0.0257	0.0026	0.0236	0.0161	-0.0029
3/4/95	0.0232	-0.0001	0.0209	0.0134	-0.0049
3/11/95	0.0238	0.0004	0.0212	0.0130	-0.0055
3/18/95	0.0235	-0.0008	0.0212	0.0135	-0.0048
3/25/95	0.0249	0.0016	0.0226	0.0151	-0.0033
4/1/95	0.0249	0.0013	0.0224	0.0147	-0.0036
4/8/95	0.0235	0.0002	0.0214	0.0136	-0.0046
4/15/95	0.0238	0.0008	0.0215	0.0139	-0.0043

9. Appendix C - Panel Shrinkage Data

9.1 Sample Calculation of Maximum Panel Shrinkage

Section 5.2.1 explained the need to find a maximum value of shrinkage for both horizontal and vertical directions of each panel. The first step in this process was to find the location in time of the maximum of the curve fitted through the shrinkage vs. time data. For the vertical direction of specimen MC1M, the equation of the fitted curve is:

$$\varepsilon = -0.0192t^2 + 2.3784t + 77.337$$

where t is the time in days and ε in the shrinkage in microstrain. The next step is to differentiate ε(t) and set it equal to zero to find the location (time) of the maximum value of ε:

$$\frac{\partial \varepsilon}{\partial t} = -0.0384t + 2.3784 = 0$$

$$t = 61.9 \text{ days}$$

The value of ε(t) at this time is not important, since the maximum value of ε will be the mean of the 7 actual data points centered around this value of t, which are as follows:

Day	Shrinkage (με)
51	129.5009
54	120.0253
58	145.2937
61	132.6595
65	180.0379
68	126.3424
72	104.2325

So, the value used as the maximum vertical panel shrinkage for panel MC1M is the mean of these seven shrinkage values, or 134 $\mu\varepsilon$.

9.2 Key to Panel Shrinkage Data

As mentioned in Section 3.5.1, some Demec points came loose and had to be reattached, nullifying previous data involving those gage points. The positions in the following tables where nullified data existed now appear as gray shaded areas.

Each data point in the tables below represents a measurement between two Demec gage points. The vertical pairs are referred to as COL #,#, while the horizontal pairs are referred to as ROW #,#. The drawing of a wall (not to scale) with Demec points below fully illustrates this

● ROW 1,1 ● ROW 1,2 ● ROW 1,3 ● ROW 1,4 ●

COL 1,1 COL 2,1 COL 3,1 COL 4,1 COL 5,1

● ROW 2,1 ● ROW 2,2 ● ROW 2,3 ● ROW 2,4 ●

COL 1,2 COL 2,2 COL 3,2 COL 4,2 COL 5,2

● ROW 3,1 ● ROW 3,2 ● ROW 3,3 ● ROW 3,4 ●

COL 1,3 COL 2,3 COL 3,3 COL 4,3 COL 5,3

● ROW 4,1 ● ROW 4,2 ● ROW 4,3 ● ROW 4,4 ●

COL 1,4 COL 2,4 COL 3,4 COL 4,4 COL 5,4

● ROW 5,1 ● ROW 5,2 ● ROW 5,3 ● ROW 5,4 ●

numbering system. All of the values in this appendix are in inches relative to the reference bar.

9.3 Panel Shrinkage Data for Specimen MC1M

DATE	TIME	COL 1,1	COL 1,2	COL 1,3	COL 1,4	COL 2,1	COL 2,2	COL 2,3	COL 2,4
12/11/94	5:40 PM	0.0060	0.0165	0.0075	0.0230	0.0100	0.0075	0.0065	0.0065
12/12/94	5:30 PM	0.0060	0.0165	0.0075	0.0225	0.0100	0.0065	0.0060	0.0065
12/13/94	5:00 PM	0.0055	0.0165	0.0080	0.0225	0.0100	0.0060	0.0060	0.0065
12/16/94	2:45 PM	0.0060	0.0160	0.0080	0.0225	0.0100	0.0065	0.0060	0.0065
12/19/94	1:00 PM	0.0050	0.0155	0.0070	0.0220	0.0095	0.0060	0.0055	0.0060
12/22/94	11:30 AM	0.0050	0.0150	0.0065	0.0215	0.0090	0.0060	0.0055	0.0060
12/24/94	5:50 PM	0.0050	0.0155	0.0070	0.0215	0.0090	0.0060	0.0060	0.0060
12/27/94	10:45 AM	0.0045	0.0150	0.0065	0.0210	0.0090	0.0055	0.0050	0.0060
12/30/94	11:10 AM	0.0055	0.0155	0.0070	0.0220	0.0095	0.0060	0.0060	0.0060
1/2/95	2:35 PM	0.0045	0.0150	0.0065	0.0210	0.0090	0.0055	0.0060	0.0060
1/4/95	2:15 PM	0.0055	0.0155	0.0070	0.0225	0.0100	0.0060	0.0060	0.0065
1/7/95	3:40 PM	0.0050	0.0155	0.0065	0.0215	0.0095	0.0060	0.0060	0.0060
1/10/95	2:20 PM	0.0055	0.0155	0.0070	0.0220	0.0095	0.0060	0.0060	0.0060
1/13/95	1:45 PM	0.0045	0.0155	0.0065	0.0215	0.0090	0.0060	0.0060	0.0060
1/16/95	12:55 PM	0.0050	0.0155	0.0065	0.0215	0.0090	0.0060	0.0060	0.0060
1/19/95	3:30 PM	0.0055	0.0155	0.0070	0.0220	0.0095	0.0060	0.0060	0.0065
1/22/95	3:25 PM	0.0050	0.0155	0.0065	0.0220	0.0090	0.0055	0.0060	0.0060
1/26/95	6:50 PM	0.0050	0.0150	0.0065	0.0215	0.0090	0.0055	0.0055	0.0060
1/30/95	6:05 AM	0.0050	0.0155	0.0065	0.0215	0.0090	0.0060	0.0060	0.0060
2/2/95	4:35 PM	0.0050	0.0155	0.0065	0.0215	0.0090	0.0060	0.0060	0.0060
2/6/95	4:50 PM	0.0045	0.0155	0.0065	0.0210	0.0085	0.0060	0.0055	0.0060
2/9/95	3:40 PM	0.0050	0.0155	0.0065	0.0215	0.0090	0.0060	0.0055	0.0060
2/13/95	4:50 PM	0.0045	0.0150	0.0060	0.0210	0.0085	0.0055	0.0050	0.0055
2/16/95	4:30 PM	0.0050	0.0155	0.0065	0.0215	0.0090	0.0060	0.0055	0.0060
2/20/95	5:55 PM	0.0055	0.0155	0.0070	0.0220	0.0090	0.0060	0.0060	0.0060
2/23/95	4:25 PM	0.0050	0.0155	0.0070	0.0215	0.0090	0.0060	0.0055	0.0060
2/28/95	3:40 PM	0.0050	0.0155	0.0065	0.0210	0.0090	0.0060	0.0055	0.0060
3/3/95	4:50 PM	0.0045	0.0150	0.0060	0.0210	0.0085	0.0060	0.0050	0.0055
3/8/95	4:10 PM	0.0045	0.0150	0.0060	0.0210	0.0080	0.0060	0.0050	0.0055
3/13/95	3:30 PM	0.0050	0.0155	0.0070	0.0210	0.0090	0.0060	0.0055	0.0060
3/18/95	2:55 PM	0.0055	0.0155	0.0070	0.0210	0.0090	0.0065	0.0055	0.0060
3/23/95	3:30 PM	0.0055	0.0160	0.0075	0.0210	0.0095	0.0065	0.0060	0.0060
3/29/95	3:30 PM	0.0050	0.0155	0.0070	0.0215	0.0090	0.0065	0.0060	0.0060
4/4/95	5:00 PM	0.0050	0.0155	0.0070	0.0210	0.0090	0.0060	0.0050	0.0060
4/11/95	5:40 PM	0.0050	0.0155	0.0070	0.0210	0.0090	0.0065	0.0060	0.0060

DATE	COL 3,1	COL 3,2	COL 3,3	COL 3,4	COL 4,1	COL 4,2	COL 4,3	COL 4,4
12/11/94	0.0055	0.0050	0.0060	0.0140	0.0070	0.0210	0.0340	0.0020
12/12/94	0.0045	0.0045	0.0060	0.0140	0.0070	0.0205	0.0335	0.0015
12/13/94	0.0045	0.0045	0.0055	0.0135	0.0070	0.0205	0.0335	0.0015
12/16/94	0.0050	0.0040	0.0055	0.0140	0.0070	0.0200	0.0330	0.0015
12/19/94	0.0045	0.0035	0.0050	0.0135	0.0060	0.0195	0.0325	0.0005
12/22/94	0.0040	0.0030	0.0045	0.0135	0.0060	0.0190	0.0320	0.0005
12/24/94	0.0040	0.0035	0.0045	0.0135	0.0060	0.0190	0.0325	0.0005
12/27/94	0.0040	0.0030	0.0045	0.0130	0.0060	0.0190	0.0320	0.0005
12/30/94	0.0045	0.0040	0.0050	0.0135	0.0065	0.0195	0.0325	0.0010
1/2/95	0.0040	0.0030	0.0045	0.0135	0.0060	0.0190	0.0320	0.0005
1/4/95	0.0050	0.0045	-0.0400	0.0140	0.0065	0.0200	0.0330	0.0015
1/7/95	0.0045	0.0040	0.0045	0.0135	0.0060	0.0195	0.0325	0.0010
1/10/95	0.0045	0.0040	0.0045	0.0135	0.0065	0.0195	0.0325	0.0010
1/13/95	0.0045	0.0035	0.0045	0.0135	0.0060	0.0190	0.0320	0.0005
1/16/95	0.0045	0.0035	0.0045	0.0135	0.0060	0.0190	0.0325	0.0005
1/19/95	0.0045	0.0040	0.0045	0.0140	0.0065	0.0195	0.0325	0.0010
1/22/95	0.0045	0.0035	0.0045	0.0135	0.0060	0.0195	0.0325	0.0010
1/26/95	0.0040	0.0035	0.0045	0.0135	0.0060	0.0190	0.0320	0.0005
1/30/95	0.0045	0.0035	0.0045	0.0135	0.0060	0.0190	0.0325	0.0005
2/2/95	0.0045	0.0040	0.0045	0.0135	0.0060	0.0195	0.0325	0.0005
2/6/95	0.0040	0.0035	0.0045	0.0135	0.0060	0.0190	0.0320	0.0005
2/9/95	0.0040	0.0035	0.0045	0.0135	0.0060	0.0195	0.0325	0.0005
2/13/95	0.0040	0.0035	0.0040	0.0130	0.0055	0.0190	0.0320	0.0005
2/16/95	0.0045	0.0035	0.0045	0.0135	0.0060	0.0195	0.0325	0.0005
2/20/95	0.0045	0.0040	0.0045	0.0135	0.0060	0.0195	0.0325	0.0010
2/23/95	0.0045	0.0035	0.0045	0.0135	0.0060	0.0195	0.0325	0.0005
2/28/95	0.0045	0.0035	0.0045	0.0135	0.0060	0.0190	0.0325	0.0005
3/3/95	0.0040	0.0030	0.0040	0.0135	0.0055	0.0190	0.0320	0.0005
3/8/95	0.0040	0.0030	0.0040	0.0135	0.0055	0.0190	0.0320	0.0005
3/13/95	0.0045	0.0035	0.0045	0.0135	0.0060	0.0190	0.0325	0.0005
3/18/95	0.0045	0.0040	0.0045	0.0135	0.0060	0.0195	0.0325	0.0005
3/23/95	0.0050	0.0040	0.0045	0.0140	0.0065	0.0195	0.0330	0.0010
3/29/95	0.0045	0.0040	0.0045	0.0135	0.0060	0.0195	0.0330	0.0005
4/4/95	0.0045	0.0035	0.0045	0.0135	0.0060	0.0195	0.0325	0.0005
4/11/95	0.0045	0.0040	0.0045	0.0135	0.0060	0.0195	0.0330	0.0005

DATE	COL 5,1	COL 5,2	COL 5,3	COL 5,4	ROW 1,1	ROW 1,2	ROW 1,3	ROW 1,4
12/11/94			0.0085	0.0065	0.0015	0.0050	-0.0240	
12/12/94			0.0085	0.0060	0.0010	0.0050	-0.0245	
12/13/94			0.0080	0.0060	0.0010	0.0045	-0.0245	
12/16/94	-0.0190	0.0070	0.0080	0.0060	0.0015	0.0050	-0.0240	-0.0005
12/19/94	-0.0190	0.0065	0.0080	0.0060	0.0005	0.0045	-0.0250	-0.0010
12/22/94	-0.0190	0.0060	0.0075	0.0055	0.0005	0.0040	-0.0250	-0.0010
12/24/94	-0.0195	0.0060	0.0080	0.0055	0.0005	0.0040	-0.0250	-0.0010
12/27/94	-0.0195	0.0060	0.0075	0.0055	0.0005	0.0035	-0.0250	-0.0010
12/30/94	-0.0190	0.0060	0.0080	0.0060	0.0005	0.0045	-0.0245	-0.0005
1/2/95	-0.0195	0.0065	0.0080	0.0055	0.0005	0.0040	-0.0250	-0.0015
1/4/95	-0.0190	0.0075	0.0080	0.0060	0.0010	0.0045	-0.0240	-0.0005
1/7/95	-0.0190	0.0070	0.0080	0.0060	0.0010	0.0040	-0.0245	-0.0005
1/10/95	-0.0190	0.0070	0.0080	0.0060	0.0015	0.0045	-0.0240	-0.0005
1/13/95	-0.0195	0.0060	0.0070	0.0055	0.0010	0.0040	-0.0250	-0.0005
1/16/95	-0.0195	0.0065	0.0075	0.0060	0.0010	0.0040	-0.0245	-0.0005
1/19/95	-0.0190	0.0070	0.0080	0.0060	0.0015	0.0045	-0.0240	-0.0005
1/22/95	-0.0190	0.0065	0.0080	0.0060	0.0010	0.0045	-0.0245	-0.0005
1/26/95	-0.0195	0.0065	0.0075	0.0055	0.0010	0.0040	-0.0245	-0.0005
1/30/95	-0.0190	0.0070	0.0070	0.0060	0.0015	0.0045	-0.0240	-0.0005
2/2/95	-0.0190	0.0070	0.0075	0.0060	0.0015	0.0045	-0.0240	-0.0005
2/6/95	-0.0190	0.0070	0.0075	0.0060	0.0010	0.0045	-0.0240	-0.0005
2/9/95	-0.0190	0.0070	0.0070	0.0060	0.0010	0.0045	-0.0245	-0.0005
2/13/95	-0.0195	0.0070	0.0070	0.0055	0.0005	0.0040	-0.0255	-0.0010
2/16/95	-0.0190	0.0075	0.0070	0.0060	0.0010	0.0045	-0.0245	-0.0005
2/20/95	-0.0190	0.0075	0.0075	0.0060	0.0015	0.0045	-0.0240	-0.0005
2/23/95	-0.0190	0.0075	0.0070	0.0060	0.0010	0.0045	-0.0240	-0.0005
2/28/95	-0.0195	0.0075	0.0075	0.0060	0.0010	0.0045	-0.0245	-0.0005
3/3/95	-0.0195	0.0070	0.0070	0.0055	0.0005	0.0040	-0.0250	-0.0010
3/8/95	-0.0200	0.0070	0.0065	0.0055	0.0005	0.0040	-0.0250	-0.0010
3/13/95	-0.0195	0.0075	0.0075	0.0060	0.0015	0.0045	-0.0240	-0.0005
3/18/95	-0.0195	0.0075	0.0075	0.0060	0.0015	0.0045	-0.0240	-0.0005
3/23/95	-0.0185	0.0085	0.0080	0.0060	0.0020	0.0050	-0.0230	0.0000
3/29/95	-0.0190	0.0080	0.0075	0.0060	0.0020	0.0045	-0.0240	-0.0005
4/4/95	-0.0190	0.0075	0.0075	0.0060	0.0010	0.0045	-0.0245	-0.0005
4/11/95	-0.0190	0.0080	0.0080	0.0060	0.0015	0.0050	-0.0240	-0.0005

DATE	ROW 2,1	ROW 2,2	ROW 2,3	ROW 2,4	ROW 3,1	ROW 3,2	ROW 3,3	ROW 3,4
12/11/94	0.0060	0.0045	0.0050		0.0045	0.0060	0.0100	0.0015
12/12/94	0.0060	0.0045	0.0050		0.0045	0.0060	0.0100	0.0005
12/13/94	0.0060	0.0045	0.0050		0.0045	0.0060	0.0100	0.0005
12/16/94	0.0060	0.0050	0.0050	0.0120	0.0045	0.0060	0.0100	0.0005
12/19/94	0.0055	0.0040	0.0045	0.0115	0.0035	0.0060	0.0090	0.0005
12/22/94	0.0055	0.0035	0.0045	0.0115	0.0040	0.0055	0.0090	0.0005
12/24/94	0.0055	0.0035	0.0045	0.0115	0.0040	0.0055	0.0090	0.0000
12/27/94	0.0050	0.0035	0.0040	0.0110	0.0035	0.0050	0.0085	0.0000
12/30/94	0.0060	0.0040	0.0045	0.0120	0.0040	0.0060	0.0095	0.0005
1/2/95	0.0055	0.0035	0.0045	0.0115	0.0035	0.0055	0.0090	0.0000
1/4/95	0.0060	0.0045	0.0045	0.0120	0.0045	0.0060	0.0100	0.0005
1/7/95	0.0060	0.0040	0.0045	0.0120	0.0040	0.0060	0.0100	0.0005
1/10/95	0.0060	0.0040	0.0050	0.0120	0.0040	0.0060	0.0010	0.0000
1/13/95	0.0055	0.0035	0.0045	0.0120	0.0030	0.0060	0.0095	-0.0005
1/16/95	0.0055	0.0040	0.0045	0.0120	0.0035	0.0055	0.0095	0.0000
1/19/95	0.0060	0.0045	0.0050	0.0120	0.0045	0.0060	0.0100	0.0005
1/22/95	0.0060	0.0045	0.0045	0.0120	0.0040	0.0060	0.0095	0.0000
1/26/95	0.0055	0.0040	0.0045	0.0120	0.0035	0.0055	0.0095	-0.0005
1/30/95	0.0060	0.0045	0.0045	0.0120	0.0045	0.0060	0.0100	0.0000
2/2/95	0.0060	0.0045	0.0050	0.0120	0.0045	0.0055	0.0100	-0.0005
2/6/95	0.0060	0.0045	0.0045	0.0120	0.0040	0.0055	0.0100	-0.0005
2/9/95	0.0060	0.0045	0.0045	0.0120	0.0040	0.0055	0.0100	-0.0005
2/13/95	0.0055	0.0040	0.0045	0.0115	0.0035	0.0050	0.0095	-0.0005
2/16/95	0.0060	0.0045	0.0045	0.0120	0.0035	0.0055	0.0100	-0.0010
2/20/95	0.0060	0.0045	0.0050	0.0120	0.0045	0.0060	0.0100	-0.0005
2/23/95	0.0060	0.0045	0.0050	0.0120	0.0040	0.0055	0.0100	-0.0005
2/28/95	0.0055	0.0045	0.0045	0.0120	0.0030	0.0055	0.0100	-0.0015
3/3/95	0.0050	0.0040	0.0045	0.0115	0.0035	0.0050	0.0045	-0.0015
3/8/95	0.0050	0.0040	0.0045	0.0115	0.0035	0.0050	0.0095	-0.0015
3/13/95	0.0060	0.0045	0.0050	0.0120	0.0040	0.0055	0.0100	-0.0015
3/18/95	0.0060	0.0045	0.0050	0.0120	0.0040	0.0055	0.0100	-0.0010
3/23/95	0.0060	0.0050	0.0060	0.0130	0.0045	0.0060	0.0105	-0.0005
3/29/95	0.0060	0.0045	0.0055	0.0120	0.0045	0.0060	0.0100	-0.0005
4/4/95	0.0060	0.0045	0.0050	0.0120	0.0040	0.0055	0.0100	-0.0015
4/11/95	0.0060	0.0045	0.0050	0.0125	0.0040	0.0060	0.0100	-0.0010

DATE	ROW 4,1	ROW 4,2	ROW 4,3	ROW 4,4	ROW 5,1	ROW 5,2	ROW 5,3	ROW 5,4
12/11/94	0.0040	0.0045	0.0005	0.0085	0.0050	0.0030	0.0065	0.0055
12/12/94	0.0040	0.0045	0.0005	0.0080	0.0045	0.0030	0.0065	0.0045
12/13/94	0.0040	0.0045	0.0005	0.0080	0.0045	0.0030	0.0065	0.0045
12/16/94	0.0040	0.0050	0.0005	0.0080	0.0050	0.0035	0.0070	0.0050
12/19/94	0.0030	0.0040	-0.0005	0.0080	0.0045	0.0025	0.0060	0.0045
12/22/94	0.0030	0.0035	-0.0005	0.0075	0.0045	0.0025	0.0060	0.0045
12/24/94	0.0030	0.0040	-0.0005	0.0080	0.0045	0.0025	0.0060	0.0045
12/27/94	0.0030	0.0035	-0.0005	0.0075	0.0040	0.0025	0.0060	0.0040
12/30/94	0.0035	0.0045	0.0000	0.0080	0.0045	0.0025	0.0060	0.0045
1/2/95	0.0030	0.0040	-0.0005	0.0075	0.0045	0.0025	0.0060	0.0045
1/4/95	0.0035	0.0045	0.0005	0.0080	0.0045	0.0025	0.0065	0.0045
1/7/95	0.0035	0.0045	0.0005	0.0080	0.0045	0.0025	0.0065	0.0045
1/10/95	0.0035	0.0045	0.0005	0.0080	0.0045	0.0025	0.0065	0.0050
1/13/95	0.0030	0.0040	0.0000	0.0080	0.0045	0.0025	0.0060	0.0045
1/16/95	0.0030	0.0040	0.0000	0.0080	0.0045	0.0025	0.0065	0.0045
1/19/95	0.0040	0.0045	0.0005	0.0080	0.0045	0.0030	0.0070	0.0050
1/22/95	0.0035	0.0045	0.0005	0.0080	0.0045	0.0025	0.0065	0.0045
1/26/95	0.0030	0.0040	0.0000	0.0080	0.0045	0.0025	0.0065	0.0045
1/30/95	0.0035	0.0045	0.0000	0.0080	0.0045	0.0025	0.0065	0.0045
2/2/95	0.0035	0.0045	0.0000	0.0080	0.0045	0.0025	0.0065	0.0045
2/6/95	0.0035	0.0045	0.0000	0.0080	0.0045	0.0025	0.0060	0.0045
2/9/95	0.0035	0.0045	0.0000	0.0080	0.0045	0.0025	0.0060	0.0045
2/13/95	0.0030	0.0040	-0.0005	0.0080	0.0040	0.0025	0.0060	0.0045
2/16/95	0.0030	0.0045	0.0000	0.0080	0.0045	0.0025	0.0065	0.0045
2/20/95	0.0035	0.0045	0.0005	0.0080	0.0045	0.0025	0.0060	0.0045
2/23/95	0.0030	0.0045	0.0000	0.0080	0.0040	0.0025	0.0065	0.0045
2/28/95	0.0030	0.0040	0.0000	0.0080	0.0045	0.0025	0.0065	0.0045
3/3/95	0.0025	0.0040	-0.0005	0.0080	0.0045	0.0020	0.0060	0.0045
3/8/95	0.0025	0.0035	-0.0005	0.0080	0.0040	0.0020	0.0060	0.0040
3/13/95	0.0035	0.0045	0.0005	0.0080	0.0045	0.0025	0.0065	0.0045
3/18/95	0.0035	0.0045	0.0005	0.0085	0.0045	0.0025	0.0065	0.0045
3/23/95	0.0040	0.0050	0.0005	0.0090	0.0050	0.0025	0.0075	0.0055
3/29/95	0.0035	0.0045	0.0005	0.0085	0.0050	0.0025	0.0065	0.0050
4/4/95	0.0030	0.0040	0.0000	0.0085	0.0045	0.0025	0.0065	0.0050
4/11/95	0.0035	0.0045	0.0005	0.0085	0.0045	0.0025	0.0065	0.0050

9.4 Panel Shrinkage Data for Specimen MC1N

DATE	COL 1,1	COL 1,2	COL 1,3	COL 1,4	COL 2,1	COL 2,2	COL 2,3	COL 2,4
12/11/94	0.0050	0.0350	0.0130	0.0060	-0.0015	0.0055		
12/12/94	0.0050	0.0355	0.0130	0.0060	-0.0010	0.0060		
12/13/94	0.0050	0.0355	0.0130	0.0060	-0.0010	0.0060		
12/16/94	0.0050	0.0350	0.0135	0.0060	-0.0005	0.0065	0.0050	0.0090
12/19/94	0.0045	0.0350	0.0130	0.0060	-0.0010	0.0060	0.0045	0.0090
12/22/94	0.0045	0.0340	0.0125	0.0060	-0.0015	0.0060	0.0045	0.0085
12/24/94	0.0045	0.0345	0.0130	0.0060	-0.0010	0.0065	0.0045	0.0085
12/27/94	0.0045	0.0340	0.0125	0.0060	-0.0025	0.0055	0.0040	0.0080
12/30/94	0.0045	0.0345	0.0130	0.0060	-0.0015	0.0065	0.0045	0.0085
1/2/95	0.0040	0.0340	0.0120	0.0050	-0.0020	0.0060	0.0040	0.0080
1/4/95	0.0040	0.0345	0.0125	0.0060	-0.0015	0.0065	0.0045	0.0085
1/7/95	0.0045	0.0345	0.0125	0.0060	-0.0015	0.0065	0.0045	0.0085
1/10/95	0.0045	0.0345	0.0130	0.0060	-0.0015	0.0065	0.0045	0.0090
1/13/95	0.0045	0.0345	0.0125	0.0060	-0.0015	0.0060	0.0040	0.0085
1/16/95	0.0045	0.0345	0.0125	0.0060	-0.0015	0.0065	0.0045	0.0085
1/19/95	0.0045	0.0345	0.0125	0.0060	-0.0015	0.0060	0.0045	0.0085
1/22/95	0.0045	0.0345	0.0130	0.0060	-0.0015	0.0065	0.0045	0.0090
1/26/95	0.0040	0.0340	0.0120	0.0060	-0.0025	0.0060	0.0040	0.0080
1/30/95	0.0045	0.0345	0.0125	0.0060	-0.0020	0.0060	0.0045	0.0085
2/2/95	0.0045	0.0345	0.0125	0.0060	-0.0020	0.0060	0.0045	0.0085
2/6/95	0.0040	0.0345	0.0120	0.0060	-0.0020	0.0060	0.0040	0.0085
2/9/95	0.0040	0.0345	0.0125	0.0060	-0.0020	0.0060	0.0045	0.0085
2/13/95	0.0035	0.0340	0.0120	0.0055	-0.0025	0.0055	0.0035	0.0080
2/16/95	0.0040	0.0345	0.0125	0.0060	-0.0020	0.0060	0.0045	0.0085
2/20/95	0.0045	0.0350	0.0130	0.0060	-0.0015	0.0065	0.0045	0.0085
2/23/95	0.0040	0.0345	0.0125	0.0060	-0.0020	0.0060	0.0045	0.0085
2/28/95	0.0035	0.0340	0.0120	0.0060	-0.0025	0.0060	0.0045	0.0080
3/3/95	0.0035	0.0340	0.0120	0.0060	-0.0025	0.0060	0.0040	0.0080
3/8/95	0.0035	0.0340	0.0120	0.0060	-0.0025	0.0060	0.0040	0.0080
3/13/95	0.0045	0.0345	0.0130	0.0060	-0.0020	0.0065	0.0045	0.0085
3/18/95	0.0045	0.0350	0.0130	0.0060	-0.0020	0.0065	0.0045	0.0085
3/23/95	0.0045	0.0350	0.0135	0.0065	-0.0015	0.0070	0.0050	0.0090
3/29/95	0.0040	0.0345	0.0125	0.0060	-0.0020	0.0060	0.0045	0.0085
4/4/95	0.0040	0.0345	0.0125	0.0060	-0.0020	0.0060	0.0045	0.0085
4/11/95	0.0045	0.0350	0.0130	0.0060	-0.0020	0.0065	0.0045	0.0085

DATE	COL 3,1	COL 3,2	COL 3,3	COL 3,4	COL 4,1	COL 4,2	COL 4,3	COL 4,4
12/11/94	0.0085			0.0315	0.0055	0.0065		
12/12/94	0.0085			0.0320	0.0055	0.0065		
12/13/94	0.0085			0.0320	0.0055	0.0065		
12/16/94	0.0085	0.0050	0.0160	0.0320	0.0060	0.0065	0.0090	0.0275
12/19/94	0.0085	0.0045	0.0155	0.0320	0.0055	0.0060	0.0085	0.0280
12/22/94	0.0080	0.0045	0.0155	0.0315	0.0050	0.0055	0.0080	0.0275
12/24/94	0.0080	0.0045	0.0155	0.0320	0.0055	0.0055	0.0080	0.0275
12/27/94	0.0080	0.0040	0.0155	0.0315	0.0045	0.0050	0.0080	0.0270
12/30/94	0.0085	0.0045	0.0155	0.0320	0.0055	0.0060	0.0085	0.0280
1/2/95	0.0080	0.0055	0.0150	0.0315	0.0045	0.0050	0.0080	0.0270
1/4/95	0.0085	0.0045	0.0155	0.0320	0.0050	0.0060	0.0085	0.0275
1/7/95	0.0085	0.0045	0.0155	0.0320	0.0055	0.0055	0.0080	0.0275
1/10/95	0.0085	0.0045	0.0155	0.0320	0.0055	0.0060	0.0080	0.0275
1/13/95	0.0085	0.0040	0.0155	0.0315	0.0050	0.0055	0.0080	0.0275
1/16/95	0.0085	0.0045	0.0155	0.0320	0.0050	0.0055	0.0080	0.0275
1/19/95	0.0080	0.0045	0.0155	0.0320	0.0050	0.0055	0.0080	0.0280
1/22/95	0.0085	0.0045	0.0155	0.0320	0.0050	0.0060	0.0085	0.0280
1/26/95	0.0080	0.0040	0.0150	0.0315	0.0045	0.0050	0.0080	0.0270
1/30/95	0.0080	0.0040	0.0155	0.0315	0.0050	0.0055	0.0080	0.0275
2/2/95	0.0080	0.0045	0.0155	0.0320	0.0050	0.0055	0.0080	0.0275
2/6/95	0.0080	0.0045	0.0155	0.0315	0.0045	0.0050	0.0080	0.0270
2/9/95	0.0080	0.0045	0.0155	0.0320	0.0050	0.0055	0.0080	0.0275
2/13/95	0.0075	0.0035	0.0145	0.0310	0.0045	0.0050	0.0080	0.0265
2/16/95	0.0080	0.0045	0.0155	0.0315	0.0050	0.0055	0.0080	0.0275
2/20/95	0.0085	0.0045	0.0155	0.0320	0.0055	0.0060	0.0085	0.0275
2/23/95	0.0080	0.0045	0.0155	0.0315	0.0050	0.0055	0.0085	0.0270
2/28/95	0.0080	0.0040	0.0155	0.0315	0.0050	0.0055	0.0085	0.0270
3/3/95	0.0075	0.0035	0.0150	0.0310	0.0045	0.0050	0.0080	0.0265
3/8/95	0.0075	0.0040	0.0150	0.0310	0.0045	0.0050	0.0080	0.0265
3/13/95	0.0080	0.0045	0.0155	0.0315	0.0055	0.0055	0.0080	0.0275
3/18/95	0.0080	0.0045	0.0155	0.0320	0.0055	0.0060	0.0080	0.0275
3/23/95	0.0085	0.0050	0.0160	0.0320	0.0060	0.0060	0.0090	0.0280
3/29/95	0.0080	0.0045	0.0155	0.0320	0.0050	0.0055	0.0085	0.0275
4/4/95	0.0080	0.0045	0.0155	0.0315	0.0050	0.0055	0.0085	0.0270
4/11/95	0.0080	0.0045	0.0155	0.0320	0.0055	0.0060	0.0090	0.0275

DATE	COL 5,1	COL 5,2	COL 5,3	COL 5,4	ROW 1,1	ROW 1,2	ROW 1,3	ROW 1,4
12/11/94	0.0070			0.0050	0.0140	0.0050	0.0060	0.0060
12/12/94	0.0070			0.0050	0.0140	0.0050	0.0055	0.0060
12/13/94	0.0070			0.0050	0.0145	0.0050	0.0060	0.0060
12/16/94	0.0075	0.1315	0.0060	0.0055	0.0145	0.0055	0.0060	0.0060
12/19/94	0.0065	0.1310	0.0060	0.0055	0.0140	0.0045	0.0055	0.0060
12/22/94	0.0060	0.1305	0.0055	0.0050	0.0135	0.0045	0.0050	0.0055
12/24/94	0.0060	0.1305	0.0055	0.0050	0.0140	0.0045	0.0055	0.0055
12/27/94	0.0060	0.1300	0.0055	0.0045	0.0135	0.0045	0.0050	0.0050
12/30/94	0.0065	0.1305	0.0060	0.0045	0.0140	0.0045	0.0055	0.0055
1/2/95	0.0060	0.1300	0.0050	0.0030	0.0130	0.0040	0.0050	0.0050
1/4/95	0.0065	0.1305	0.0055	0.0050	0.0140	0.0045	0.0055	0.0055
1/7/95	0.0065	0.1305	0.0055	0.0050	0.0140	0.0045	0.0055	0.0060
1/10/95	0.0065	0.1305	0.0055	0.0045	0.0145	0.0045	0.0060	0.0060
1/13/95	0.0065	0.1305	0.0055	0.0045	0.0140	0.0045	0.0055	0.0055
1/16/95	0.0065	0.1305	0.0055	0.0045	0.0140	0.0045	0.0060	0.0060
1/19/95	0.0065	0.1305	0.0055	0.0050	0.0145	0.0045	0.0060	0.0060
1/22/95	0.0065	0.1305	0.0055	0.0050	0.0145	0.0050	0.0060	0.0060
1/26/95	0.0060	0.1305	0.0050	0.0045	0.0140	0.0045	0.0055	0.0055
1/30/95	0.0060	0.1305	0.0055	0.0050	0.0145	0.0050	0.0060	0.0060
2/2/95	0.0060	0.1305	0.0055	0.0050	0.0145	0.0050	0.0060	0.0060
2/6/95	0.0060	0.1305	0.0050	0.0045	0.0140	0.0045	0.0055	0.0055
2/9/95	0.0060	0.1305	0.0055	0.0050	0.0145	0.0050	0.0060	0.0060
2/13/95	0.0055	0.1300	0.0045	0.0045	0.0135	0.0045	0.0050	0.0050
2/16/95	0.0060	0.1305	0.0055	0.0050	0.0145	0.0045	0.0060	0.0060
2/20/95	0.0060	0.1305	0.0055	0.0050	0.0150	0.0050	0.0060	0.0060
2/23/95	0.0060	0.1305	0.0055	0.0050	0.0145	0.0050	0.0060	0.0060
2/28/95	0.0060	0.1305	0.0055	0.0050	0.0145	0.0045	0.0060	0.0055
3/3/95	0.0060	0.1305	0.0050	0.0045	0.0140	0.0045	0.0055	0.0055
3/8/95	0.0060	0.1305	0.0050	0.0045	0.0140	0.0045	0.0055	0.0055
3/13/95	0.0060	0.1315	0.0055	0.0050	0.0145	0.0050	0.0060	0.0060
3/18/95	0.0065	0.1315	0.0060	0.0050	0.0150	0.0050	0.0060	0.0060
3/23/95	0.0070	0.1320	0.0060	0.0060	0.0150	0.0055	0.0065	0.0065
3/29/95	0.0060	0.1315	0.0055	0.0055	0.0145	0.0050	0.0060	0.0060
4/4/95	0.0060	0.1305	0.0055	0.0045	0.0145	0.0050	0.0060	0.0060
4/11/95	0.0065	0.1310	0.0060	0.0055	0.0145	0.0050	0.0060	0.0060

DATE	ROW 2,1	ROW 2,2	ROW 2,3	ROW 2,4	ROW 3,1	ROW 3,2	ROW 3,3	ROW 3,4
12/11/94	0.0060	0.0055	0.0045	0.0060	0.0025			
12/12/94	0.0060	0.0055	0.0045	0.0060	0.0030			
12/13/94	0.0060	0.0055	0.0045	0.0060	0.0030			
12/16/94	0.0065	0.0060	0.0050	0.0060	0.0035	0.0025	0.0070	0.0040
12/19/94	0.0060	0.0055	0.0045	0.0060	0.0025	0.0020	0.0070	0.0045
12/22/94	0.0055	0.0050	0.0045	0.0050	0.0025	0.0020	0.0065	0.0040
12/24/94	0.0060	0.0055	0.0045	0.0055	0.0035	0.0025	0.0070	0.0040
12/27/94	0.0055	0.0050	0.0045	0.0050	0.0025	0.0020	0.0065	0.0035
12/30/94	0.0060	0.0055	0.0045	0.0055	0.0025	0.0025	0.0070	0.0040
1/2/95	0.0050	0.0050	0.0040	0.0050	0.0020	0.0020	0.0060	0.0035
1/4/95	0.0060	0.0055	0.0045	0.0055	0.0025	0.0025	0.0065	0.0045
1/7/95	0.0060	0.0055	0.0045	0.0055	0.0025	0.0025	0.0065	0.0045
1/10/95	0.0060	0.0060	0.0050	0.0060	0.0025	0.0025	0.0070	0.0045
1/13/95	0.0060	0.0055	0.0045	0.0055	0.0025	0.0025	0.0065	0.0045
1/16/95	0.0060	0.0055	0.0045	0.0055	0.0025	0.0025	0.0065	0.0045
1/19/95	0.0060	0.0055	0.0050	0.0060	0.0025	0.0025	0.0065	0.0045
1/22/95	0.0060	0.0060	0.0050	0.0060	0.0025	0.0030	0.0070	0.0045
1/26/95	0.0060	0.0055	0.0045	0.0055	0.0025	0.0025	0.0060	0.0040
1/30/95	0.0060	0.0060	0.0050	0.0060	0.0025	0.0030	0.0070	0.0045
2/2/95	0.0060	0.0060	0.0050	0.0060	0.0025	0.0030	0.0065	0.0045
2/6/95	0.0060	0.0055	0.0045	0.0060	0.0025	0.0025	0.0065	0.0045
2/9/95	0.0060	0.0060	0.0050	0.0060	0.0025	0.0030	0.0070	0.0045
2/13/95	0.0055	0.0050	0.0045	0.0055	0.0020	0.0025	0.0060	0.0040
2/16/95	0.0060	0.0055	0.0045	0.0060	0.0025	0.0030	0.0070	0.0045
2/20/95	0.0060	0.0060	0.0055	0.0060	0.0025	0.0035	0.0070	0.0045
2/23/95	0.0060	0.0060	0.0050	0.0060	0.0025	0.0030	0.0065	0.0045
2/28/95	0.0060	0.0055	0.0045	0.0060	0.0025	0.0030	0.0065	0.0045
3/3/95	0.0055	0.0050	0.0045	0.0055	0.0020	0.0025	0.0060	0.0040
3/8/95	0.0055	0.0055	0.0045	0.0055	0.0020	0.0025	0.0060	0.0040
3/13/95	0.0060	0.0060	0.0050	0.0060	0.0025	0.0030	0.0070	0.0045
3/18/95	0.0060	0.0060	0.0055	0.0060	0.0025	0.0035	0.0070	0.0045
3/23/95	0.0060	0.0060	0.0060	0.0070	0.0030	0.0040	0.0080	0.0055
3/29/95	0.0060	0.0060	0.0050	0.0060	0.0025	0.0035	0.0070	0.0045
4/4/95	0.0060	0.0060	0.0050	0.0060	0.0025	0.0035	0.0070	0.0045
4/11/95	0.0060	0.0060	0.0050	0.0060	0.0025	0.0035	0.0070	0.0045

DATE	ROW 4,1	ROW 4,2	ROW 4,3	ROW 4,4	ROW 5,1	ROW 5,2	ROW 5,3	ROW 5,4
12/11/94					0.0045	-0.0160	0.0025	0.0080
12/12/94					0.0045	-0.0160	0.0020	0.0085
12/13/94					0.0045	-0.0160	0.0025	0.0085
12/16/94	0.0035	0.0085	-0.0090	0.0065	0.0050	-0.0155	0.0020	0.0085
12/19/94	0.0040	0.0080	-0.0080	0.0065	0.0045	-0.0165	0.0020	0.0080
12/22/94	0.0035	0.0080	-0.0080	0.0060	0.0040	-0.0170	0.0020	0.0080
12/24/94	0.0040	-0.0315	-0.0075	0.0060	0.0045	-0.0165	0.0020	0.0080
12/27/94	0.0035	0.0080	-0.0080	0.0060	0.0035	-0.0170	0.0015	0.0080
12/30/94	0.0040	0.0085	-0.0075	0.0060	0.0045	-0.0165	0.0020	0.0080
1/2/95	0.0030	0.0080	-0.0080	0.0060	0.0035	-0.0170	0.0015	0.0075
1/4/95	0.0040	0.0085	-0.0075	0.0060	0.0045	-0.0165	0.0020	0.0080
1/7/95	0.0040	0.0085	-0.0075	0.0060	0.0045	-0.0165	0.0025	0.0080
1/10/95	0.0040	0.0085	-0.0070	0.0065	0.0045	-0.0160	0.0025	0.0080
1/13/95	0.0035	0.0080	-0.0075	0.0065	0.0040	-0.0165	0.0020	0.0080
1/16/95	0.0040	0.0085	-0.0075	0.0065	0.0045	-0.0160	0.0025	0.0080
1/19/95	0.0040	0.0085	-0.0075	0.0065	0.0045	-0.0165	0.0025	0.0080
1/22/95	0.0045	0.0085	-0.0070	0.0060	0.0045	-0.0160	0.0025	0.0080
1/26/95	0.0035	0.0080	-0.0075	0.0060	0.0040	-0.0165	0.0020	0.0080
1/30/95	0.0040	0.0085	-0.0070	0.0060	0.0045	-0.0165	0.0025	0.0080
2/2/95	0.0040	0.0085	-0.0070	0.0060	0.0045	-0.0160	0.0025	0.0080
2/6/95	0.0035	0.0080	-0.0075	0.0060	0.0045	-0.0165	0.0020	0.0080
2/9/95	0.0040	0.0085	-0.0070	0.0060	0.0045	-0.0165	0.0025	0.0080
2/13/95	0.0030	0.0080	-0.0075	0.0055	0.0035	-0.0170	0.0015	0.0075
2/16/95	0.0035	0.0085	-0.0070	0.0060	0.0045	-0.0165	0.0020	0.0080
2/20/95	0.0040	0.0090	-0.0065	0.0060	0.0040	-0.0160	0.0025	0.0080
2/23/95	0.0035	0.0085	-0.0070	0.0060	0.0045	-0.0165	0.0020	0.0080
2/28/95	0.0035	0.0085	-0.0070	0.0060	0.0040	-0.0160	0.0020	0.0080
3/3/95	0.0030	0.0080	-0.0075	0.0060	0.0035	-0.0165	0.0015	0.0080
3/8/95	0.0025	0.0080	-0.0075	0.0060	0.0030	-0.0170	0.0015	0.0080
3/13/95	0.0035	0.0090	-0.0065	0.0060	0.0040	-0.0160	0.0020	0.0080
3/18/95	0.0035	0.0090	-0.0065	0.0060	0.0040	-0.0160	0.0025	0.0085
3/23/95	0.0040	0.0095	-0.0060	0.0070	0.0045	-0.0155	0.0025	0.0090
3/29/95	0.0035	0.0090	-0.0065	0.0060	0.0045	-0.0160	0.0025	0.0085
4/4/95	0.0035	0.0085	-0.0065	0.0060	0.0040	-0.0160	0.0025	0.0085
4/11/95	0.0035	0.0090	-0.0065	0.0060	0.0040	-0.0160	0.0025	0.0085

9.5 Panel Shrinkage Data for Specimen MC2S

DATE	COL 1,1	COL 1,2	COL 1,3	COL 1,4	COL 2,1	COL 2,2	COL 2,3	COL 2,4
1/15/95	0.0100				0.0060	0.0060	0.0060	0.0065
1/16/95	0.0100				0.0060	0.0060	0.0060	0.0070
1/17/95	0.0100	0.0070	0.0095	0.0045	0.0060	0.0060	0.0060	0.0070
1/19/95	0.0095	0.0060	0.0095	0.0045	0.0060	0.0060	0.0060	0.0065
1/22/95	0.0100	0.0065	0.0100	0.0050	0.0060	0.0060	0.0060	0.0070
1/26/95	0.0095	0.0055	0.0090	0.0035	0.0050	0.0050	0.0050	0.0060
1/30/95	0.0095	0.0060	0.0100	0.0045	0.0060	0.0060	0.0060	0.0065
2/2/95	0.0100	0.0060	0.0100	0.0045	0.0060	0.0060	0.0060	0.0065
2/6/95	0.0095	0.0060	0.0100	0.0040	0.0060	0.0060	0.0060	0.0065
2/9/95	0.0095	0.0060	0.0095	0.0040	0.0060	0.0060	0.0055	0.0065
2/13/95	0.0090	0.0055	0.0090	0.0035	0.0050	0.0050	0.0050	0.0060
2/16/95	0.0095	0.0060	0.0100	0.0040	0.0060	0.0060	0.0055	0.0065
2/20/95	0.0100	0.0065	0.0100	0.0045	0.0060	0.0060	0.0060	0.0070
2/23/95	0.0095	0.0060	0.0100	0.0040	0.0060	0.0060	0.0060	0.0065
2/28/95	0.0090	0.0055	0.0090	0.0035	0.0055	0.0055	0.0050	0.0060
3/3/95	0.0090	0.0055	0.0095	0.0035	0.0055	0.0055	0.0050	0.0060
3/8/95	0.0090	0.0055	0.0090	0.0035	0.0055	0.0055	0.0050	0.0060
3/13/95	0.0100	0.0060	0.0100	0.0045	0.0060	0.0060	0.0060	0.0070
3/18/95	0.0100	0.0060	0.0100	0.0040	0.0060	0.0060	0.0060	0.0070
3/23/95	0.0100	0.0060	0.0100	0.0045	0.0060	0.0060	0.0060	0.0070
3/29/95	0.0095	0.0060	0.0095	0.0040	0.0055	0.0055	0.0055	0.0065
4/4/95	0.0090	0.0060	0.0095	0.0040	0.0055	0.0060	0.0055	0.0065
4/11/95	0.0095	0.0060	0.0100	0.0040	0.0055	0.0060	0.0055	0.0065

DATE	COL 3,1	COL 3,2	COL 3,3	COL 3,4	COL 4,1	COL 4,2	COL 4,3	COL 4,4
1/15/95	-0.0005	0.0100	0.0065	0.0060	0.0060	0.0065	0.0045	0.0105
1/16/95	-0.0005	0.0105	0.0060	0.0060	0.0060	0.0070	0.0050	0.0115
1/17/95	-0.0005	0.0100	0.0065	0.0060	0.0060	0.0070	0.0050	0.0115
1/19/95	-0.0005	0.0100	0.0065	0.0060	0.0060	0.0065	0.0045	0.0110
1/22/95	0.0000	0.0100	0.0065	0.0060	0.0065	0.0070	0.0050	0.0110
1/26/95	-0.0015	0.0095	0.0050	0.0050	0.0050	0.0060	0.0035	0.0100
1/30/95	-0.0005	0.0100	0.0065	0.0060	0.0060	0.0070	0.0045	0.0105
2/2/95	-0.0005	0.0100	0.0065	0.0055	0.0060	0.0070	0.0045	0.0105
2/6/95	-0.0005	0.0100	0.0065	0.0055	0.0060	0.0065	0.0045	0.0105
2/9/95	-0.0010	0.0100	0.0065	0.0055	0.0060	0.0065	0.0045	0.0100
2/13/95	-0.0015	0.0095	0.0060	0.0050	0.0055	0.0060	0.0040	0.0100
2/16/95	-0.0005	0.0100	0.0065	0.0060	0.0060	0.0065	0.0045	0.0105
2/20/95	-0.0005	0.0105	0.0065	0.0060	0.0060	0.0070	0.0045	0.0105
2/23/95	-0.0005	0.0100	0.0065	0.0060	0.0060	0.0070	0.0045	0.0105
2/28/95	-0.0015	0.0100	0.0060	0.0055	0.0055	0.0060	0.0045	0.0100
3/3/95	-0.0015	0.0100	0.0060	0.0055	0.0055	0.0060	0.0045	0.0100
3/8/95	-0.0015	0.0100	0.0060	0.0055	0.0055	0.0060	0.0040	0.0100
3/13/95	-0.0005	0.0105	0.0060	0.0060	0.0060	0.0070	0.0045	0.0105
3/18/95	-0.0005	0.0105	0.0060	0.0060	0.0060	0.0065	0.0045	0.0105
3/23/95	-0.0005	0.0105	0.0065	0.0060	0.0065	0.0070	0.0050	0.0105
3/29/95	-0.0010	0.0100	0.0060	0.0060	0.0060	0.0065	0.0045	0.0100
4/4/95	-0.0010	0.0100	0.0060	0.0055	0.0060	0.0065	0.0045	0.0100
4/11/95	-0.0010	0.0100	0.0060	0.0060	0.0060	0.0065	0.0045	0.0100

DATE	COL 5,1	COL 5,2	COL 5,3	COL 5,4	ROW 1,1	ROW 1,2	ROW 1,3	ROW 1,4
1/15/95	0.0055	0.0055			0.0060	0.0065	0.0050	0.0060
1/16/95	0.0055	0.0060			0.0060	0.0080	0.0050	0.0060
1/17/95	0.0060	0.0060	0.0050	0.0135	0.0060	0.0070	0.0055	0.0060
1/19/95	0.0055	0.0055	0.0050	0.0130	0.0060	0.0070	0.0060	0.0060
1/22/95	0.0060	0.0060	0.0050	0.0140	0.0060	0.0070	0.0060	0.0060
1/26/95	0.0045	0.0045	0.0040	0.0120	0.0045	0.0060	0.0045	0.0050
1/30/95	0.0055	0.0055	0.0050	0.0130	0.0050	0.0070	0.0060	0.0060
2/2/95	0.0050	0.0055	0.0050	0.0135	0.0055	0.0070	0.0060	0.0060
2/6/95	0.0050	0.0050	0.0045	0.0130	0.0050	0.0070	0.0060	0.0060
2/9/95	0.0050	0.0050	0.0045	0.0130	0.0050	0.0070	0.0055	0.0055
2/13/95	0.0045	0.0045	0.0045	0.0125	0.0045	0.0070	0.0050	0.0055
2/16/95	0.0050	0.0055	0.0050	0.0130	0.0045	0.0075	0.0060	0.0060
2/20/95	0.0055	0.0060	0.0055	0.0135	0.0050	0.0080	0.0060	0.0060
2/23/95	0.0050	0.0055	0.0050	0.0130	0.0050	0.0080	0.0060	0.0060
2/28/95	0.0045	0.0050	0.0045	0.0120	0.0045	0.0070	0.0050	0.0050
3/3/95	0.0045	0.0050	0.0045	0.0130	0.0045	0.0070	0.0050	0.0055
3/8/95	0.0045	0.0050	0.0045	0.0125	0.0045	0.0070	0.0055	0.0055
3/13/95	0.0050	0.0060	0.0050	0.0135	0.0050	0.0080	0.0060	0.0060
3/18/95	0.0050	0.0060	0.0050	0.0130	0.0050	0.0080	0.0060	0.0060
3/23/95	0.0055	0.0060	0.0055	0.0135	0.0050	0.0080	0.0065	0.0060
3/29/95	0.0045	0.0055	0.0050	0.0130	0.0045	0.0075	0.0055	0.0055
4/4/95	0.0045	0.0055	0.0045	0.0125	0.0040	0.0065	0.0050	0.0055
4/11/95	0.0045	0.0055	0.0050	0.0130	0.0045	0.0080	0.0060	0.0060

DATE	ROW 2,1	ROW 2,2	ROW 2,3	ROW 2,4	ROW 3,1	ROW 3,2	ROW 3,3	ROW 3,4
1/15/95	0.0050	0.0060	0.0060	0.0060		0.0060	0.0040	0.0060
1/16/95	0.0050	0.0065	0.0060	0.0060		0.0070	0.0040	0.0060
1/17/95	0.0055	0.0060	0.0060	0.0060	0.0120	0.0070	0.0040	0.0060
1/19/95	0.0055	0.0060	0.0060	0.0060	0.0120	0.0060	0.0045	0.0055
1/22/95	0.0055	0.0060	0.0060	0.0060	0.0125	0.0060	0.0045	0.0060
1/26/95	0.0045	0.0050	0.0050	0.0050	0.0110	0.0045	0.0025	0.0045
1/30/95	0.0050	0.0060	0.0060	0.0060	0.0120	0.0060	0.0040	0.0060
2/2/95	0.0055	0.0060	0.0060	0.0060	0.0120	0.0060	0.0040	0.0060
2/6/95	0.0050	0.0060	0.0060	0.0060	0.0120	0.0060	0.0040	0.0060
2/9/95	0.0050	0.0055	0.0060	0.0060	0.0120	0.0060	0.0035	0.0055
2/13/95	0.0045	0.0050	0.0055	0.0055	0.0115	0.0055	0.0030	0.0050
2/16/95	0.0050	0.0060	0.0060	0.0060	0.0120	0.0060	0.0040	0.0060
2/20/95	0.0055	0.0060	0.0065	0.0060	0.0120	0.0060	0.0040	0.0060
2/23/95	0.0050	0.0060	0.0060	0.0060	0.0120	0.0060	0.0040	0.0060
2/28/95	0.0045	0.0050	0.0060	0.0055	0.0115	0.0055	0.0030	0.0050
3/3/95	0.0045	0.0050	0.0060	0.0055	0.0115	0.0055	0.0035	0.0050
3/8/95	0.0045	0.0050	0.0060	0.0055	0.0115	0.0055	0.0035	0.0050
3/13/95	0.0050	0.0060	0.0065	0.0060	0.0120	0.0060	0.0045	0.0060
3/18/95	0.0050	0.0060	0.0065	0.0060	0.0120	0.0060	0.0045	0.0060
3/23/95	0.0055	0.0060	0.0065	0.0065	0.0120	0.0065	0.0045	0.0060
3/29/95	0.0045	0.0055	0.0060	0.0055	0.0115	0.0060	0.0035	0.0055
4/4/95	0.0040	0.0050	0.0055	0.0050	0.0110	0.0055	0.0030	0.0045
4/11/95	0.0045	0.0060	0.0060	0.0060	0.0115	0.0060	0.0040	0.0055

DATE	ROW 4,1	ROW 4,2	ROW 4,3	ROW 4,4	ROW 5,1	ROW 5,2	ROW 5,3	ROW 5,4
1/15/95		0.0060	0.0040		0.0045	0.0060	0.0080	0.0040
1/16/95		0.0060	0.0045		0.0045	0.0060	0.0080	0.0045
1/17/95	0.0015	0.0060	0.0045	0.0030	0.0050	0.0060	0.0080	0.0045
1/19/95	0.0015	0.0060	0.0045	0.0030	0.0055	0.0060	0.0080	0.0045
1/22/95	0.0015	0.0060	0.0045	0.0030	0.0050	0.0060	0.0080	0.0045
1/26/95	0.0000	0.0045	0.0030	0.0020	0.0040	0.0050	0.0070	0.0030
1/30/95	0.0005	0.0055	0.0040	0.0030	0.0045	0.0060	0.0080	0.0040
2/2/95	0.0010	0.0055	0.0045	0.0025	0.0050	0.0060	0.0080	0.0040
2/6/95	0.0005	0.0055	0.0045	0.0025	0.0045	0.0060	0.0080	0.0040
2/9/95	0.0005	0.0055	0.0040	0.0025	0.0050	0.0060	0.0080	0.0040
2/13/95	0.0005	0.0045	0.0035	0.0025	0.0045	0.0050	0.0075	0.0030
2/16/95	0.0005	0.0055	0.0045	0.0030	0.0050	0.0060	0.0080	0.0040
2/20/95	0.0010	0.0055	0.0045	0.0025	0.0050	0.0060	0.0080	0.0045
2/23/95	0.0005	0.0055	0.0045	0.0030	0.0050	0.0060	0.0080	0.0040
2/28/95	0.0005	0.0050	0.0040	0.0025	0.0045	0.0050	0.0075	0.0035
3/3/95	0.0001	0.0050	0.0040	0.0025	0.0045	0.0050	0.0075	0.0035
3/8/95	0.0005	0.0045	0.0040	0.0020	0.0045	0.0050	0.0075	0.0035
3/13/95	0.0010	0.0055	0.0045	0.0025	0.0050	0.0060	0.0080	0.0045
3/18/95	0.0010	0.0055	0.0045	0.0025	0.0050	0.0060	0.0080	0.0040
3/23/95	0.0015	0.0060	0.0045	0.0035	0.0055	0.0060	0.0085	0.0045
3/29/95	0.0005	0.0050	0.0045	0.0025	0.0045	0.0055	0.0080	0.0035
4/4/95	0.0000	0.0045	0.0035	0.0020	0.0040	0.0050	0.0075	0.0030
4/11/95	0.0005	0.0055	0.0045	0.0025	0.0045	0.0060	0.0080	0.0040

9.6 Panel Shrinkage Data for Specimen MC2N

DATE	COL 1,1	COL 1,2	COL 1,3	COL 1,4	COL 2,1	COL 2,2	COL 2,3	COL 2,4
1/15/95	0.0105	0.0060	0.0060	0.0080	0.0065	0.0060	0.0070	0.0115
1/16/95	0.0115	0.0065	0.0065	0.0085	0.0065	0.0060	0.0060	0.0105
1/17/95	0.0110	0.0060	0.0060	0.0080	0.0060	0.0060	0.0060	0.0100
1/19/95	0.0120	0.0065	0.0065	0.0085	0.0065	0.0065	0.0060	0.0105
1/22/95	0.0120	0.0070	0.0070	0.0090	0.0070	0.0065	0.0065	0.0110
1/26/95	0.0110	0.0060	0.0060	0.0085	0.0060	0.0060	0.0060	0.0105
1/30/95	0.0115	0.0065	0.0065	0.0085	0.0065	0.0065	0.0060	0.0105
2/2/95	0.0110	0.0060	0.0060	0.0080	0.0060	0.0060	0.0060	0.0100
2/6/95	0.0110	0.0060	0.0060	0.0080	0.0060	0.0060	0.0060	0.0100
2/9/95	0.0110	0.0060	0.0060	0.0080	0.0060	0.0060	0.0060	0.0100
2/13/95	0.0100	0.0060	0.0060	0.0075	0.0055	0.0055	0.0055	0.0100
2/16/95	0.0110	0.0060	0.0060	0.0080	0.0060	0.0060	0.0060	0.0100
2/20/95	0.0110	0.0065	0.0065	0.0080	0.0060	0.0065	0.0060	0.0100
2/23/95	0.0110	0.0060	0.0060	0.0080	0.0060	0.0060	-0.0005	0.0100
2/28/95	0.0100	0.0060	0.0060	0.0075	0.0050	0.0055	0.0055	0.0100
3/3/95	0.0100	0.0060	0.0060	0.0080	0.0055	0.0060	0.0055	0.0100
3/8/95	0.0100	0.0060	0.0060	0.0075	0.0050	0.0055	0.0055	0.0100
3/13/95	0.0110	0.0060	0.0060	0.0080	0.0060	0.0060	0.0060	0.0100
3/18/95	0.0110	0.0065	0.0060	0.0080	0.0060	0.0060	0.0060	0.0105
3/23/95	0.0115	0.0070	0.0065	0.0085	0.0060	0.0060	0.0065	0.0110
3/29/95	0.0100	0.0060	0.0060	0.0080	0.0055	0.0055	0.0055	0.0100
4/4/95	0.0110	0.0060	0.0060	0.0080	0.0060	0.0060	0.0060	0.0100
4/11/95	0.0105	0.0060	0.0060	0.0080	0.0055	0.0060	0.0060	0.0100

DATE	COL 3,1	COL 3,2	COL 3,3	COL 3,4	COL 4,1	COL 4,2	COL 4,3	COL 4,4
1/15/95	0.0060	0.0060	-0.0005	0.1505	0.0060	0.0105	0.0305	-0.0005
1/16/95	0.0065	0.0060	0.0000	0.1510	0.0065	0.0110	0.0305	0.0005
1/17/95	0.0060	0.0060	0.0000	0.1510	0.0060	0.0110	0.0310	0.0000
1/19/95	0.0065	0.0060	0.0005	0.1515	0.0065	0.0115	0.0310	0.0005
1/22/95	0.0065	0.0065	0.0005	0.1515	0.0070	0.0115	0.0315	0.0005
1/26/95	0.0060	0.0060	-0.0005	0.1505	0.0060	0.0110	0.0305	0.0000
1/30/95	0.0060	0.0060	0.0000	0.1510	0.0065	0.0115	0.0310	0.0005
2/2/95	0.0060	0.0060	0.0000	0.1505	0.0065	0.0110	0.0310	0.0000
2/6/95	0.0060	0.0060	-0.0005	0.1505	0.0060	0.0110	0.0305	0.0000
2/9/95	0.0060	0.0060	-0.0005	0.1505	0.0060	0.0110	0.0305	0.0000
2/13/95	0.0055	0.0055	-0.0010	0.1505	0.0060	0.0100	0.0305	-0.0005
2/16/95	0.0060	0.0060	-0.0005	0.1505	0.0060	0.0110	0.0305	0.0000
2/20/95	0.0060	0.0060	0.0000	0.1510	0.0065	0.0110	0.0310	0.0000
2/23/95	0.0060	0.0060	-0.0005	0.1505	0.0065	0.0110	0.0305	0.0000
2/28/95	0.0055	0.0055	-0.0005	0.1505	0.0060	0.0105	0.0305	-0.0005
3/3/95	0.0055	0.0055	-0.0005	0.1505	0.0060	0.0105	0.0305	-0.0005
3/8/95	0.0055	0.0055	-0.0010	0.1505	0.0060	0.0105	0.0305	-0.0005
3/13/95	0.0060	0.0060	-0.0005	0.1510	0.0060	0.0115	0.0310	0.0000
3/18/95	0.0060	0.0060	-0.0005	0.1510	0.0060	0.0115	0.0310	0.0000
3/23/95	0.0060	0.0065	0.0000	0.1520	0.0070	0.0120	0.0315	0.0005
3/29/95	0.0055	0.0060	-0.0005	0.1505	0.0060	0.0105	0.0305	-0.0005
4/4/95	0.0055	0.0060	-0.0005	0.1510	0.0060	0.0110	0.0305	-0.0005
4/11/95	0.0055	0.0060	-0.0005	0.1510	0.0065	0.0110	0.0305	0.0000

DATE	COL 5,1	COL 5,2	COL 5,3	COL 5,4	ROW 1,1	ROW 1,2	ROW 1,3	ROW 1,4
1/15/95	0.0065	0.0340	0.0075	-0.0005	0.0065	0.0060	0.0055	0.0060
1/16/95	0.0070	0.0345	0.0080	0.0000	0.0075	0.0065	0.0060	0.0065
1/17/95	0.0070	0.0340	0.0075	0.0000	0.0075	0.0060	0.0060	0.0060
1/19/95	0.0075	0.0345	0.0080	0.0000	0.0075	0.0065	0.0060	0.0070
1/22/95	0.0075	0.0345	0.0080	0.0005	0.0075	0.0065	0.0060	0.0065
1/26/95	0.0065	0.0340	0.0075	-0.0005	0.0075	0.0060	0.0060	0.0065
1/30/95	0.0070	0.0340	0.0080	-0.0005	0.0075	0.0065	0.0060	0.0065
2/2/95	0.0070	0.0340	0.0080	-0.0005	0.0070	0.0065	0.0060	0.0060
2/6/95	0.0065	0.0340	0.0075	-0.0005	0.0070	0.0060	0.0060	0.0060
2/9/95	0.0070	0.0340	0.0075	-0.0005	0.0070	0.0060	0.0060	0.0060
2/13/95	0.0060	0.0335	0.0070	-0.0010	0.0065	0.0060	0.0055	0.0060
2/16/95	0.0065	0.0340	0.0080	-0.0005	0.0070	0.0060	0.0060	0.0060
2/20/95	0.0070	0.0340	0.0080	-0.0005	0.0075	0.0065	0.0060	0.0065
2/23/95	0.0070	0.0340	0.0080	-0.0010	0.0070	0.0065	0.0060	0.0065
2/28/95	0.0060	0.0335	0.0070	-0.0010	0.0060	0.0060	0.0055	0.0060
3/3/95	0.0065	0.0340	0.0075	-0.0010	0.0065	0.0060	0.0055	0.0060
3/8/95	0.0060	0.0335	0.0075	-0.0010	0.0065	0.0060	0.0055	0.0060
3/13/95	0.0075	0.0340	0.0080	-0.0005	0.0075	0.0065	0.0060	0.0065
3/18/95	0.0070	0.0340	0.0080	-0.0005	0.0075	0.0065	0.0060	0.0065
3/23/95	0.0080	0.0350	0.0080	-0.0005	0.0080	0.0070	0.0065	0.0075
3/29/95	0.0065	0.0340	0.0075	-0.0010	0.0065	0.0060	0.0060	0.0060
4/4/95	0.0070	0.0340	0.0075	-0.0010	0.0070	0.0060	0.0060	0.0060
4/11/95	0.0070	0.0340	0.0080	-0.0010	0.0075	0.0065	0.0060	0.0065

DATE	ROW 2,1	ROW 2,2	ROW 2,3	ROW 2,4	ROW 3,1	ROW 3,2	ROW 3,3	ROW 3,4
1/15/95	-0.0005	0.0060	0.0065	0.0060	0.0065	0.0055	0.0050	-0.0845
1/16/95	0.0000	0.0070	0.0080	0.0065	0.0075	0.0060	0.0060	-0.0850
1/17/95	0.0000	0.0065	0.0075	0.0060	0.0070	0.0060	0.0060	-0.0850
1/19/95	0.0000	0.0065	0.0075	0.0065	0.0075	0.0060	0.0060	-0.0845
1/22/95	0.0000	0.0065	0.0075	0.0060	0.0070	0.0060	0.0060	-0.0850
1/26/95	0.0000	0.0065	0.0075	0.0060	0.0075	0.0055	0.0060	-0.0850
1/30/95	-0.0005	0.0065	0.0075	0.0060	0.0070	0.0060	0.0060	-0.0850
2/2/95	-0.0005	0.0065	0.0075	0.0060	0.0070	0.0060	0.0060	-0.0850
2/6/95	-0.0005	0.0065	0.0075	0.0060	0.0070	0.0055	0.0055	-0.0855
2/9/95	-0.0005	0.0065	0.0075	0.0060	0.0070	0.0055	0.0055	-0.0855
2/13/95	-0.0010	0.0060	0.0070	0.0055	0.0065	0.0050	0.0050	-0.0860
2/16/95	-0.0005	0.0065	0.0075	0.0060	0.0070	0.0055	0.0055	-0.0850
2/20/95	-0.0005	0.0070	0.0080	0.0060	0.0075	0.0060	0.0060	-0.0850
2/23/95	-0.0005	0.0065	0.0075	0.0060	0.0070	0.0055	0.0055	-0.0850
2/28/95	-0.0015	0.0060	0.0070	0.0055	0.0060	0.0050	0.0050	-0.0860
3/3/95	-0.0010	0.0060	0.0070	0.0055	0.0065	0.0050	0.0050	-0.0860
3/8/95	-0.0010	0.0060	0.0070	0.0055	0.0065	0.0050	0.0050	-0.0860
3/13/95	-0.0005	0.0070	0.0080	0.0060	0.0075	0.0060	0.0060	-0.0850
3/18/95	-0.0005	0.0070	0.0080	0.0060	0.0075	0.0060	0.0055	-0.0850
3/23/95	-0.0005	0.0075	0.0080	0.0065	0.0080	0.0060	0.0060	-0.0845
3/29/95	-0.0010	0.0060	0.0075	0.0055	0.0070	0.0055	0.0055	-0.0855
4/4/95	-0.0005	0.0065	0.0080	0.0060	0.0070	0.0055	0.0055	-0.0855
4/11/95	-0.0005	0.0070	0.0080	0.0060	0.0075	0.0060	0.0060	-0.0850

DATE	ROW 4,1	ROW 4,2	ROW 4,3	ROW 4,4	ROW 5,1	ROW 5,2	ROW 5,3	ROW 5,4
1/15/95	0.0050	0.0090	-0.0270	0.0060	0.0045	-0.0435	0.0045	0.0200
1/16/95	0.0060	0.0095	-0.0260	0.0065	0.0050	-0.0435	0.0060	0.0210
1/17/95	0.0060	0.0090	-0.0265	0.0065	0.0050	-0.0435	0.0055	0.0205
1/19/95	0.0060	0.0095	-0.0260	0.0065	0.0055	-0.0430	0.0055	0.0210
1/22/95	0.0060	0.0095	-0.0260	0.0065	0.0055	-0.0435	0.0055	0.0210
1/26/95	0.0060	0.0090	-0.0265	0.0060	0.0050	-0.0430	0.0055	0.0205
1/30/95	0.0060	0.0095	-0.0265	0.0065	0.0050	-0.0435	0.0055	0.0205
2/2/95	0.0055	0.0090	-0.0265	0.0060	0.0050	-0.0435	0.0055	0.0205
2/6/95	0.0055	0.0090	-0.0265	0.0060	0.0045	-0.0435	0.0055	0.0200
2/9/95	0.0055	0.0090	-0.0265	0.0060	0.0050	-0.0435	0.0055	0.0205
2/13/95	0.0050	0.0085	-0.0270	0.0060	0.0045	-0.0440	0.0050	0.0195
2/16/95	0.0055	0.0090	-0.0265	0.0060	0.0050	-0.0435	0.0055	0.0205
2/20/95	0.0055	0.0095	-0.0265	0.0060	0.0050	-0.0435	0.0055	0.0205
2/23/95	0.0055	0.0090	-0.0265	0.0065	0.0045	-0.0435	0.0055	0.0205
2/28/95	0.0045	0.0085	-0.0270	0.0060	0.0045	-0.0440	0.0045	0.0200
3/3/95	0.0050	0.0085	-0.0270	0.0060	0.0045	-0.0435	0.0050	0.0195
3/8/95	0.0050	0.0085	-0.0270	0.0060	0.0045	-0.0435	0.0045	0.0195
3/13/95	0.0055	0.0095	-0.0265	0.0065	0.0050	-0.0435	0.0055	0.0205
3/18/95	0.0060	0.0095	-0.0265	0.0065	0.0045	-0.0435	0.0055	0.0205
3/23/95	0.0060	0.0100	-0.0260	0.0075	0.0055	-0.0425	0.0060	0.0210
3/29/95	0.0050	0.0090	-0.0265	0.0060	0.0045	-0.0435	0.0050	0.0200
4/4/95	0.0055	0.0090	-0.0265	0.0065	0.0045	-0.0430	0.0055	0.0200
4/11/95	0.0060	0.0095	-0.0265	0.0065	0.0050	-0.0430	0.0055	0.0205

9.7 Panel Shrinkage Data for Specimen PCLM

DATE	COL 1,1	COL 1,2	COL 1,3	COL 1,4	COL 2,1	COL 2,2	COL 2,3	COL 2,4
1/22/95	0.0065	0.0070	0.0070	0.0060	0.0060	0.0065	0.0065	0.0060
1/23/95	0.0060	0.0065	0.0065	0.0060	0.0055	0.0060	0.0060	0.0060
1/24/95	0.0060	0.0065	0.0065	0.0060	0.0060	0.0060	0.0065	0.0060
1/25/95	0.0060	0.0065	0.0065	0.0060	0.0060	0.0060	0.0065	0.0060
1/26/95	0.0060	0.0060	0.0065	0.0060	0.0055	0.0060	0.0060	0.0060
1/27/95	0.0065	0.0065	0.0065	0.0060	0.0060	0.0060	0.0065	0.0060
1/30/95	0.0065	0.0065	0.0070	0.0065	0.0060	0.0060	0.0065	0.0060
2/2/95	0.0060	0.0065	0.0065	0.0060	0.0060	0.0060	0.0065	0.0060
2/6/95	0.0060	0.0060	0.0060	0.0060	0.0055	0.0060	0.0060	0.0060
2/9/95	0.0060	0.0060	0.0060	0.0060	0.0055	0.0055	0.0060	0.0060
2/13/95	0.0055	0.0060	0.0060	0.0055	0.0045	0.0050	0.0060	0.0055
2/16/95	0.0060	0.0060	0.0065	0.0060	0.0055	0.0055	0.0065	0.0060
2/20/95	0.0060	0.0065	0.0065	0.0060	0.0060	0.0060	0.0065	0.0060
2/23/95	0.0060	0.0060	0.0065	0.0060	0.0055	0.0060	0.0065	0.0060
2/28/95	0.0055	0.0060	0.0060	0.0060	0.0050	0.0055	0.0065	0.0060
3/3/95	0.0050	0.0060	0.0060	0.0060	0.0050	0.0050	0.0060	0.0055
3/8/95	0.0055	0.0060	0.0060	0.0060	0.0050	0.0055	0.0060	0.0060
3/13/95	0.0060	0.0060	0.0065	0.0060	0.0055	0.0055	0.0065	0.0060
3/18/95	0.0060	0.0065	0.0065	0.0060	0.0060	0.0060	0.0065	0.0060
3/23/95	0.0060	0.0070	0.0065	0.0065	0.0060	0.0060	0.0070	0.0060
3/29/95	0.0055	0.0060	0.0060	0.0060	0.0055	0.0055	0.0065	0.0060
4/4/95	0.0050	0.0060	0.0060	0.0060	0.0050	0.0050	0.0060	0.0055
4/11/95	0.0055	0.0060	0.0060	0.0060	0.0055	0.0055	0.0065	0.0060

DATE	COL 3,1	COL 3,2	COL 3,3	COL 3,4	COL 4,1	COL 4,2	COL 4,3	COL 4,4
1/22/95	0.0080	0.0060	0.0080	0.0060	0.0060	0.0040	0.0065	0.0070
1/23/95	0.0080	0.0055	0.0080	0.0060	0.0060	0.0035	0.0060	0.0070
1/24/95	0.0080	0.0055	0.0075	0.0060	0.0060	0.0035	0.0060	0.0070
1/25/95	0.0080	0.0055	0.0075	0.0060	0.0060	0.0035	0.0060	0.0065
1/26/95	0.0075	0.0050	0.0075	0.0060	0.0060	0.0030	0.0060	0.0065
1/27/95	0.0080	0.0055	0.0075	0.0060	0.0060	0.0030	0.0060	0.0065
1/30/95	0.0080	0.0060	0.0080	0.0065	0.0060	0.0035	0.0070	0.0070
2/2/95	0.0080	0.0060	0.0080	0.0060	0.0060	0.0035	0.0065	0.0070
2/6/95	0.0075	0.0050	0.0075	0.0060	0.0055	0.0030	0.0060	0.0065
2/9/95	0.0075	0.0050	0.0075	0.0060	0.0055	0.0030	0.0060	0.0065
2/13/95	0.0070	0.0045	0.0065	0.0055	0.0050	0.0025	0.0060	0.0060
2/16/95	0.0075	0.0055	0.0075	0.0060	0.0060	0.0030	0.0060	0.0070
2/20/95	0.0080	0.0055	0.0080	0.0060	0.0060	0.0035	0.0065	0.0070
2/23/95	0.0075	0.0055	0.0075	0.0060	0.0060	0.0030	0.0060	0.0065
2/28/95	0.0075	0.0050	0.0070	0.0060	0.0055	0.0025	0.0060	0.0065
3/3/95	0.0070	0.0045	0.0070	0.0055	0.0050	0.0025	0.0060	0.0060
3/8/95	0.0075	0.0050	0.0070	0.0060	0.0055	0.0025	0.0060	0.0065
3/13/95	0.0075	0.0050	0.0075	0.0060	0.0060	0.0030	0.0065	0.0065
3/18/95	0.0080	0.0055	0.0075	0.0060	0.0060	0.0030	0.0065	0.0070
3/23/95	0.0080	0.0060	0.0080	0.0065	0.0060	0.0035	0.0070	0.0075
3/29/95	0.0075	0.0050	0.0075	0.0060	0.0055	0.0025	0.0065	0.0065
4/4/95	0.0070	0.0045	0.0070	0.0055	0.0050	0.0025	0.0060	0.0065
4/11/95	0.0075	0.0050	0.0075	0.0060	0.0055	0.0025	0.0060	0.0065

DATE	COL 5,1	COL 5,2	COL 5,3	COL 5,4	ROW 1,1	ROW 1,2	ROW 1,3	ROW 1,4
1/22/95	0.0080	0.0065	0.0060	0.0060	0.0065	0.0080	0.0065	0.0065
1/23/95	0.0075	0.0060	0.0060	0.0060	0.0060	0.0070	0.0060	0.0060
1/24/95	0.0075	0.0060	0.0060	0.0060	0.0060	0.0070	0.0060	0.0060
1/25/95	0.0075	0.0055	0.0060	0.0060	0.0060	0.0070	0.0060	0.0060
1/26/95	0.0075	0.0045	0.0050	0.0060	0.0060	0.0070	0.0060	0.0060
1/27/95	0.0075	0.0055	0.0060	0.0060	0.0060	0.0070	0.0060	0.0060
1/30/95	0.0080	0.0060	0.0060	0.0060	0.0060	0.0075	0.0060	0.0065
2/2/95	0.0080	0.0065	0.0060	0.0060	0.0060	0.0075	0.0060	0.0065
2/6/95	0.0075	0.0060	0.0060	0.0060	0.0060	0.0070	0.0060	0.0060
2/9/95	0.0075	0.0060	0.0055	0.0060	0.0060	0.0070	0.0060	0.0060
2/13/95	0.0070	0.0055	0.0055	0.0055	0.0050	0.0060	0.0055	0.0060
2/16/95	0.0075	0.0060	0.0060	0.0060	0.0060	0.0070	0.0060	0.0060
2/20/95	0.0080	0.0060	0.0060	0.0060	0.0060	0.0075	0.0060	0.0065
2/23/95	0.0075	0.0060	0.0060	0.0060	0.0060	0.0070	0.0060	0.0060
2/28/95	0.0070	0.0060	0.0060	0.0060	0.0055	0.0065	0.0055	0.0060
3/3/95	0.0070	0.0055	0.0055	0.0055	0.0055	0.0065	0.0055	0.0060
3/8/95	0.0070	0.0060	0.0060	0.0055	0.0055	0.0065	0.0055	0.0060
3/13/95	0.0075	0.0060	0.0060	0.0060	0.0060	0.0075	0.0060	0.0060
3/18/95	0.0075	0.0060	0.0060	0.0060	0.0060	0.0075	0.0060	0.0065
3/23/95	0.0080	0.0065	0.0065	0.0065	0.0060	0.0080	0.0065	0.0070
3/29/95	0.0075	0.0060	0.0060	0.0060	0.0060	0.0070	0.0060	0.0060
4/4/95	0.0070	0.0060	0.0060	0.0055	0.0055	0.0070	0.0060	0.0060
4/11/95	0.0075	0.0060	0.0060	0.0060	0.0060	0.0075	0.0060	0.0060

DATE	ROW 2,1	ROW 2,2	ROW 2,3	ROW 2,4	ROW 3,1	ROW 3,2	ROW 3,3	ROW 3,4
1/22/95	0.0060	0.0060	0.0060	0.0060	0.0095	0.0060	0.0060	0.0100
1/23/95	0.0060	0.0050	0.0055	0.0060	0.0090	0.0055	0.0050	0.0095
1/24/95	0.0060	0.0050	0.0055	0.0060	0.0090	0.0055	0.0050	0.0095
1/25/95	0.0060	0.0050	0.0055	0.0060	0.0090	0.0055	0.0060	0.0095
1/26/95	0.0055	0.0050	0.0055	0.0060	0.0090	0.0055	0.0050	0.0095
1/27/95	0.0055	0.0050	0.0055	0.0060	0.0090	0.0055	0.0050	0.0095
1/30/95	0.0060	0.0055	0.0060	0.0060	0.0095	0.0060	0.0055	0.0100
2/2/95	0.0060	0.0050	0.0060	0.0060	0.0090	0.0060	0.0066	0.0100
2/6/95	0.0055	0.0050	0.0055	0.0060	0.0085	0.0055	0.0050	0.0095
2/9/95	0.0055	0.0050	0.0055	0.0060	0.0090	0.0055	0.0050	0.0095
2/13/95	0.0050	0.0045	0.0050	0.0055	0.0080	0.0050	0.0045	0.0090
2/16/95	0.0055	0.0050	0.0055	0.0060	0.0090	0.0060	0.0050	0.0095
2/20/95	0.0060	0.0055	0.0060	0.0060	0.0090	0.0060	0.0055	0.0100
2/23/95	0.0060	0.0050	0.0055	0.0060	0.0090	0.0060	0.0050	0.0095
2/28/95	0.0055	0.0045	0.0055	0.0055	0.0085	0.0055	0.0045	0.0095
3/3/95	0.0050	0.0045	0.0050	0.0055	0.0085	0.0050	0.0045	0.0090
3/8/95	0.0050	0.0045	0.0050	0.0055	0.0085	0.0055	0.0045	0.0090
3/13/95	0.0060	0.0050	0.0060	0.0060	0.0090	0.0060	0.0050	0.0100
3/18/95	0.0060	0.0055	0.0060	0.0060	0.0090	0.0060	0.0050	0.0100
3/23/95	0.0060	0.0060	0.0060	0.0065	0.0095	0.0065	0.0055	0.0100
3/29/95	0.0060	0.0050	0.0055	0.0060	0.0085	0.0060	0.0050	0.0095
4/4/95	0.0055	0.0050	0.0050	0.0055	0.0085	0.0055	0.0045	0.0090
4/11/95	0.0055	0.0050	0.0055	0.0060	0.0085	0.0060	0.0050	0.0095

DATE	ROW 4,1	ROW 4,2	ROW 4,3	ROW 4,4	ROW 5,1	ROW 5,2	ROW 5,3	ROW 5,4
1/22/95	0.0055	0.0070	0.0065	0.0060	0.0100	0.0060	0.0065	0.0070
1/23/95	0.0045	0.0065	0.0060	0.0055	0.0095	0.0055	0.0060	0.0060
1/24/95	0.0045	0.0065	0.0060	0.0055	0.0090	0.0055	0.0065	0.0065
1/25/95	0.0060	0.0065	0.0060	0.0060	0.0095	0.0060	0.0065	0.0065
1/26/95	0.0045	0.0065	0.0060	0.0055	0.0090	0.0060	0.0060	0.0065
1/27/95	0.0045	0.0065	0.0060	0.0055	0.0090	0.0055	0.0060	0.0060
1/30/95	0.0050	0.0065	0.0065	0.0060	0.0095	0.0060	0.0065	0.0065
2/2/95	0.0050	0.0065	0.0060	0.0060	0.0095	0.0060	0.0065	0.0065
2/6/95	0.0045	0.0060	0.0060	0.0055	0.0090	0.0055	0.0060	0.0060
2/9/95	0.0045	0.0065	0.0060	0.0055	0.0095	0.0055	0.0060	0.0060
2/13/95	0.0045	0.0060	0.0055	0.0050	0.0085	0.0050	0.0060	0.0060
2/16/95	0.0050	0.0065	0.0060	0.0055	0.0095	0.0060	0.0060	0.0065
2/20/95	0.0050	0.0065	0.0060	0.0060	0.0095	0.0060	0.0060	0.0065
2/23/95	0.0050	0.0065	0.0060	0.0055	0.0090	0.0060	0.0060	0.0060
2/28/95	0.0045	0.0060	0.0060	0.0050	0.0090	0.0060	0.0060	0.0060
3/3/95	0.0045	0.0060	0.0060	0.0050	0.0085	0.0055	0.0060	0.0060
3/8/95	0.0045	0.0060	0.0060	0.0050	0.0090	0.0055	0.0060	0.0060
3/13/95	0.0050	0.0065	0.0060	0.0055	0.0095	0.0060	0.0060	0.0065
3/18/95	0.0050	0.0065	0.0065	0.0060	0.0095	0.0060	0.0060	0.0065
3/23/95	0.0055	0.0070	0.0070	0.0060	0.0100	0.0065	0.0065	0.0070
3/29/95	0.0050	0.0065	0.0060	0.0055	0.0090	0.0060	0.0060	0.0065
4/4/95	0.0045	0.0060	0.0060	0.0055	0.0085	0.0055	0.0060	0.0060
4/11/95	0.0050	0.0060	0.0060	0.0055	0.0090	0.0060	0.0060	0.0065

9.8 Panel Shrinkage Data for Specimen PCLS

DATE	COL 1,1	COL 1,2	COL 1,3	COL 1,4	COL 2,1	COL 2,2	COL 2,3	COL 2,4
1/22/95	0.0080	0.0080	0.0075	0.0075	0.0055	0.0075	0.0085	0.0075
1/23/95	0.0060	0.0060	0.0060	0.0060	0.0040	0.0055	0.0070	0.0060
1/24/95	0.0060	0.0060	0.0060	0.0060	0.0040	0.0055	0.0070	0.0060
1/25/95	0.0060	0.0060	0.0060	0.0060	0.0040	0.0055	0.0070	0.0060
1/26/95	0.0060	0.0060	0.0060	0.0060	0.0040	0.0055	0.0070	0.0060
1/27/95	0.0060	0.0060	0.0060	0.0060	0.0045	0.0060	0.0070	0.0060
1/30/95	0.0065	0.0065	0.0065	0.0065	0.0045	0.0060	0.0080	0.0060
2/2/95	0.0060	0.0060	0.0060	0.0060	0.0040	0.0060	0.0075	0.0060
2/6/95	0.0055	0.0060	0.0055	0.0055	0.0030	0.0050	0.0065	0.0055
2/9/95	0.0060	0.0060	0.0060	0.0060	0.0035	0.0055	0.0070	0.0060
2/13/95	0.0055	0.0055	0.0055	0.0055	0.0030	0.0050	0.0065	0.0055
2/16/95	0.0060	0.0060	0.0060	0.0060	0.0035	0.0055	0.0070	0.0060
2/20/95	0.0060	0.0060	0.0060	0.0060	0.0040	0.0060	0.0075	0.0060
2/23/95	0.0060	0.0060	0.0060	0.0060	0.0035	0.0060	0.0070	0.0060
2/28/95	0.0050	0.0055	0.0050	0.0055	0.0030	0.0050	0.0065	0.0050
3/3/95	0.0055	0.0055	0.0055	0.0055	0.0030	0.0050	0.0065	0.0055
3/8/95	0.0055	0.0060	0.0055	0.0055	0.0030	0.0055	0.0065	0.0055
3/13/95	0.0060	0.0060	0.0060	0.0060	0.0035	0.0060	0.0070	0.0060
3/18/95	0.0060	0.0060	0.0060	0.0060	0.0035	0.0060	0.0070	0.0060
3/23/95	0.0060	0.0065	0.0060	0.0060	0.0040	0.0060	0.0075	0.0060
3/29/95	0.0060	0.0060	0.0060	0.0060	0.0035	0.0055	0.0070	0.0060
4/4/95	0.0050	0.0055	0.0050	0.0055	0.0025	0.0050	0.0065	0.0055
4/11/95	0.0055	0.0060	0.0055	0.0060	0.0030	0.0055	0.0065	0.0060

DATE	COL 3,1	COL 3,2	COL 3,3	COL 3,4	COL 4,1	COL 4,2	COL 4,3	COL 4,4
1/22/95	0.0080	0.0080	0.0080	0.0090	0.0075	0.0065	0.0075	0.0080
1/23/95	0.0060	0.0060	0.0060	0.0080	0.0060	0.0050	0.0060	0.0065
1/24/95	0.0065	0.0060	0.0060	0.0080	0.0060	0.0050	0.0060	0.0065
1/25/95	0.0060	0.0060	0.0060	0.0075	0.0060	0.0050	0.0060	0.0065
1/26/95	0.0060	0.0060	0.0060	0.0075	0.0060	0.0050	0.0060	0.0065
1/27/95	0.0065	0.0060	0.0065	0.0080	0.0060	0.0055	0.0060	0.0065
1/30/95	0.0070	0.0065	0.0065	0.0080	0.0065	0.0055	0.0065	0.0070
2/2/95	0.0060	0.0060	0.0060	0.0075	0.0060	0.0055	0.0060	0.0065
2/6/95	0.0060	0.0060	0.0060	0.0070	0.0055	0.0045	0.0055	0.0060
2/9/95	0.0060	0.0060	0.0060	0.0075	0.0060	0.0050	0.0060	0.0065
2/13/95	0.0060	0.0060	0.0060	0.0070	0.0055	0.0045	0.0055	0.0060
2/16/95	0.0060	0.0060	0.0060	0.0075	0.0060	0.0050	0.0060	0.0065
2/20/95	0.0065	0.0065	0.0065	0.0080	0.0060	0.0055	0.0060	0.0065
2/23/95	0.0060	0.0060	0.0060	0.0075	0.0060	0.0050	0.0060	0.0065
2/28/95	0.0055	0.0055	0.0060	0.0065	0.0050	0.0045	0.0055	0.0060
3/3/95	0.0055	0.0055	0.0060	0.0070	0.0055	0.0045	0.0055	0.0060
3/8/95	0.0060	0.0060	0.0060	0.0070	0.0055	0.0045	0.0060	0.0060
3/13/95	0.0060	0.0060	0.0060	0.0075	0.0060	0.0050	0.0060	0.0065
3/18/95	0.0060	0.0060	0.0060	0.0075	0.0060	0.0050	0.0060	0.0065
3/23/95	0.0065	0.0065	0.0065	0.0080	0.0060	0.0055	0.0065	0.0070
3/29/95	0.0060	0.0060	0.0060	0.0075	0.0060	0.0045	0.0060	0.0065
4/4/95	0.0055	0.0055	0.0055	0.0070	0.0050	0.0045	0.0055	0.0060
4/11/95	0.0060	0.0060	0.0060	0.0075	0.0060	0.0045	0.0060	0.0060

DATE	COL 5,1	COL 5,2	COL 5,3	COL 5,4	ROW 1,1	ROW 1,2	ROW 1,3	ROW 1,4
1/22/95	0.0080	0.0080	0.0080	0.0125	0.0075	0.0080	0.0075	0.0080
1/23/95	0.0060	0.0070	0.0070	0.0110	0.0060	0.0065	0.0060	0.0065
1/24/95	0.0060	0.0065	0.0070	0.0110	0.0060	0.0065	0.0060	0.0070
1/25/95	0.0060	0.0065	0.0070	0.0110	0.0060	0.0065	0.0060	0.0070
1/26/95	0.0060	0.0065	0.0070	0.0110	0.0060	0.0065	0.0060	0.0070
1/27/95	0.0065	0.0070	0.0070	0.0115	0.0060	0.0065	0.0060	0.0070
1/30/95	0.0065	0.0075	0.0080	0.0115	0.0065	0.0070	0.0065	0.0075
2/2/95	0.0065	0.0070	0.0075	0.0110	0.0060	0.0065	0.0060	0.0070
2/6/95	0.0060	0.0065	0.0070	0.0105	0.0060	0.0060	0.0060	0.0065
2/9/95	0.0060	0.0065	0.0070	0.0110	0.0060	0.0065	0.0060	0.0070
2/13/95	0.0060	0.0060	0.0065	0.0105	0.0060	0.0060	0.0060	0.0065
2/16/95	0.0060	0.0065	0.0070	0.0110	0.0060	0.0065	0.0060	0.0070
2/20/95	0.0065	0.0070	0.0075	0.0115	0.0065	0.0070	0.0065	0.0075
2/23/95	0.0060	0.0070	0.0070	0.0110	0.0060	0.0065	0.0060	0.0070
2/28/95	0.0055	0.0060	0.0065	0.0105	0.0055	0.0060	0.0055	0.0060
3/3/95	0.0060	0.0060	0.0065	0.0105	0.0055	0.0060	0.0055	0.0065
3/8/95	0.0060	0.0065	0.0070	0.0105	0.0055	0.0060	0.0060	0.0065
3/13/95	0.0060	0.0070	0.0075	0.0110	0.0060	0.0065	0.0060	0.0070
3/18/95	0.0060	0.0070	0.0075	0.0110	0.0060	0.0070	0.0060	0.0070
3/23/95	0.0065	0.0075	0.0080	0.0115	0.0065	0.0070	0.0070	0.0075
3/29/95	0.0060	0.0065	0.0070	0.0110	0.0060	0.0070	0.0065	0.0070
4/4/95	0.0060	0.0060	0.0065	0.0105	0.0060	0.0060	0.0060	0.0065
4/11/95	0.0060	0.0065	0.0070	0.0105	0.0060	0.0070	0.0060	0.0070

DATE	ROW 2,1	ROW 2,2	ROW 2,3	ROW 2,4	ROW 3,1	ROW 3,2	ROW 3,3	ROW 3,4
1/22/95	0.0060	0.0080	0.0070	0.0085	0.0080	0.0075	0.0100	0.0100
1/23/95	0.0045	0.0060	0.0055	0.0070	0.0060	0.0060	0.0080	0.0080
1/24/95	0.0045	0.0060	0.0055	0.0070	0.0060	0.0060	0.0080	0.0085
1/25/95	0.0045	0.0060	0.0055	0.0075	0.0060	0.0060	0.0080	0.0085
1/26/95	0.0045	0.0060	0.0055	0.0070	0.0060	0.0060	0.0080	0.0085
1/27/95	0.0045	0.0060	0.0060	0.0075	0.0060	0.0060	0.0080	0.0085
1/30/95	0.0050	0.0065	0.0060	0.0080	0.0065	0.0065	0.0085	0.0090
2/2/95	0.0045	0.0060	0.0060	0.0075	0.0060	0.0060	0.0085	0.0085
2/6/95	0.0045	0.0060	0.0050	0.0070	0.0060	0.0055	0.0080	0.0080
2/9/95	0.0045	0.0060	0.0055	0.0070	0.0060	0.0060	0.0080	0.0080
2/13/95	0.0045	0.0060	0.0050	0.0065	0.0060	0.0055	0.0080	0.0080
2/16/95	0.0045	0.0060	0.0055	0.0070	0.0060	0.0060	0.0085	0.0085
2/20/95	0.0050	0.0065	0.0060	0.0075	0.0065	0.0060	0.0085	0.0090
2/23/95	0.0045	0.0060	0.0055	0.0075	0.0060	0.0060	0.0085	0.0085
2/28/95	0.0045	0.0055	0.0050	0.0065	0.0060	0.0055	0.0080	0.0080
3/3/95	0.0045	0.0060	0.0050	0.0065	0.0060	0.0055	0.0080	0.0080
3/8/95	0.0045	0.0060	0.0050	0.0065	0.0060	0.0055	0.0080	0.0080
3/13/95	0.0050	0.0060	0.0060	0.0075	0.0065	0.0060	0.0085	0.0085
3/18/95	0.0050	0.0065	0.0060	0.0075	0.0065	0.0060	0.0085	0.0085
3/23/95	0.0055	0.0070	0.0060	0.0080	0.0070	0.0065	0.0090	0.0090
3/29/95	0.0045	0.0065	0.0060	0.0075	0.0065	0.0060	0.0085	0.0085
4/4/95	0.0045	0.0060	0.0055	0.0070	0.0060	0.0055	0.0080	0.0080
4/11/95	0.0045	0.0065	0.0060	0.0075	0.0065	0.0060	0.0085	0.0085

DATE	ROW 4,1	ROW 4,2	ROW 4,3	ROW 4,4	ROW 5,1	ROW 5,2	ROW 5,3	ROW 5,4
1/22/95	0.0080	0.0095	0.0070	0.0065	0.0080	0.0060	0.0055	0.0095
1/23/95	0.0060	0.0075	0.0055	0.0050	0.0065	0.0045	0.0040	0.0080
1/24/95	0.0060	0.0080	0.0055	0.0050	0.0065	0.0045	0.0040	0.0080
1/25/95	0.0065	0.0080	0.0055	0.0050	0.0070	0.0050	0.0045	0.0080
1/26/95	0.0060	0.0075	0.0055	0.0050	0.0065	0.0045	0.0045	0.0075
1/27/95	0.0065	0.0080	0.0055	0.0055	0.0070	0.0050	0.0045	0.0080
1/30/95	0.0070	0.0080	0.0060	0.0055	0.0075	0.0055	0.0045	0.0080
2/2/95	0.0060	0.0080	0.0055	0.0055	0.0065	0.0045	0.0045	0.0080
2/6/95	0.0060	0.0075	0.0050	0.0045	0.0060	0.0045	0.0040	0.0075
2/9/95	0.0060	0.0075	0.0050	0.0050	0.0065	0.0045	0.0040	0.0075
2/13/95	0.0060	0.0070	0.0050	0.0045	0.0060	0.0045	0.0035	0.0070
2/16/95	0.0060	0.0080	0.0055	0.0050	0.0065	0.0045	0.0045	0.0080
2/20/95	0.0065	0.0080	0.0055	0.0055	0.0065	0.0050	0.0045	0.0080
2/23/95	0.0060	0.0080	0.0055	0.0050	0.0065	0.0045	0.0040	0.0075
2/28/95	0.0060	0.0075	0.0050	0.0045	0.0060	0.0045	0.0035	0.0075
3/3/95	0.0060	0.0075	0.0050	0.0045	0.0060	0.0045	0.0035	0.0075
3/8/95	0.0060	0.0075	0.0050	0.0045	0.0060	0.0045	0.0035	0.0070
3/13/95	0.0060	0.0080	0.0055	0.0050	0.0065	0.0045	0.0045	0.0080
3/18/95	0.0060	0.0080	0.0060	0.0050	0.0065	0.0050	0.0045	0.0080
3/23/95	0.0065	0.0080	0.0060	0.0055	0.0070	0.0055	0.0045	0.0080
3/29/95	0.0060	0.0080	0.0060	0.0050	0.0065	0.0045	0.0045	0.0080
4/4/95	0.0060	0.0080	0.0055	0.0045	0.0060	0.0045	0.0040	0.0075
4/11/95	0.0060	0.0080	0.0055	0.0050	0.0065	0.0045	0.0045	0.0080

9.9 Panel Shrinkage Data for Specimen PCLN

DATE	COL 1,1	COL 1,2	COL 1,3	COL 1,4	COL 2,1	COL 2,2	COL 2,3	COL 2,4
1/29/95	0.0080	0.0070	0.0070	0.0065	0.0055	0.0065	0.0075	0.0065
1/30/95	0.0065	0.0060	0.0060	0.0060	0.0050	0.0060	0.0065	0.0060
1/31/95	0.0065	0.0060	0.0060	0.0060	0.0045	0.0055	0.0060	0.0060
2/1/95	0.0070	0.0060	0.0060	0.0060	0.0045	0.0060	0.0065	0.0060
2/2/95	0.0065	0.0060	0.0060	0.0060	0.0045	0.0060	0.0060	0.0060
2/6/95	0.0065	0.0060	0.0060	0.0060	0.0045	0.0055	0.0060	0.0055
2/9/95	0.0060	0.0055	0.0055	0.0055	0.0040	0.0050	0.0055	0.0050
2/13/95	0.0060	0.0055	0.0055	0.0055	0.0040	0.0050	0.0055	0.0050
2/16/95	0.0065	0.0060	0.0060	0.0060	0.0045	0.0055	0.0060	0.0060
2/20/95	0.0065	0.0060	0.0060	0.0060	0.0050	0.0055	0.0060	0.0060
2/23/95	0.0065	0.0060	0.0060	0.0060	0.0045	0.0055	0.0060	0.0060
2/28/95	0.0060	0.0055	0.0060	0.0055	0.0045	0.0050	0.0060	0.0055
3/3/95	0.0060	0.0050	0.0055	0.0055	0.0040	0.0045	0.0055	0.0050
3/8/95	0.0060	0.0055	0.0060	0.0060	0.0045	0.0050	0.0060	0.0055
3/13/95	0.0065	0.0060	0.0060	0.0060	0.0045	0.0055	0.0060	0.0060
3/18/95	0.0065	0.0060	0.0060	0.0060	0.0050	0.0055	0.0060	0.0060
3/23/95	0.0065	0.0060	0.0060	0.0060	0.0050	0.0055	0.0060	0.0060
3/29/95	0.0060	0.0055	0.0060	0.0060	0.0045	0.0050	0.0060	0.0055
4/4/95	0.0060	0.0050	0.0055	0.0050	0.0045	0.0045	0.0055	0.0050
4/11/95	0.0060	0.0050	0.0055	0.0055	0.0045	0.0045	0.0055	0.0050

DATE	COL 3,1	COL 3,2	COL 3,3	COL 3,4	COL 4,1	COL 4,2	COL 4,3	COL 4,4
1/29/95	0.0060	0.0065	0.0070	0.0070	0.0070	0.0045	0.0080	0.0075
1/30/95	0.0055	0.0060	0.0065	0.0060	0.0065	0.0040	0.0080	0.0065
1/31/95	0.0050	0.0060	0.0060	0.0060	0.0060	0.0040	0.0080	0.0060
2/1/95	0.0055	0.0060	0.0065	0.0060	0.0060	0.0040	0.0080	0.0060
2/2/95	0.0050	0.0055	0.0060	0.0060	0.0060	0.0040	0.0080	0.0060
2/6/95	0.0045	0.0055	0.0060	0.0060	0.0060	0.0035	0.0075	0.0060
2/9/95	0.0045	0.0050	0.0060	0.0055	0.0050	0.0030	0.0070	0.0060
2/13/95	0.0045	0.0050	0.0060	0.0055	0.0050	0.0030	0.0070	0.0055
2/16/95	0.0045	0.0055	0.0060	0.0060	0.0055	0.0035	0.0080	0.0060
2/20/95	0.0050	0.0060	0.0065	0.0060	0.0060	0.0040	0.0080	0.0060
2/23/95	0.0050	0.0055	0.0060	0.0060	0.0055	0.0035	0.0080	0.0060
2/28/95	0.0045	0.0055	0.0060	0.0055	0.0050	0.0030	0.0075	0.0060
3/3/95	0.0040	0.0050	0.0060	0.0050	0.0050	0.0030	0.0070	0.0055
3/8/95	0.0045	0.0050	0.0060	0.0055	0.0050	0.0030	0.0075	0.0055
3/13/95	0.0045	0.0055	0.0060	0.0060	0.0055	0.0035	0.0080	0.0060
3/18/95	0.0045	0.0060	0.0065	0.0060	0.0060	0.0040	0.0080	0.0060
3/23/95	0.0045	0.0060	0.0065	0.0060	0.0060	0.0040	0.0080	0.0060
3/29/95	0.0045	0.0055	0.0060	0.0060	0.0055	0.0035	0.0075	0.0060
4/4/95	0.0040	0.0050	0.0060	0.0050	0.0050	0.0025	0.0070	0.0055
4/11/95	0.0040	0.0050	0.0060	0.0055	0.0050	0.0030	0.0075	0.0055

DATE	COL 5,1	COL 5,2	COL 5,3	COL 5,4	ROW 1,1	ROW 1,2	ROW 1,3	ROW 1,4
1/29/95	0.0085	0.0080	0.0060	0.0060	0.0080	0.0080	0.0070	0.0070
1/30/95	0.0080	0.0080	0.0060	0.0060	0.0070	0.0075	0.0060	0.0060
1/31/95	0.0075	0.0080	0.0060	0.0060	0.0070	0.0075	0.0060	0.0060
2/1/95	0.0075	0.0080	0.0060	0.0060	0.0075	0.0080	0.0065	0.0065
2/2/95	0.0075	0.0080	0.0055	0.0060	0.0070	0.0075	0.0060	0.0060
2/6/95	0.0070	0.0080	0.0055	0.0060	0.0065	0.0075	0.0060	0.0060
2/9/95	0.0065	0.0075	0.0050	0.0060	0.0060	0.0070	0.0055	0.0055
2/13/95	0.0065	0.0075	0.0050	0.0060	0.0060	0.0070	0.0055	0.0055
2/16/95	0.0070	0.0080	0.0055	0.0060	0.0065	0.0075	0.0060	0.0060
2/20/95	0.0075	0.0080	0.0060	0.0060	0.0070	0.0080	0.0060	0.0060
2/23/95	0.0070	0.0080	0.0055	0.0060	0.0065	0.0075	0.0060	0.0060
2/28/95	0.0070	0.0080	0.0050	0.0060	0.0065	0.0070	0.0060	0.0060
3/3/95	0.0065	0.0075	0.0050	0.0060	0.0060	0.0065	0.0055	0.0055
3/8/95	0.0065	0.0075	0.0055	0.0060	0.0065	0.0070	0.0060	0.0060
3/13/95	0.0070	0.0080	0.0060	0.0060	0.0070	0.0075	0.0060	0.0060
3/18/95	0.0075	0.0080	0.0060	0.0060	0.0075	0.0075	0.0065	0.0060
3/23/95	0.0075	0.0080	0.0060	0.0065	0.0075	0.0080	0.0065	0.0065
3/29/95	0.0070	0.0080	0.0055	0.0060	0.0070	0.0075	0.0060	0.0060
4/4/95	0.0065	0.0075	0.0050	0.0060	0.0065	0.0070	0.0060	0.0060
4/11/95	0.0065	0.0080	0.0055	0.0060	0.0070	0.0075	0.0060	0.0060

DATE	ROW 2,1	ROW 2,2	ROW 2,3	ROW 2,4	ROW 3,1	ROW 3,2	ROW 3,3	ROW 3,4
1/29/95	0.0070	0.0045	0.0060	0.0070	0.0070	0.0060	0.0065	0.0070
1/30/95	0.0060	0.0040	0.0055	0.0065	0.0060	0.0055	0.0060	0.0060
1/31/95	0.0060	0.0040	0.0060	0.0060	0.0060	0.0055	0.0060	0.0060
2/1/95	0.0065	0.0045	0.0060	0.0065	0.0060	0.0060	0.0060	0.0060
2/2/95	0.0060	0.0040	0.0055	0.0060	0.0060	0.0055	0.0060	0.0060
2/6/95	0.0060	0.0035	0.0055	0.0060	0.0055	0.0055	0.0060	0.0060
2/9/95	0.0055	0.0030	0.0050	0.0055	0.0055	0.0050	0.0055	0.0055
2/13/95	0.0055	0.0030	0.0050	0.0060	0.0050	0.0050	0.0055	0.0055
2/16/95	0.0060	0.0035	0.0055	0.0060	0.0060	0.0055	0.0060	0.0060
2/20/95	0.0060	0.0040	0.0060	0.0065	0.0060	0.0060	0.0060	0.0060
2/23/95	0.0060	0.0035	0.0055	0.0060	0.0055	0.0055	0.0060	0.0060
2/28/95	0.0060	0.0030	0.0050	0.0060	0.0055	0.0050	0.0055	0.0060
3/3/95	0.0055	0.0030	0.0050	0.0055	0.0050	0.0045	0.0050	0.0055
3/8/95	0.0060	0.0035	0.0050	0.0060	0.0055	0.0050	0.0055	0.0055
3/13/95	0.0060	0.0040	0.0055	0.0060	0.0055	0.0055	0.0060	0.0060
3/18/95	0.0060	0.0040	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060
3/23/95	0.0065	0.0045	0.0060	0.0065	0.0060	0.0060	0.0065	0.0065
3/29/95	0.0060	0.0040	0.0055	0.0060	0.0055	0.0060	0.0060	0.0060
4/4/95	0.0060	0.0035	0.0050	0.0060	0.0050	0.0050	0.0060	0.0060
4/11/95	0.0060	0.0040	0.0055	0.0060	0.0055	0.0055	0.0060	0.0060

DATE	ROW 4,1	ROW 4,2	ROW 4,3	ROW 4,4	ROW 5,1	ROW 5,2	ROW 5,3	ROW 5,4
1/29/95	0.0070	0.0075	0.0070	0.0060	0.0090	0.0055	0.0065	0.0065
1/30/95	0.0065	0.0065	0.0065	0.0050	0.0085	0.0045	0.0055	0.0060
1/31/95	0.0065	0.0065	0.0065	0.0050	0.0080	0.0045	0.0060	0.0060
2/1/95	0.0065	0.0065	0.0065	0.0055	0.0085	0.0045	0.0060	0.0060
2/2/95	0.0060	0.0065	0.0060	0.0050	0.0080	0.0045	0.0060	0.0060
2/6/95	0.0060	0.0060	0.0060	0.0050	0.0080	0.0045	0.0055	0.0055
2/9/95	0.0055	0.0060	0.0060	0.0045	0.0080	0.0040	0.0050	0.0050
2/13/95	0.0055	0.0060	0.0055	0.0045	0.0080	0.0040	0.0050	0.0050
2/16/95	0.0060	0.0065	0.0060	0.0050	0.0080	0.0045	0.0055	0.0060
2/20/95	0.0060	0.0065	0.0060	0.0055	0.0080	0.0045	0.0060	0.0060
2/23/95	0.0060	0.0065	0.0060	0.0050	0.0080	0.0045	0.0055	0.0055
2/28/95	0.0060	0.0060	0.0060	0.0045	0.0080	0.0045	0.0055	0.0055
3/3/95	0.0055	0.0060	0.0055	0.0045	0.0080	0.0040	0.0050	0.0050
3/8/95	0.0055	0.0060	0.0060	0.0045	0.0080	0.0040	0.0055	0.0055
3/13/95	0.0060	0.0065	0.0060	0.0050	0.0080	0.0045	0.0055	0.0060
3/18/95	0.0060	0.0070	0.0060	0.0055	0.0080	0.0045	0.0060	0.0060
3/23/95	0.0060	0.0075	0.0065	0.0055	0.0080	0.0050	0.0060	0.0060
3/29/95	0.0060	0.0065	0.0060	0.0050	0.0080	0.0045	0.0055	0.0060
4/4/95	0.0055	0.0060	0.0060	0.0045	0.0080	0.0045	0.0055	0.0055
4/11/95	0.0060	0.0065	0.0060	0.0050	0.0080	0.0045	0.0055	0.0060

9.10 Panel Shrinkage Data for Specimen PCLO

DATE	COL 1,1	COL 1,2	COL 1,3	COL 1,4	COL 2,1	COL 2,2	COL 2,3	COL 2,4
1/29/95	0.0090	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060
1/30/95	0.0095	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060
1/31/95	0.0095	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060
2/1/95	0.0095	0.0065	0.0060	0.0060	0.0065	0.0060	0.0065	0.0060
2/2/95	0.0095	0.0065	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060
2/6/95	0.0090	0.0060	0.0060	0.0055	0.0060	0.0055	0.0060	0.0060
2/9/95	0.0085	0.0055	0.0055	0.0050	0.0055	0.0050	0.0055	0.0055
2/13/95	0.0085	0.0055	0.0055	0.0050	0.0060	0.0050	0.0060	0.0055
2/16/95	0.0090	0.0060	0.0060	0.0055	0.0060	0.0055	0.0060	0.0060
2/20/95	0.0090	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060
2/23/95	0.0090	0.0060	0.0060	0.0055	0.0060	0.0055	0.0060	0.0060
2/28/95	0.0085	0.0060	0.0055	0.0050	0.0055	0.0050	0.0060	0.0055
3/3/95	0.0080	0.0055	0.0055	0.0050	0.0055	0.0050	0.0055	0.0050
3/8/95	0.0085	0.0060	0.0055	0.0050	0.0055	0.0050	0.0055	0.0055
3/13/95	0.0090	0.0060	0.0060	0.0055	0.0060	0.0055	0.0060	0.0060
3/18/95	0.0090	0.0060	0.0060	0.0055	0.0060	0.0055	0.0060	0.0060
3/23/95	0.0090	0.0065	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060
3/29/95	0.0085	0.0060	0.0060	0.0055	0.0060	0.0055	0.0060	0.0060
4/4/95	0.0080	0.0055	0.0050	0.0050	0.0055	0.0050	0.0055	0.0050
4/11/95	0.0085	0.0060	0.0055	0.0050	0.0055	0.0050	0.0060	0.0055

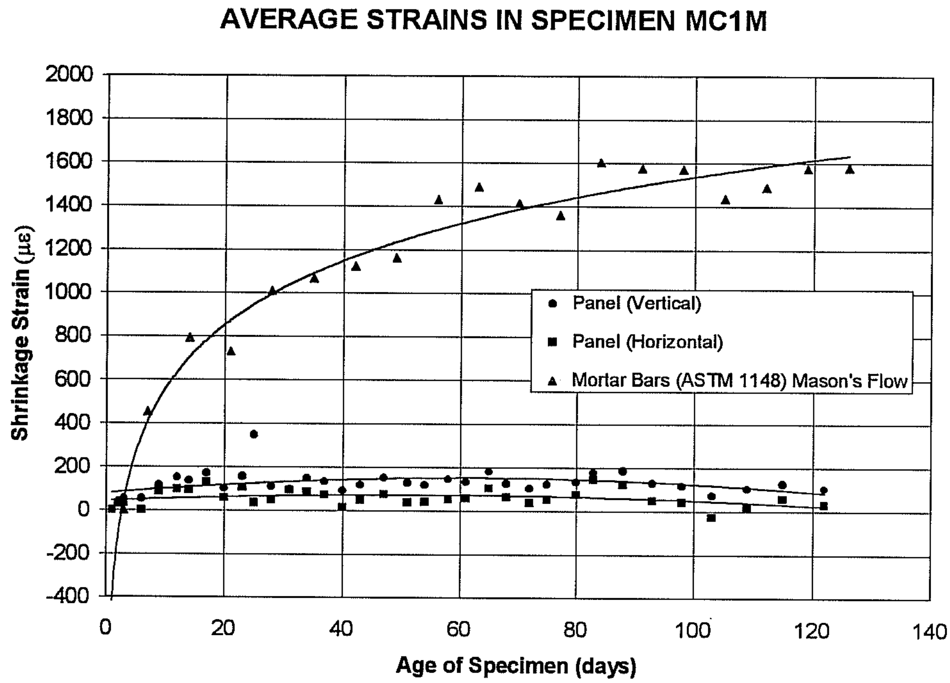
DATE	COL 3,1	COL 3,2	COL 3,3	COL 3,4	COL 4,1	COL 4,2	COL 4,3	COL 4,4
1/29/95	0.0035	0.0060	0.0065	0.0065	0.0060	0.0060	0.0070	0.0060
1/30/95	0.0035	0.0060	0.0070	0.0065	0.0060	0.0065	0.0075	0.0060
1/31/95	0.0030	0.0060	0.0065	0.0065	0.0060	0.0065	0.0075	0.0065
2/1/95	0.0035	0.0060	0.0070	0.0070	0.0060	0.0070	0.0080	0.0075
2/2/95	0.0030	0.0060	0.0065	0.0070	0.0060	0.0065	0.0075	0.0070
2/6/95	0.0025	0.0055	0.0060	0.0065	0.0055	0.0060	0.0070	0.0065
2/9/95	0.0025	0.0050	0.0060	0.0060	0.0050	0.0060	0.0065	0.0060
2/13/95	0.0025	0.0050	0.0060	0.0060	0.0055	0.0060	0.0070	0.0060
2/16/95	0.0025	0.0055	0.0060	0.0065	0.0060	0.0060	0.0075	0.0070
2/20/95	0.0030	0.0055	0.0065	0.0065	0.0060	0.0065	0.0075	0.0070
2/23/95	0.0025	0.0055	0.0060	0.0065	0.0055	0.0060	0.0075	0.0065
2/28/95	0.0025	0.0050	0.0060	0.0060	0.0055	0.0060	0.0070	0.0065
3/3/95	0.0020	0.0045	0.0060	0.0060	0.0050	0.0060	0.0065	0.0060
3/8/95	0.0025	0.0050	0.0060	0.0060	0.0050	0.0060	0.0070	0.0065
3/13/95	0.0025	0.0055	0.0060	0.0065	0.0055	0.0060	0.0075	0.0065
3/18/95	0.0025	0.0055	0.0065	0.0065	0.0055	0.0065	0.0075	0.0070
3/23/95	0.0030	0.0060	0.0065	0.0070	0.0060	0.0065	0.0080	0.0070
3/29/95	0.0025	0.0055	0.0060	0.0065	0.0055	0.0065	0.0075	0.0070
4/4/95	0.0020	0.0045	0.0060	0.0060	0.0050	0.0060	0.0065	0.0060
4/11/95	0.0025	0.0055	0.0060	0.0065	0.0055	0.0060	0.0070	0.0065

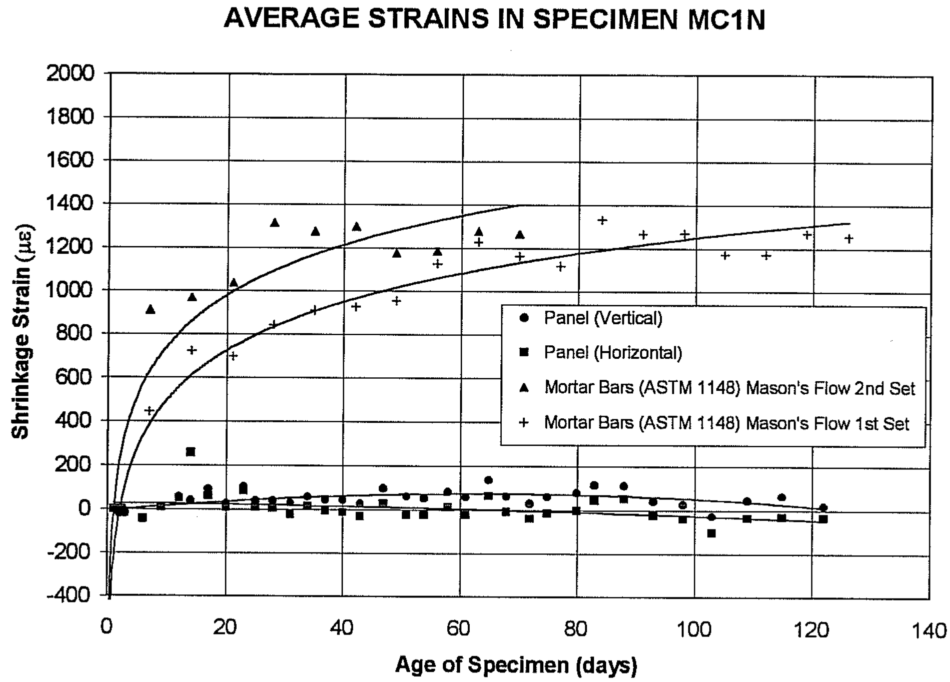
DATE	COL 5,1	COL 5,2	COL 5,3	COL 5,4	ROW 1,1	ROW 1,2	ROW 1,3	ROW 1,4
1/29/95	0.0070	0.0080	0.0080	0.0080	0.0060	0.0065	0.0060	0.0060
1/30/95	0.0070	0.0080	0.0075	0.0060	0.0055	0.0065	0.0060	0.0060
1/31/95	0.0065	0.0080	0.0070	0.0060	0.0060	0.0065	0.0060	0.0060
2/1/95	0.0070	0.0080	0.0080	0.0080	0.0065	0.0070	0.0065	0.0060
2/2/95	0.0065	0.0080	0.0075	0.0075	0.0060	0.0065	0.0060	0.0060
2/6/95	0.0060	0.0080	0.0070	0.0075	0.0060	0.0060	0.0060	0.0055
2/9/95	0.0060	0.0070	0.0065	0.0070	0.0055	0.0060	0.0055	0.0050
2/13/95	0.0060	0.0075	0.0070	0.0070	0.0055	0.0060	0.0060	0.0050
2/16/95	0.0060	0.0080	0.0075	0.0075	0.0060	0.0060	0.0060	0.0055
2/20/95	0.0065	0.0080	0.0075	0.0075	0.0060	0.0065	0.0065	0.0060
2/23/95	0.0065	0.0080	0.0070	0.0075	0.0060	0.0060	0.0060	0.0055
2/28/95	0.0060	0.0075	0.0070	0.0070	0.0060	0.0060	0.0060	0.0050
3/3/95	0.0060	0.0075	0.0065	0.0065	0.0055	0.0060	0.0060	0.0045
3/8/95	0.0060	0.0075	0.0070	0.0070	0.0060	0.0060	0.0060	0.0050
3/13/95	0.0060	0.0080	0.0070	0.0075	0.0060	0.0065	0.0060	0.0055
3/18/95	0.0065	0.0080	0.0075	0.0075	0.0060	0.0065	0.0065	0.0055
3/23/95	0.0065	0.0080	0.0080	0.0080	0.0065	0.0070	0.0070	0.0060
3/29/95	0.0060	0.0080	0.0075	0.0075	0.0065	0.0065	0.0065	0.0055
4/4/95	0.0060	0.0075	0.0065	0.0070	0.0060	0.0060	0.0060	0.0050
4/11/95	0.0060	0.0080	0.0070	0.0075	0.0060	0.0065	0.0065	0.0055

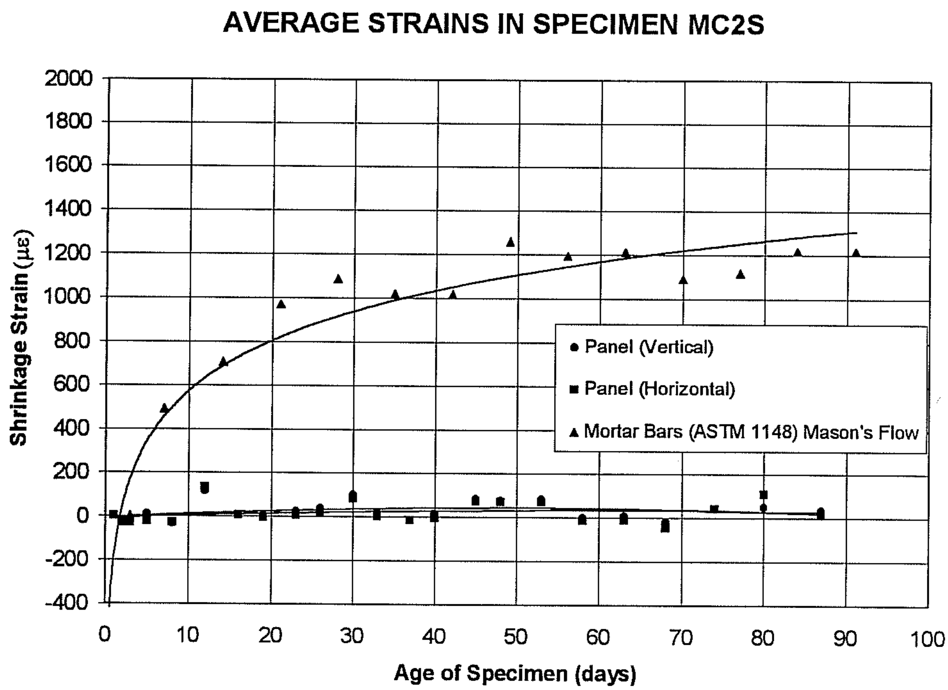
DATE	ROW 2,1	ROW 2,2	ROW 2,3	ROW 2,4	ROW 3,1	ROW 3,2	ROW 3,3	ROW 3,4
1/29/95	0.0065	0.0060	0.0070	0.0065	0.0060	0.0060	0.0055	0.0060
1/30/95	0.0060	0.0060	0.0070	0.0065	0.0060	0.0055	0.0050	0.0060
1/31/95	0.0060	0.0060	0.0070	0.0065	0.0060	0.0060	0.0050	0.0060
2/1/95	0.0065	0.0060	0.0075	0.0070	0.0060	0.0060	0.0055	0.0065
2/2/95	0.0060	0.0060	0.0075	0.0065	0.0060	0.0060	0.0050	0.0060
2/6/95	0.0060	0.0055	0.0070	0.0060	0.0055	0.0055	0.0045	0.0060
2/9/95	0.0055	0.0050	0.0065	0.0060	0.0050	0.0050	0.0045	0.0055
2/13/95	0.0055	0.0050	0.0065	0.0060	0.0050	0.0050	0.0045	0.0060
2/16/95	0.0060	0.0055	0.0070	0.0065	0.0055	0.0055	0.0050	0.0060
2/20/95	0.0060	0.0060	0.0070	0.0065	0.0060	0.0060	0.0050	0.0060
2/23/95	0.0060	0.0060	0.0070	0.0065	0.0055	0.0055	0.0050	0.0060
2/28/95	0.0055	0.0055	0.0065	0.0060	0.0055	0.0055	0.0045	0.0060
3/3/95	0.0055	0.0050	0.0060	0.0060	0.0050	0.0050	0.0045	0.0055
3/8/95	0.0055	0.0055	0.0065	0.0060	0.0055	0.0055	0.0045	0.0060
3/13/95	0.0060	0.0060	0.0070	0.0065	0.0055	0.0060	0.0050	0.0060
3/18/95	0.0060	0.0060	0.0070	0.0065	0.0060	0.0060	0.0050	0.0060
3/23/95	0.0060	0.0060	0.0075	0.0070	0.0060	0.0060	0.0055	0.0065
3/29/95	0.0060	0.0060	0.0070	0.0065	0.0060	0.0060	0.0055	0.0065
4/4/95	0.0055	0.0055	0.0065	0.0060	0.0055	0.0055	0.0045	0.0060
4/11/95	0.0060	0.0060	0.0070	0.0065	0.0060	0.0060	0.0050	0.0060

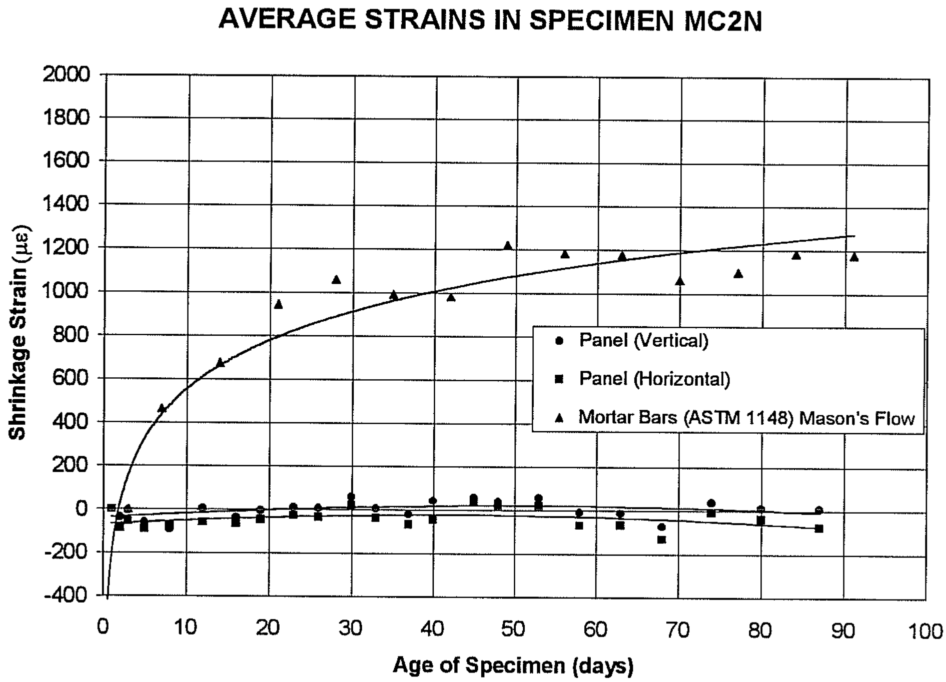
DATE	ROW 4,1	ROW 4,2	ROW 4,3	ROW 4,4	ROW 5,1	ROW 5,2	ROW 5,3	ROW 5,4
1/29/95	0.0060	0.0065	0.0055	0.0060	0.0080	0.0060	0.0060	0.0040
1/30/95	0.0060	0.0060	0.0055	0.0060	0.0080	0.0045	0.0060	0.0035
1/31/95	0.0060	0.0060	0.0055	0.0065	0.0075	0.0050	0.0060	0.0035
2/1/95	0.0060	0.0065	0.0060	0.0070	0.0080	0.0060	0.0065	0.0040
2/2/95	0.0060	0.0065	0.0060	0.0065	0.0080	0.0055	0.0060	0.0035
2/6/95	0.0055	0.0060	0.0050	0.0060	0.0075	0.0050	0.0060	0.0030
2/9/95	0.0050	0.0060	0.0050	0.0060	0.0070	0.0045	0.0055	0.0025
2/13/95	0.0050	0.0060	0.0050	0.0060	0.0075	0.0045	0.0055	0.0030
2/16/95	0.0055	0.0060	0.0055	0.0065	0.0080	0.0050	0.0060	0.0035
2/20/95	0.0060	0.0060	0.0060	0.0065	0.0080	0.0055	0.0060	0.0035
2/23/95	0.0055	0.0060	0.0055	0.0065	0.0075	0.0050	0.0060	0.0030
2/28/95	0.0050	0.0060	0.0050	0.0060	0.0075	0.0050	0.0060	0.0030
3/3/95	0.0050	0.0060	0.0050	0.0060	0.0070	0.0045	0.0055	0.0025
3/8/95	0.0050	0.0060	0.0050	0.0060	0.0075	0.0050	0.0055	0.0030
3/13/95	0.0055	0.0060	0.0055	0.0065	0.0075	0.0055	0.0060	0.0030
3/18/95	0.0060	0.0060	0.0060	0.0065	0.0080	0.0055	0.0060	0.0035
3/23/95	0.0060	0.0065	0.0060	0.0070	0.0080	0.0060	0.0065	0.0040
3/29/95	0.0060	0.0060	0.0060	0.0065	0.0080	0.0055	0.0060	0.0035
4/4/95	0.0050	0.0060	0.0055	0.0060	0.0075	0.0050	0.0060	0.0030
4/11/95	0.0055	0.0060	0.0060	0.0065	0.0075	0.0055	0.0060	0.0035

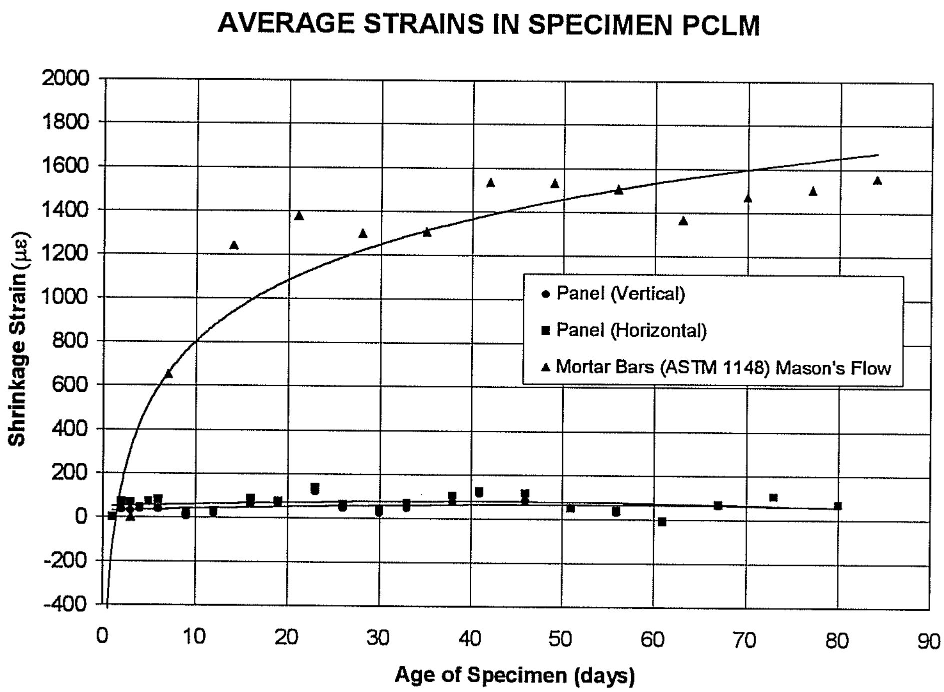
9.11 Shrinkage vs. Time Graphs for all Panels and Bars

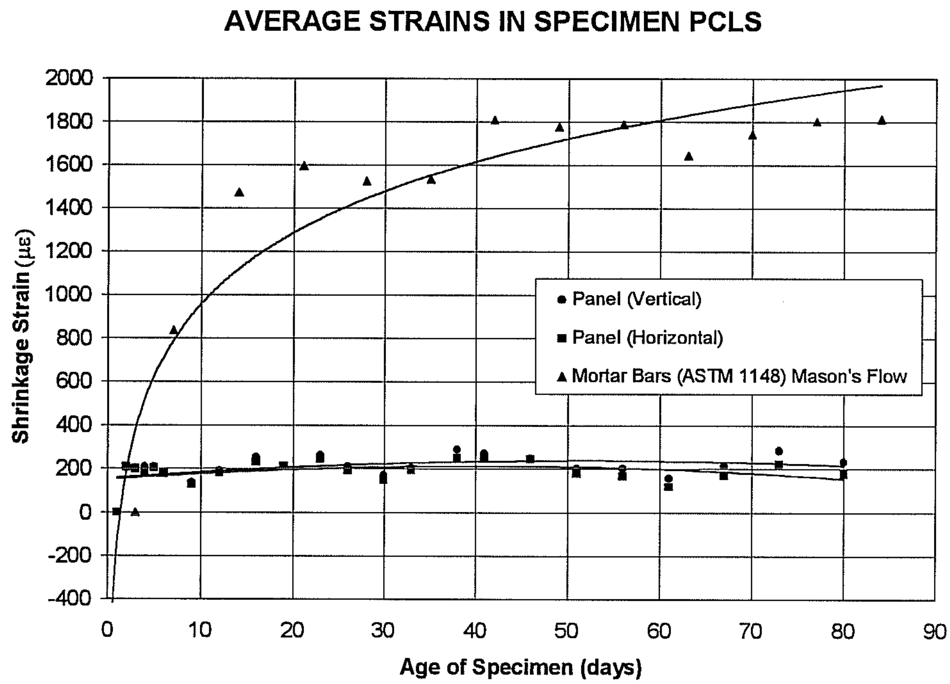


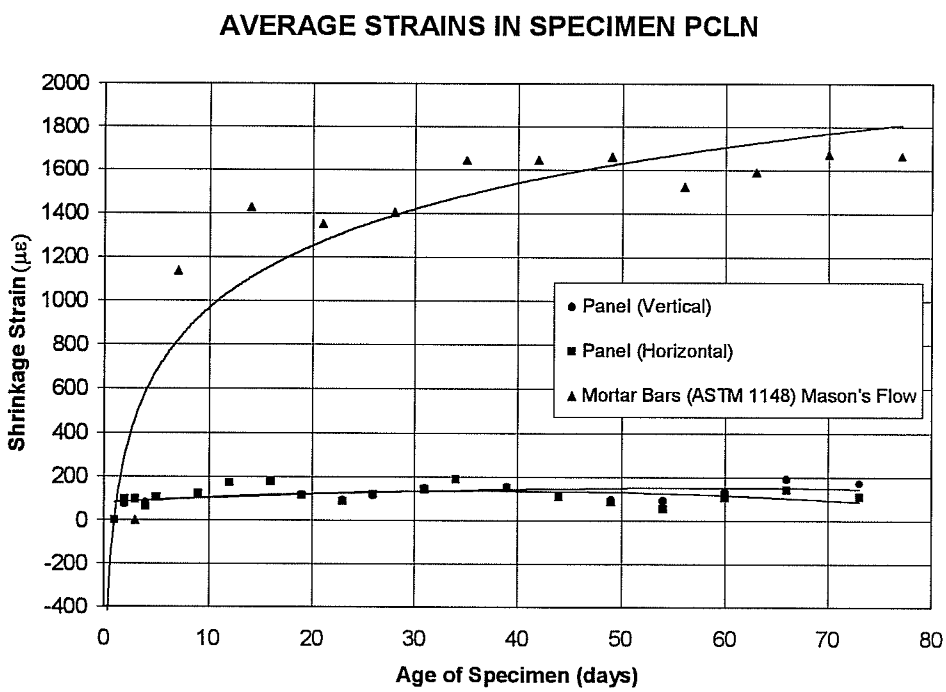

AVERAGE STRAINS IN SPECIMEN MC1N
Shrinkage Strain (με)
Age of Specimen (days)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
-400
0
20
40
60
80
100
120
140
Panel (Vertical)
Panel (Horizontal)
Mortar Bars (ASTM 1148) Mason's Flow 2nd Set
Mortar Bars (ASTM 1148) Mason's Flow 1st Set


AVERAGE STRAINS IN SPECIMEN MC2S
Shrinkage Strain (με)
Age of Specimen (days)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
-400
0
10
20
30
40
50
60
70
80
90
100
Panel (Vertical)
Panel (Horizontal)
Mortar Bars (ASTM 1148) Mason's Flow

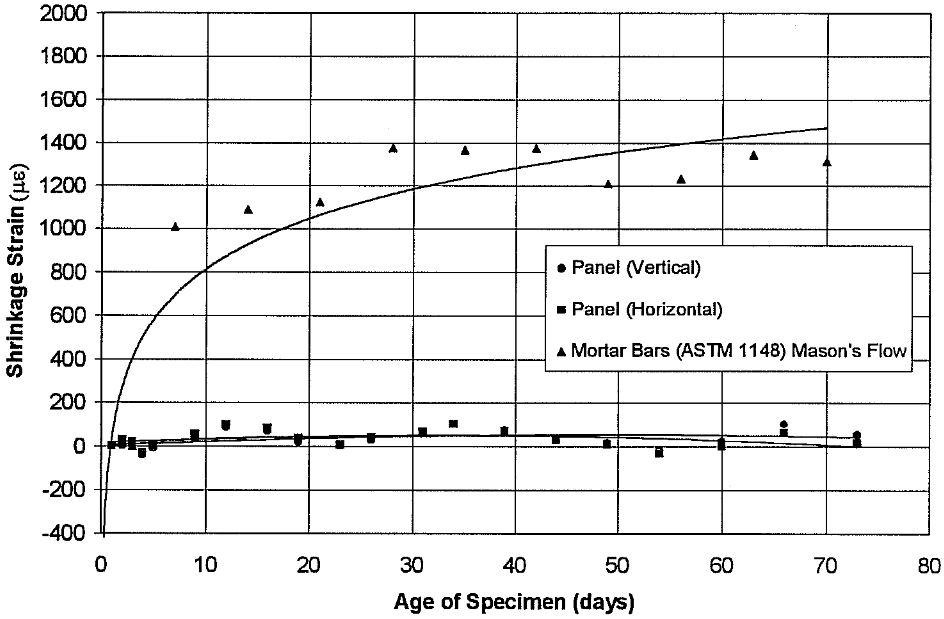

AVERAGE STRAINS IN SPECIMEN MC2N
Shrinkage Strain (με)
Age of Specimen (days)
Panel (Vertical)
Panel (Horizontal)
Mortar Bars (ASTM 1148) Mason's Flow
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
-400
0
10
20
30
40
50
60
70
80
90
100


AVERAGE STRAINS IN SPECIMEN PCLM
Shrinkage Strain (με)
Age of Specimen (days)
Panel (Vertical)
Panel (Horizontal)
Mortar Bars (ASTM 1148) Mason's Flow
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
-400
0
10
20
30
40
50
60
70
80
90


AVERAGE STRAINS IN SPECIMEN PCLS
Shrinkage Strain (με)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
-400
0
10
20
30
40
50
60
70
80
90
Age of Specimen (days)
Panel (Vertical)
Panel (Horizontal)
Mortar Bars (ASTM 1148) Mason's Flow


AVERAGE STRAINS IN SPECIMEN PCLN
Shrinkage Strain (με)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
-400
0
10
20
30
40
50
60
70
80
Age of Specimen (days)
Panel (Vertical)
Panel (Horizontal)
Mortar Bars (ASTM 1148) Mason's Flow

AVERAGE STRAINS IN SPECIMEN PCLO



10. Appendix D - Panel Cracking Data

In Appendix D, there is a chart and corresponding computer-generated drawing of the cracking for each wall only for dates when changes in cracking were noted. A list of dates when the walls were observed for cracking but no changes were noted appears at the beginning of the section for each panel.

10.1 Sample Calculation of Cracking Indices' Standard Deviations

As explained in Section 5.3.1, the following equation was used to calculate the standard deviation of one w2l term in the summation of the cracking index:

$$\sigma^2_{w^2\ell} = \left(\frac{\partial f}{\partial w}\right)^2 \sigma^2_w + \left(\frac{\partial f}{\partial \ell}\right)^2 \sigma^2_\ell$$

where:

$$f(w,\ell) = w^2\ell$$

σ_w = measurement error in the crack width

σ_1 = measurement error in the crack length

Simplifying this expression:

$$\sigma^2_{w^2\ell} = (2w\ell)^2 \sigma^2_w + (w^2)^2 \sigma^2_\ell$$

$$\sigma^2_{w^2\ell} = 4w^2\ell^2\sigma^2_w + w^4\sigma^2_\ell$$

Now, evaluating this expression for one crack, say the first crack in specimen MC1M for 1/26/95 shown below, yields:

$$\sigma^2_{w^2\ell} = 4(5)^2(1)^2(1)^2 + (5)^4(0.25)^2$$

$$\sigma^2_{w^2\ell} = 139.1$$

The variances (σ^2) for the 4 other cracks are 1025, 139.1, 934.1, and 11600, respectively. Now, the variance of the cracking index (the sum of the individual w2l terms), is the sum of the variances calculated above, which is 13837.3. The standard deviation of the cracking index is then the square root of the variance, or 117.6. So for specimen MC1M on 1/26/95, the cracking index was 648 with a standard deviation of 117.6.

10.2 Cracking in Specimen MC1M

Dates on which no changes were observed:

1/10, 1/13, 1/17, 1/23, 2/15, 2/21, 3/14

10.2.1 Quantitative Data for MC1M

1/20/95					1/26/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l		#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)				(1/1000 in)	(joint widths)	
1	5	1	25		1	5	1	25
SUM			25		1	10	1	100
					1	5	1	25
					1	7	2	98
					1	20	1	400
					SUM			648

1/31/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	5	1	25
1	10	1	100
1	5	1	25
1	7	2	98
1	20	1	400
1	7	2	98
5	5	1	125
SUM			871

2/5/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	5	1	25
1	10	1	100
1	5	1	25
1	7	2	98
1	20	1	400
1	7	2	98
5	5	1	125
1	9	1	81
SUM			952

2/10/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	5	1	25
1	10	1	100
1	5	1	25
1	7	2	98
1	20	1	400
1	10	2	200
5	5	1	125
1	9	1	81
SUM			1054

2/27/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	5	1	25
1	10	1	100
1	5	1	25
1	7	2	98
1	20	1	400
1	10	2	200
5	5	1	125
1	9	1	81
1	13	1	169
SUM			1223

3/7/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	5	1	25
1	10	1	100
1	5	1	25
1	7	2	98
1	20	1	400
1	10	2	200
5	5	1	125
1	9	1	81
1	13	1	169
2	10	1	200
1	3	1	9
SUM			1432

3/20/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	5	1	25
1	10	1	100
1	5	1	25
1	7	2	98
1	20	1	400
1	10	2	200
5	5	1	125
1	9	1	81
1	13	1	169
2	10	1	200
1	3	1	9
1	2	2	8
SUM			1440

3/27/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	5	1	25
1	10	1	100
1	5	1	25
1	7	2	98
1	20	1	400
1	10	2	200
5	5	1	125
1	9	1	81
1	13	1	169
2	10	1	200
1	3	1	9
1	2	2	8
1	5	1	25
SUM			1465

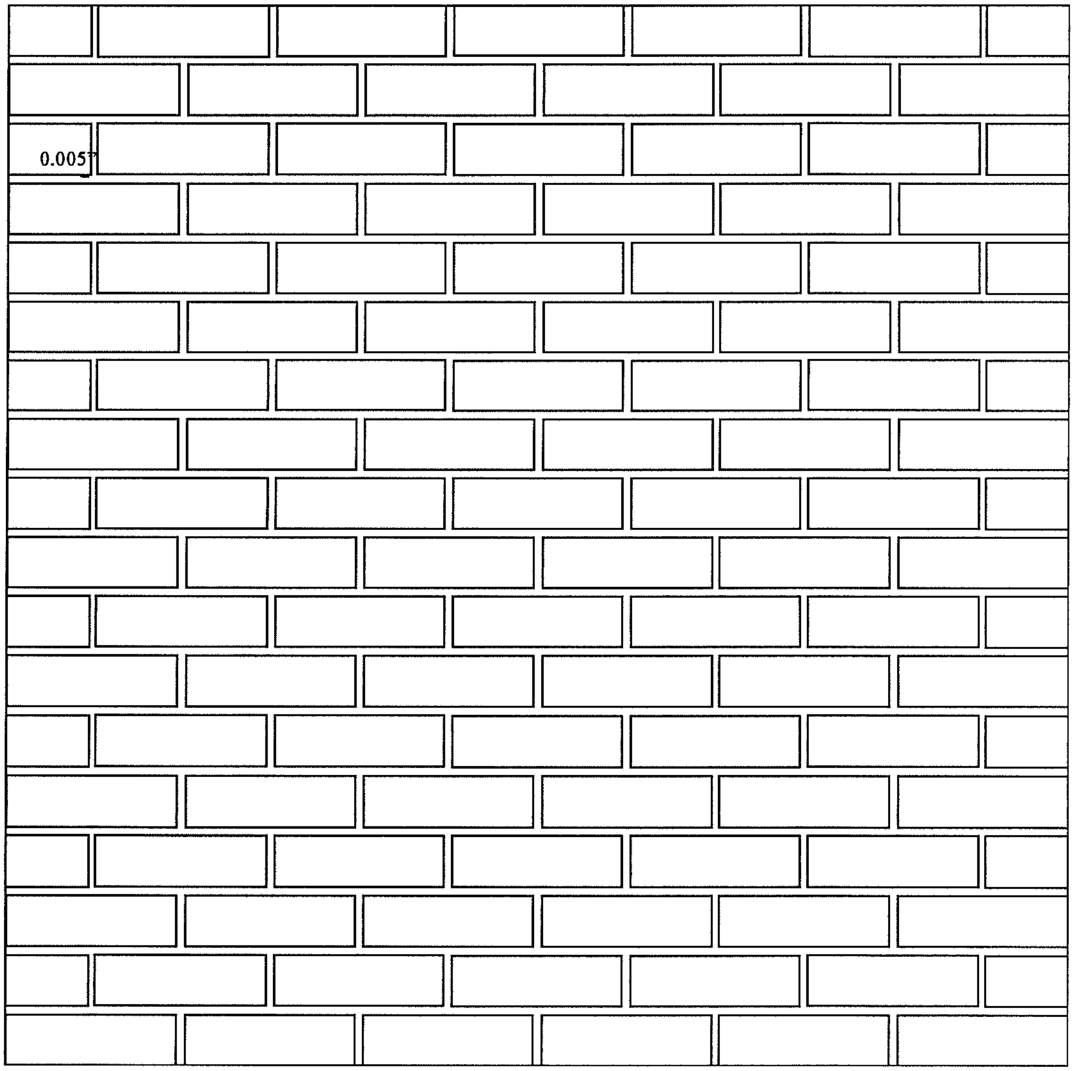
4/3/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	5	1	25
1	10	1	100
1	5	1	25
1	7	2	98
1	20	1	400
1	10	2	200
5	5	1	125
1	9	1	81
1	13	1	169
2	10	1	200
1	3	1	9
1	2	2	8
1	5	1	25
1	7	1	49
1	3	6	54
SUM			1568

4/12/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	5	1	25
1	10	1	100
1	5	1	25
1	7	2	98
1	20	1	400
1	10	2	200
5	5	1	125
1	9	1	81
1	13	1	169
2	10	1	200
1	3	1	9
1	2	2	8
1	5	1	25
1	7	1	49
1	3	6	54
1	2	2	8
1	5	1	25
SUM			1601

10.2.2 Panel Drawings for MC1M

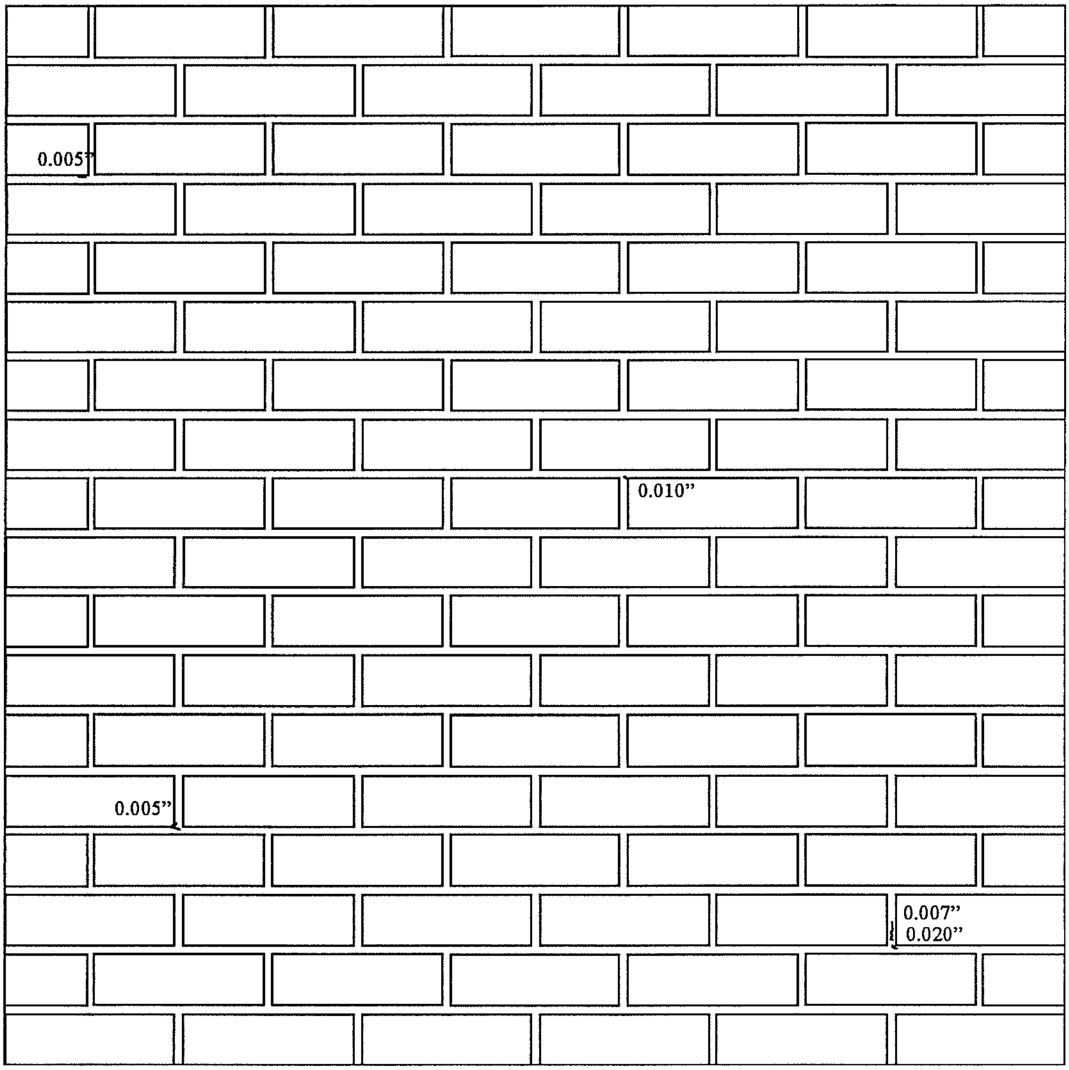
WALL: MC1M DATE: 1/20/95

SIDE: south



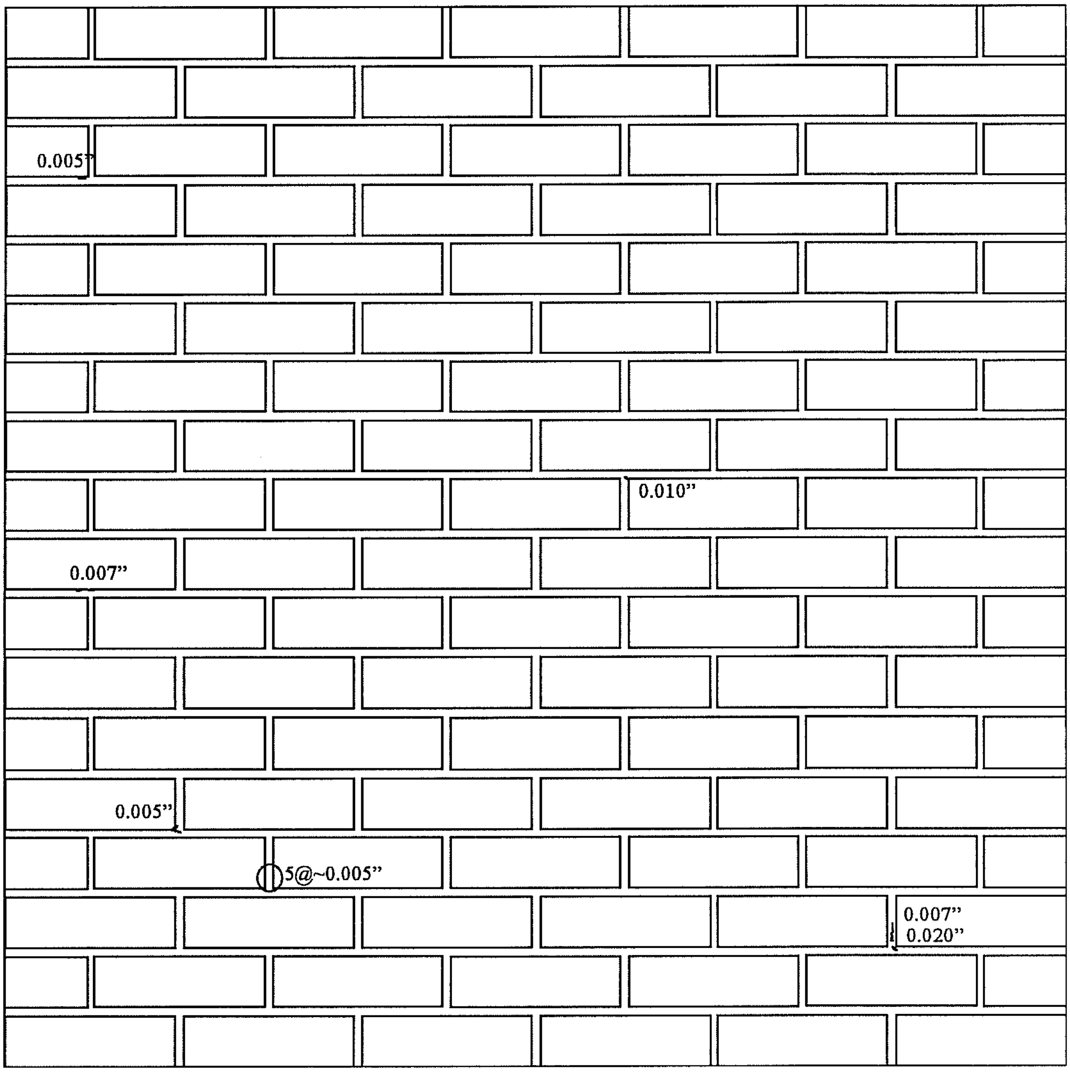
WALL: MC1M DATE: 1/26/95

SIDE: south



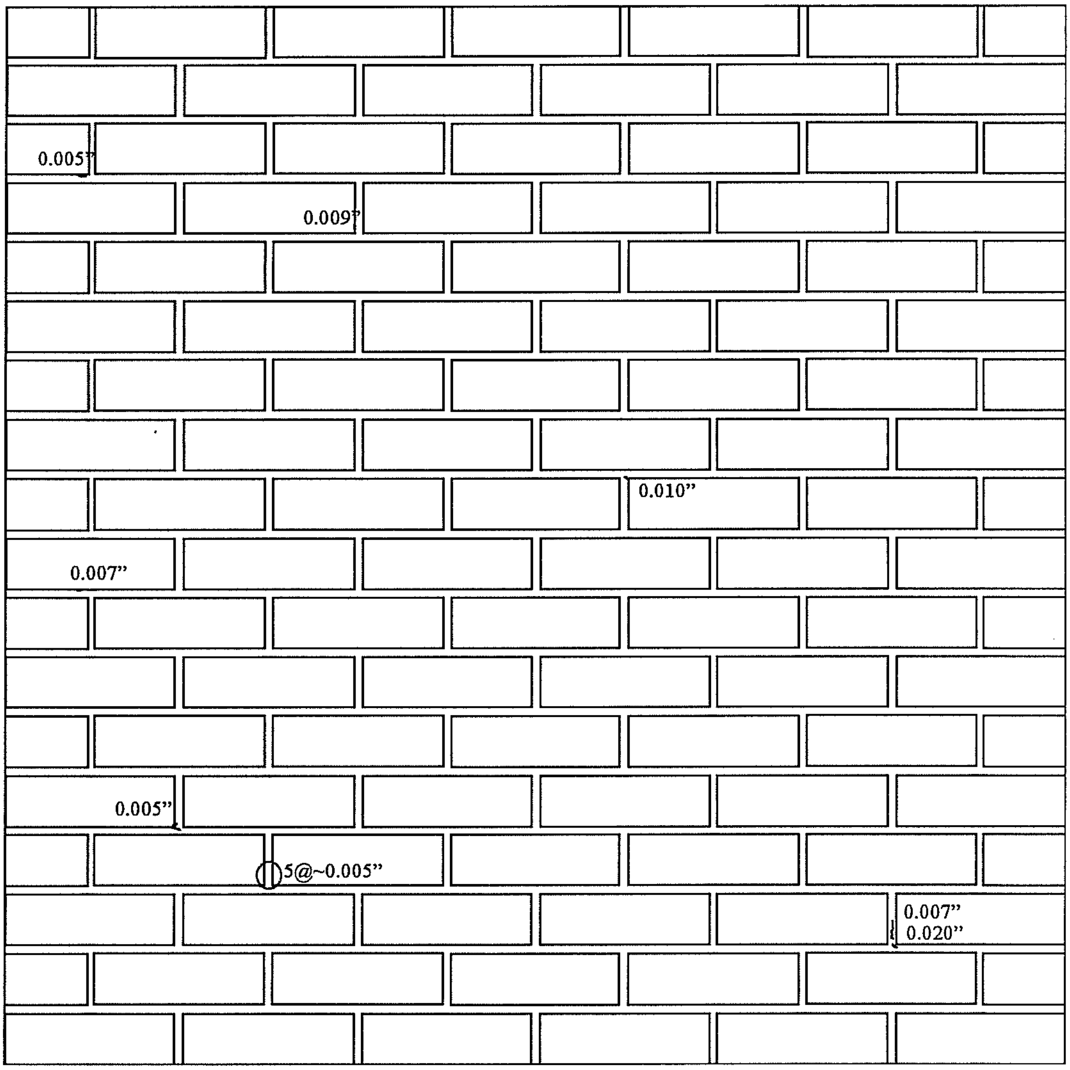
WALL: MC1M DATE: 1/31/95

SIDE: south



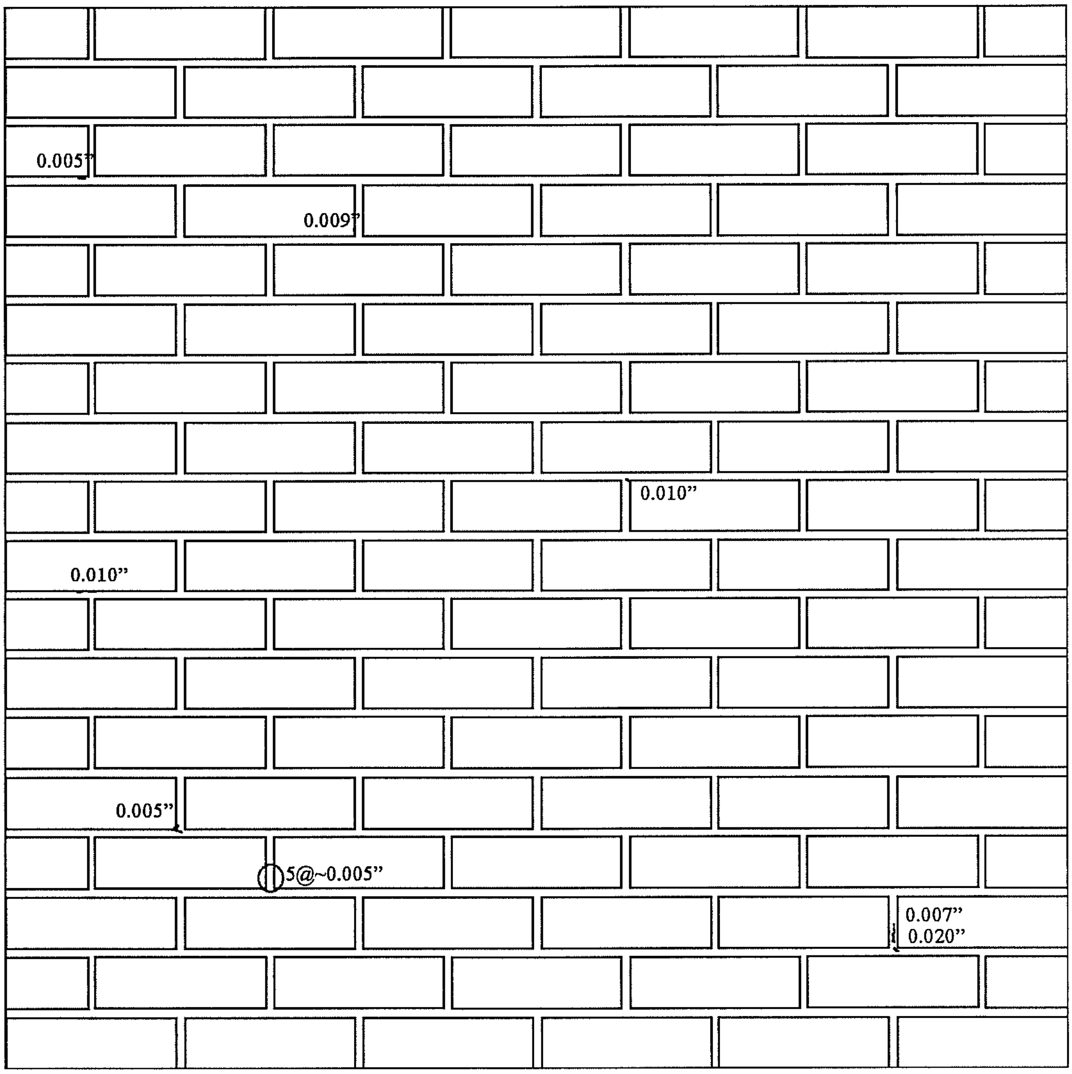
WALL: MC1M DATE: 2/5/95

SIDE: south



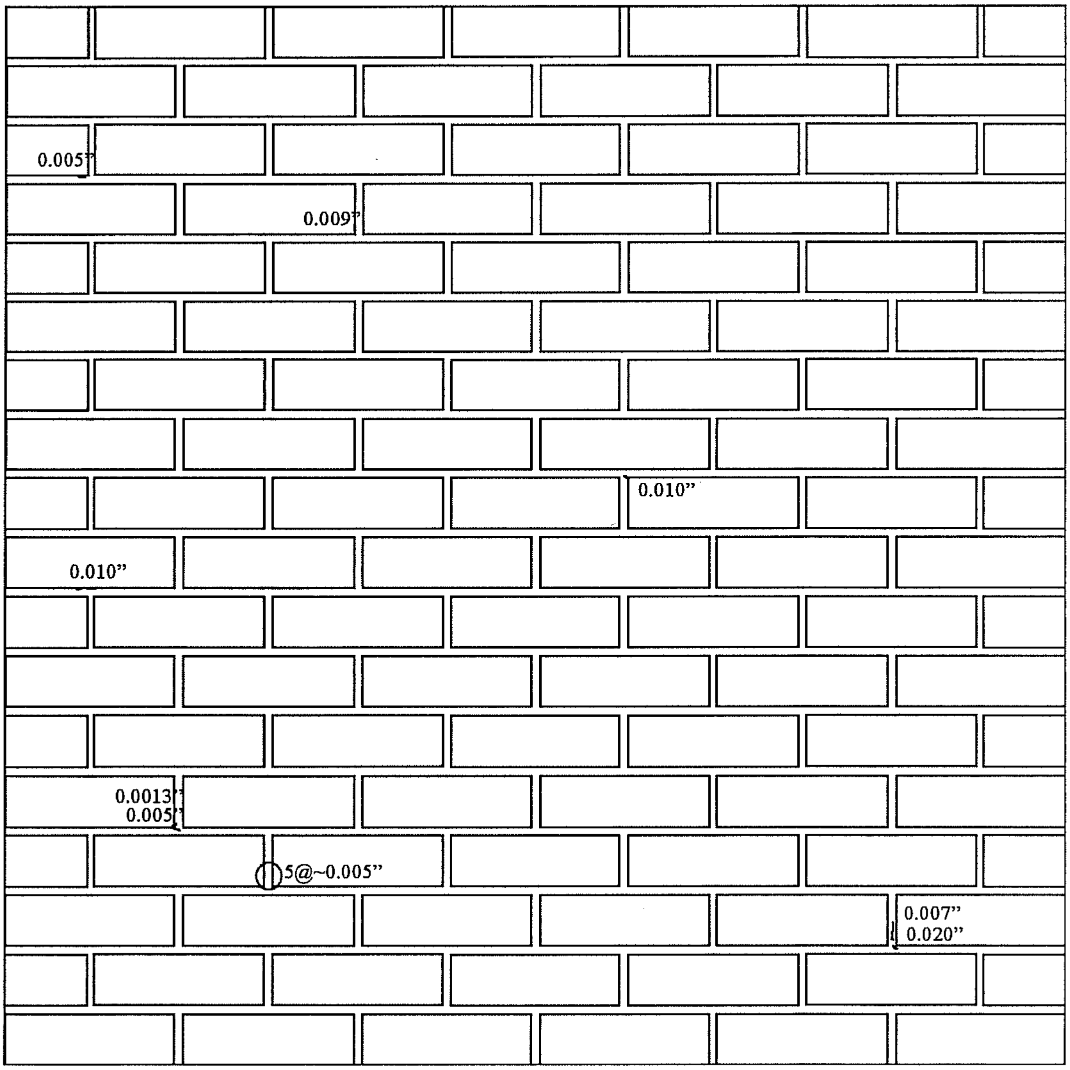
WALL: MC1M DATE: 2/10/95

SIDE: south



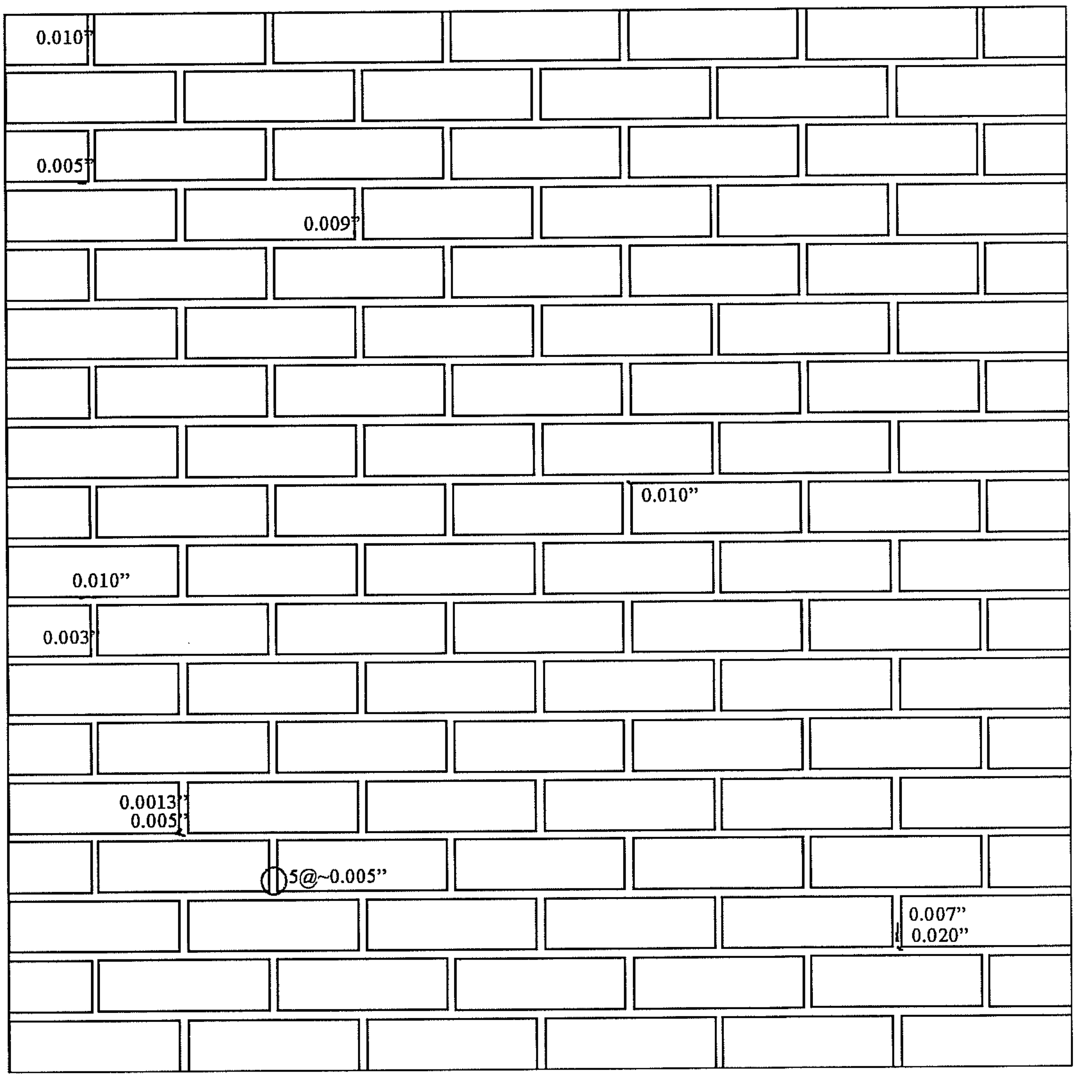
WALL: MC1M DATE: 2/27/95

SIDE: south



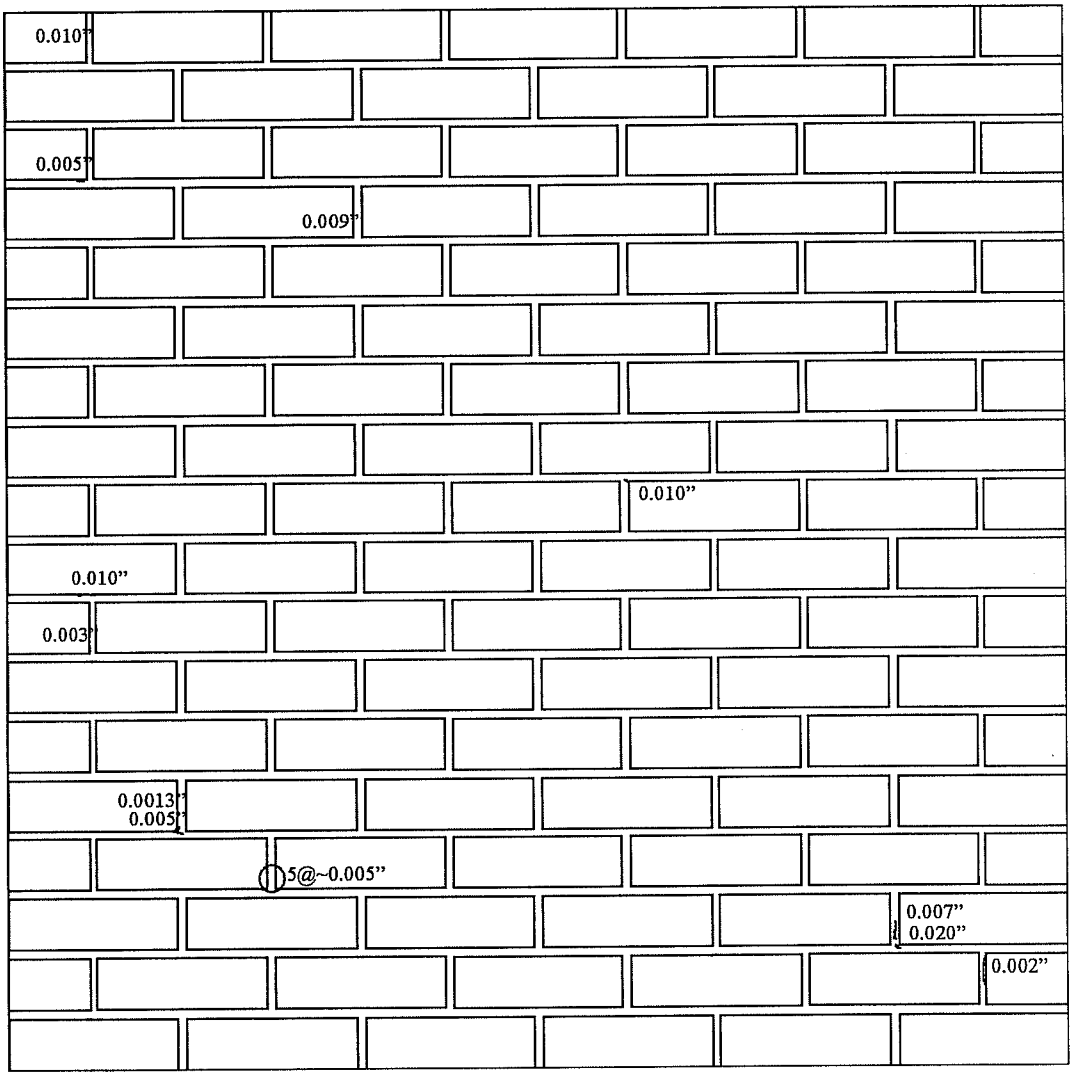
WALL: MC1M DATE: 3/7/95

SIDE: south



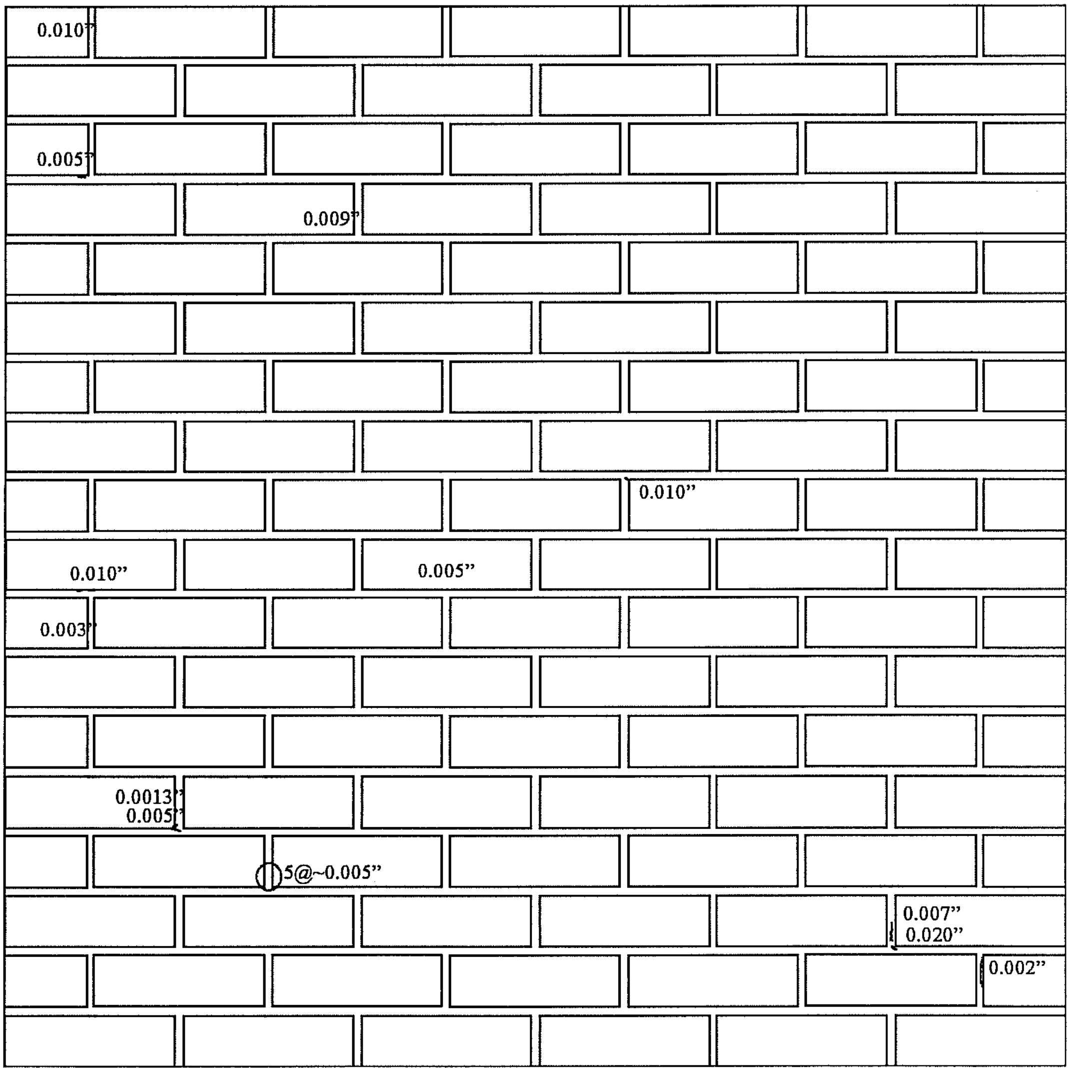
WALL: MC1M DATE: 3/20/95

SIDE: south



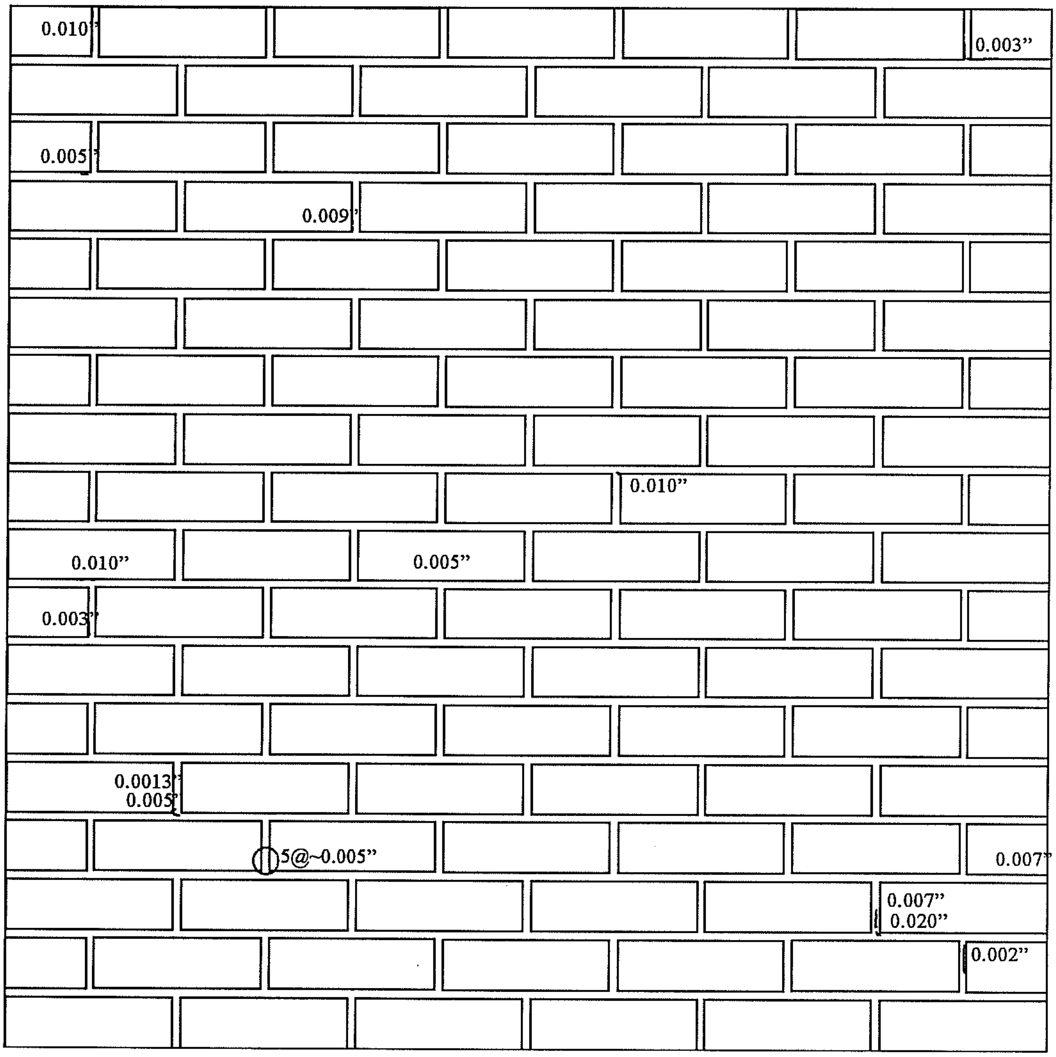
WALL: MC1M DATE: 3/27/95

SIDE: south



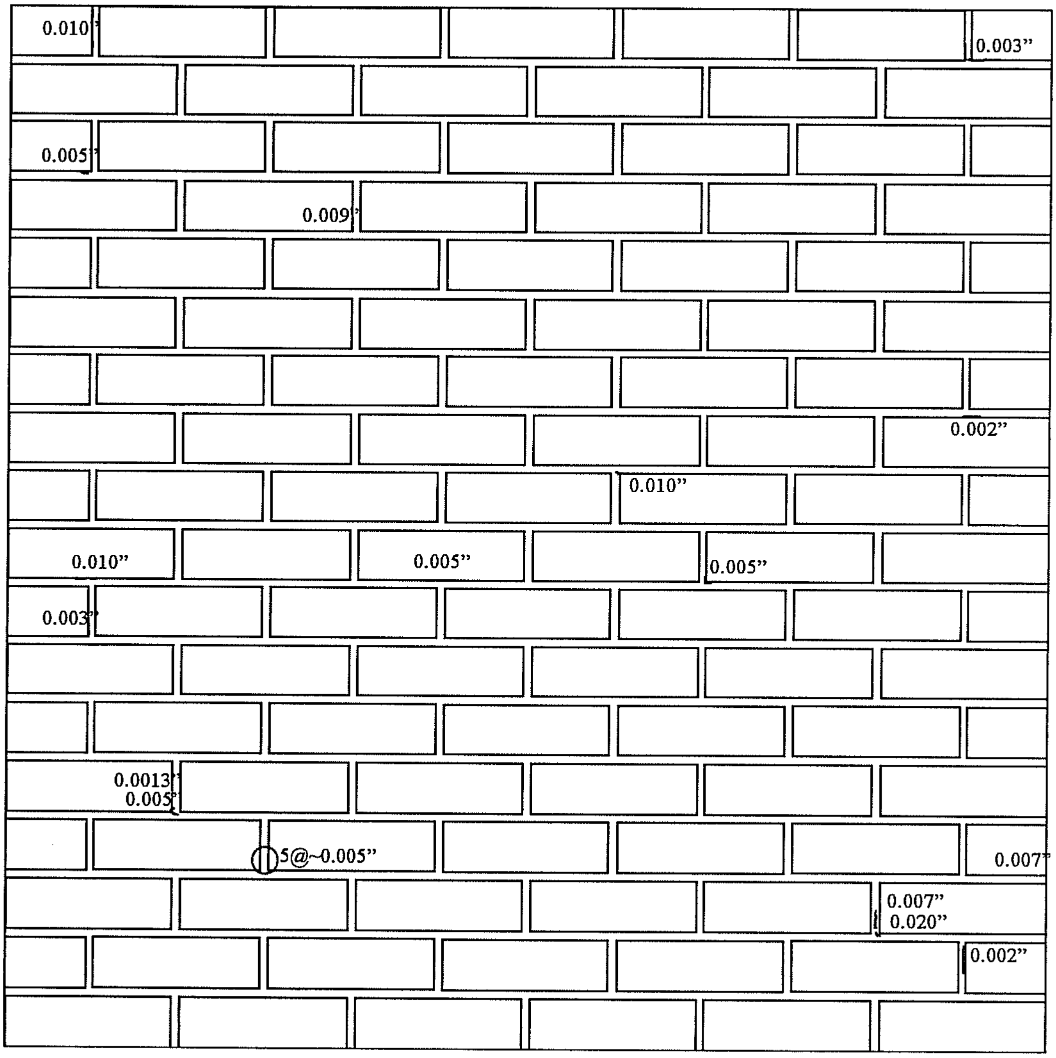
WALL: MC1M DATE: 4/3/95

SIDE: south

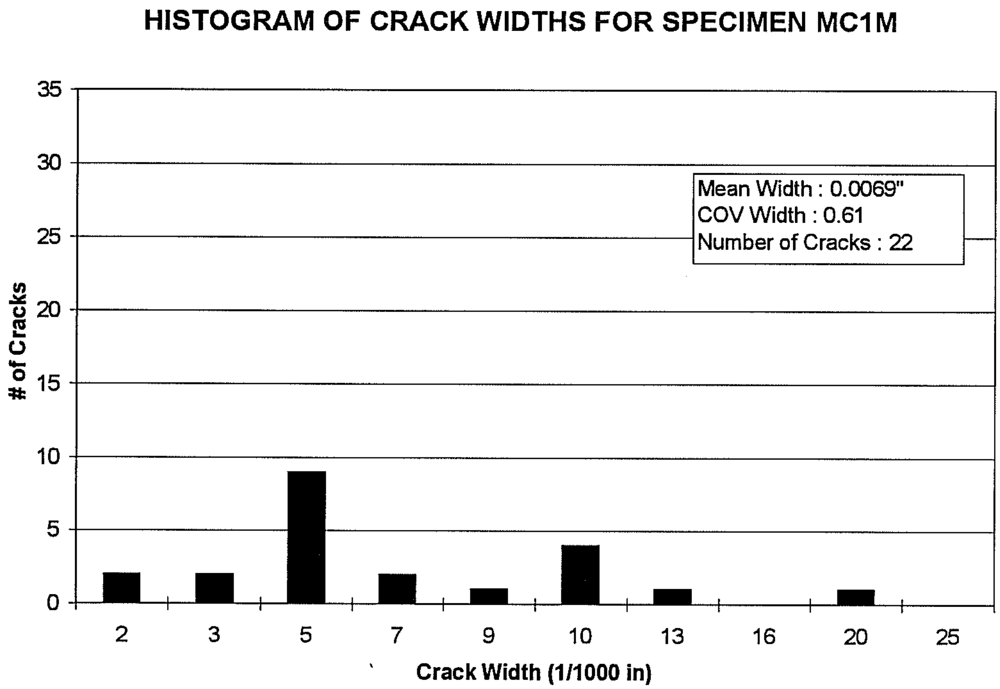


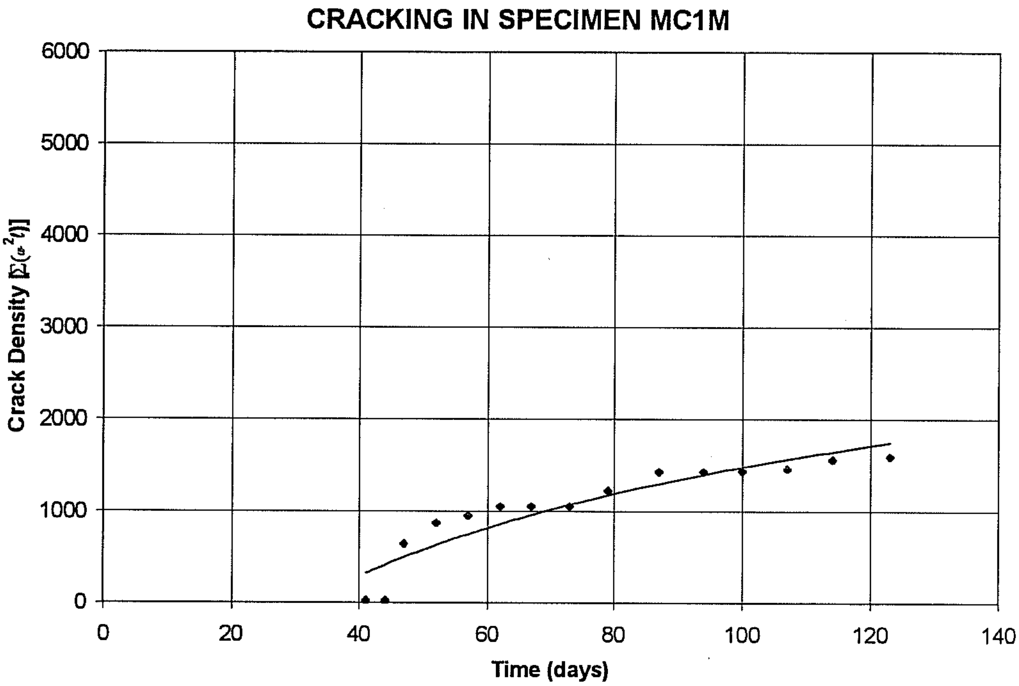
WALL: MC1M DATE: 4/12/95

SIDE: south



10.2.3 Histogram of Crack Widths and Cracking vs. Time for MC1M





10.3 Cracking in Specimen MC1N

Dates on which no changes were observed:

1/10, 2/15, 3/14

10.3.1 Quantitative Data for MC1N

12/13/94				
#	CRACK WIDTH	CRACK LENGTH	w^2l	
	(1/1000 in)	(joint widths)		
1	16	1	256	
SUM			256	

12/22/94			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	25	1	625
1	7	1	49
SUM			674

1/2/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	25	1	625
1	7	1	49
1	2	2	8
SUM			682

1/4/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	25	1	625
1	7	1	49
1	2	2	8
1	16	1	256
SUM			938

1/13/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	25	1	625
1	7	1	49
1	2	2	8
1	16	1	256
1	9	2	162
1	16	1	256
1	9	1	81
SUM			1437

1/17/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	25	1	625
1	7	1	49
1	2	2	8
1	16	1	256
1	9	2	162
1	16	1	256
1	9	1	81
1	5	1	25
SUM			1462

1/20/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	25	1	625
1	7	1	49
1	2	2	8
1	16	1	256
1	9	2	162
1	16	1	256
1	9	1	81
1	5	1	25
3	7	1	147
1	2	2	8
3	7	1	147
3	9	1	243
SUM			2007

1/23/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	25	1	625
1	7	1	49
1	13	2	338
1	16	1	256
1	9	2	162
1	16	1	256
1	9	1	81
1	5	1	25
3	7	1	147
1	2	2	8
1	13	1	169
2	9	1	162
1	5	1	25
6	3	1	54
1	16	1	256
1	10	1	100
1	9	1	81
SUM			2794

1/26/95					1/31/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l		#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)				(1/1000 in)	(joint widths)	
1	25	1	625		1	25	1	625
1	7	1	49		3	5	1	75
1	13	2	338		1	13	2	338
1	16	1	256		1	16	1	256
1	9	2	162		1	9	2	162
8	10	1	800		8	10	1	800
1	9	1	81		1	9	1	81
1	5	1	25		1	5	1	25
3	7	1	147		3	7	1	147
1	2	2	8		1	2	2	8
1	3	1	9		1	3	1	9
1	16	1	256		1	16	1	256
1	5	1	25		1	5	1	25
6	3	1	54		6	3	1	54
1	10	1	100		1	10	1	100
1	3	1	9		1	3	1	9
1	5	1	25		1	5	1	25
8	5	1	200		8	5	1	200
1	10	1	100		1	10	1	100
2	7	1	98		2	7	1	98
3	10	1	300		3	10	1	300
1	9	1	81		1	9	1	81
1	10	1	100		1	10	1	100
SUM			3848		1	5	1	25
					1	13	1	169
					1	7	1	49
					SUM			4117

2/5/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	25	1	625
3	5	1	75
1	13	2	338
1	16	1	256
1	9	2	162
8	10	1	800
1	9	1	81
1	5	1	25
3	7	1	147
1	2	2	8
2	2	1	8
1	16	1	256
1	5	1	25
6	3	1	54
1	10	1	100
1	3	1	9
1	5	1	25
8	5	1	200
1	10	1	100
2	7	1	98
3	10	1	300
1	9	1	81
1	10	1	100
1	5	1	25
1	13	1	169
1	7	1	49
1	9	1	81
1	9	1	81
5	5	1	125
SUM			4403

2/10/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	25	1	625
3	5	1	75
1	13	2	338
1	16	1	256
1	9	2	162
8	10	1	800
1	9	1	81
1	5	1	25
3	7	1	147
1	2	2	8
2	2	1	8
1	16	1	256
1	5	1	25
6	3	1	54
1	10	1	100
1	3	1	9
1	5	1	25
8	5	1	200
1	10	1	100
2	7	1	98
3	10	1	300
1	9	1	81
1	10	1	100
1	5	1	25
1	13	1	169
1	7	1	49
1	9	1	81
1	9	1	81
5	5	1	125
1	9	1	81
2	3	1	18
3	7	1	147
SUM			4649

2/21/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	25	1	625
3	5	1	75
1	13	2	338
1	16	1	256
1	9	2	162
8	10	1	800
1	9	1	81
1	5	1	25
3	7	1	147
1	2	2	8
2	2	1	8
1	16	1	256
1	5	1	25
6	5	1	150
1	10	1	100
1	3	1	9
1	5	1	25
8	5	1	200
1	10	1	100
2	7	1	98
3	10	1	300
1	9	1	81
1	10	1	100
1	5	1	25
1	13	1	169
1	7	1	49
1	9	1	81
1	9	1	81
5	5	1	125
1	9	1	81
2	3	1	18
3	7	1	147
2	3	1	18
1	7	1	49
2	2	1	8
SUM			4820

2/27/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	25	1	625
3	5	1	75
1	13	2	338
1	16	1	256
1	9	2	162
8	10	1	800
1	9	1	81
1	5	1	25
3	7	1	147
1	2	2	8
2	2	1	8
1	16	1	256
1	5	1	25
6	5	1	150
1	10	1	100
1	3	1	9
1	5	1	25
8	5	1	200
1	10	1	100
2	7	1	98
3	10	1	300
1	9	1	81
1	10	1	100
1	5	1	25
1	13	1	169
1	7	1	49
1	9	1	81
1	9	1	81
5	5	1	125
1	9	1	81
2	3	1	18
3	7	1	147
2	3	1	18
1	7	1	49
2	2	1	8
1	3	1	9
1	2	4	16
1	7	1	49
1	2	1	4
1	2	1	4
1	5	1	25
1	7	1	49
1	16	1	256
SUM			5232

3/7/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	25	1	625
3	5	1	75
1	13	2	338
1	16	1	256
1	9	2	162
8	10	1	800
1	9	1	81
1	5	1	25
3	7	1	147
1	2	2	8
2	2	1	8
1	16	1	256
1	5	1	25
6	5	1	150
1	10	1	100
1	3	1	9
1	5	1	25
8	5	1	200
1	10	1	100
2	7	1	98
3	10	1	300
1	9	1	81
1	10	1	100
1	5	1	25
1	13	1	169
1	7	1	49
1	9	1	81
1	9	1	81
5	5	1	125
1	9	1	81
2	3	1	18
3	7	1	147
2	3	1	18
1	7	1	49
2	2	1	8
1	3	1	9
1	2	4	16
1	7	1	49
1	2	1	4
1	2	1	4
1	5	1	25
1	7	1	49
1	16	1	256
4	5	1	100
SUM			5332

3/20/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	25	1	625
3	5	1	75
1	13	2	338
1	16	1	256
1	9	2	162
8	10	1	800
1	9	1	81
1	5	1	25
3	7	1	147
1	2	2	8
2	2	1	8
1	16	1	256
1	5	1	25
6	5	1	150
1	10	1	100
1	3	1	9
1	5	1	25
8	5	1	200
1	10	1	100
2	7	1	98
3	10	1	300
1	9	1	81
1	10	1	100
1	5	1	25
1	13	1	169
1	7	1	49
1	9	1	81
1	9	1	81
5	5	1	125
1	9	1	81
2	3	1	18
3	7	1	147
2	3	1	18
1	7	1	49
2	2	1	8
1	3	1	9
1	2	4	16
1	7	1	49
1	2	1	4
1	2	1	4
1	5	1	25
1	7	1	49
1	16	1	256
4	5	1	100
1	3	1	9
SUM			5341

3/27/95			
#	CRACK WIDTH (1/1000 in)	CRACK LENGTH (joint widths)	w^2l
1	25	1	625
3	5	1	75
1	13	2	338
1	16	1	256
1	9	2	162
8	10	1	800
1	9	1	81
1	5	1	25
3	7	1	147
1	2	2	8
2	2	1	8
1	16	1	256
1	5	1	25
6	5	1	150
1	10	1	100
1	3	1	9
1	5	1	25
8	5	1	200
1	10	1	100
2	7	1	98
3	10	1	300
1	9	1	81
1	10	1	100
1	5	1	25
1	13	1	169
1	7	1	49
1	9	1	81
1	9	1	81
5	5	1	125
1	9	1	81
2	3	1	18
3	7	1	147
2	3	1	18
1	7	1	49
2	2	1	8
1	3	1	9
1	2	4	16
1	7	1	49
1	2	1	4
1	2	1	4
1	5	1	25
1	7	1	49
1	16	1	256
4	5	1	100
1	3	1	9
1	5	1	25
1	7	1	49
3	2	1	12
SUM			5427

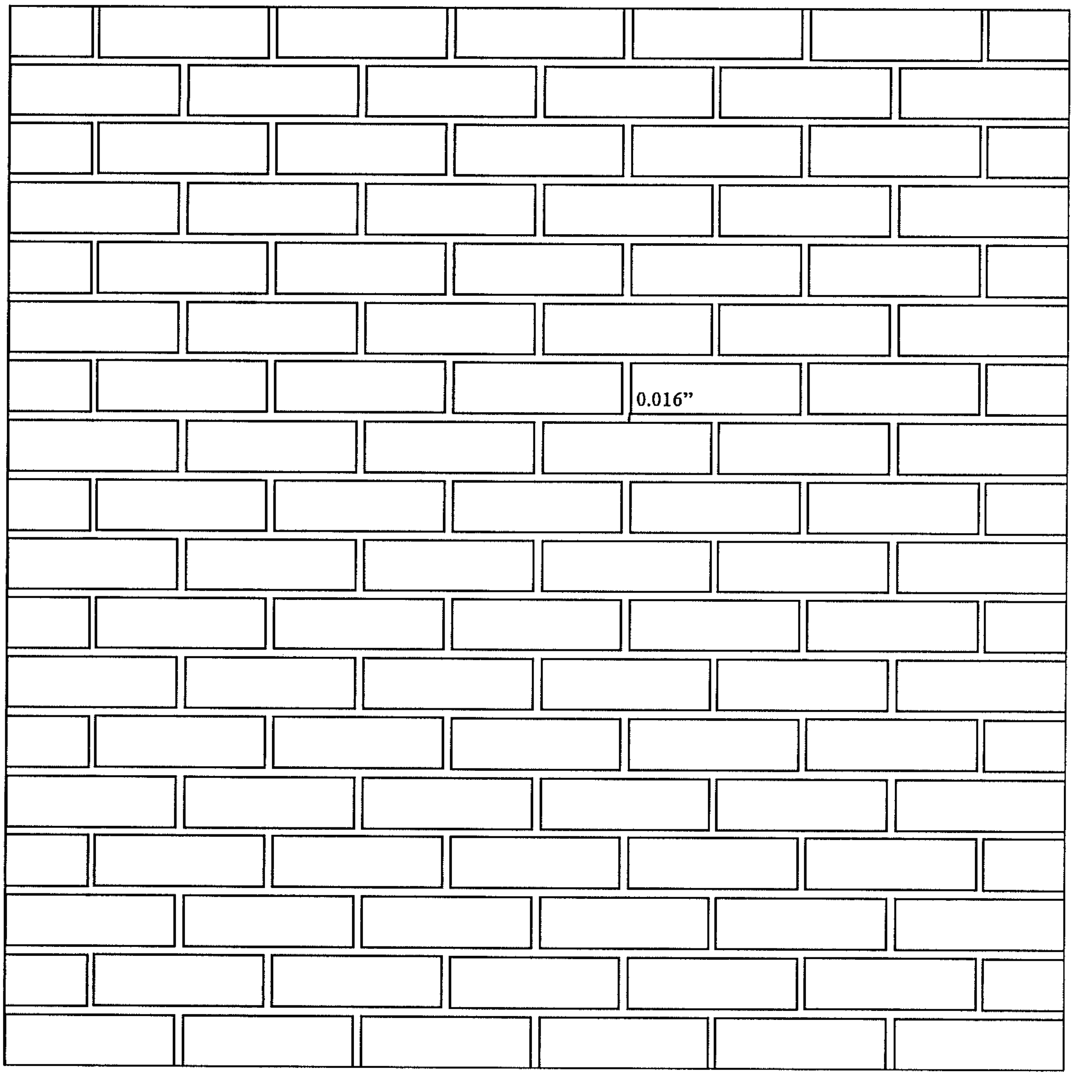
4/3/95			
#	CRACK WIDTH (1/1000 in)	CRACK LENGTH (joint widths)	w^2l
1	25	1	625
3	5	1	75
1	13	2	338
1	16	1	256
1	9	2	162
8	10	1	800
1	9	1	81
1	5	1	25
3	7	1	147
1	2	2	8
2	2	1	8
1	16	1	256
1	5	1	25
6	5	1	150
1	10	1	100
1	3	1	9
1	5	1	25
8	5	1	200
1	10	1	100
2	7	1	98
3	10	1	300
1	9	1	81
1	10	1	100
1	5	1	25
1	13	1	169
1	7	1	49
1	9	1	81
1	9	1	81
5	5	1	125
1	9	1	81
2	3	1	18
3	7	1	147
2	3	1	18
1	7	1	49
2	2	1	8
1	3	1	9
1	2	4	16
1	7	1	49
1	2	1	4
1	2	1	4
1	5	1	25
1	7	1	49
1	16	1	256
4	5	1	100
1	3	1	9
1	5	1	25
1	7	1	49
3	2	1	12
1	2	1	4
1	2	2	8
1	7	1	49
1	20	1	400
SUM			5888

4/12/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	25	1	625
3	5	1	75
1	13	2	338
1	16	1	256
1	9	2	162
8	10	1	800
1	9	1	81
1	5	1	25
3	7	1	147
1	2	2	8
2	2	1	8
1	16	1	256
1	5	1	25
6	5	1	150
1	10	1	100
1	3	1	9
1	5	1	25
8	5	1	200
1	10	1	100
2	7	1	98
3	10	1	300
1	9	1	81
1	10	1	100
1	5	1	25
1	13	1	169
1	7	1	49
1	9	1	81
1	9	1	81
5	5	1	125
1	9	1	81
2	3	1	18
3	7	1	147
2	3	1	18
1	7	1	49
2	2	1	8
1	3	1	9
1	2	4	16
1	7	1	49
1	2	1	4
1	2	1	4
1	5	1	25
1	7	1	49
1	16	1	256
4	5	1	100
1	3	1	9
1	5	1	25
1	7	1	49
3	2	1	12
1	2	1	4
1	2	2	8
1	7	1	49
1	20	1	400
1	2	4	16
1	2	4	16
1	2	1	4
1	2	4	16
2	2	1	8
SUM			5948

10.3.2 Panel Drawings for MC1N

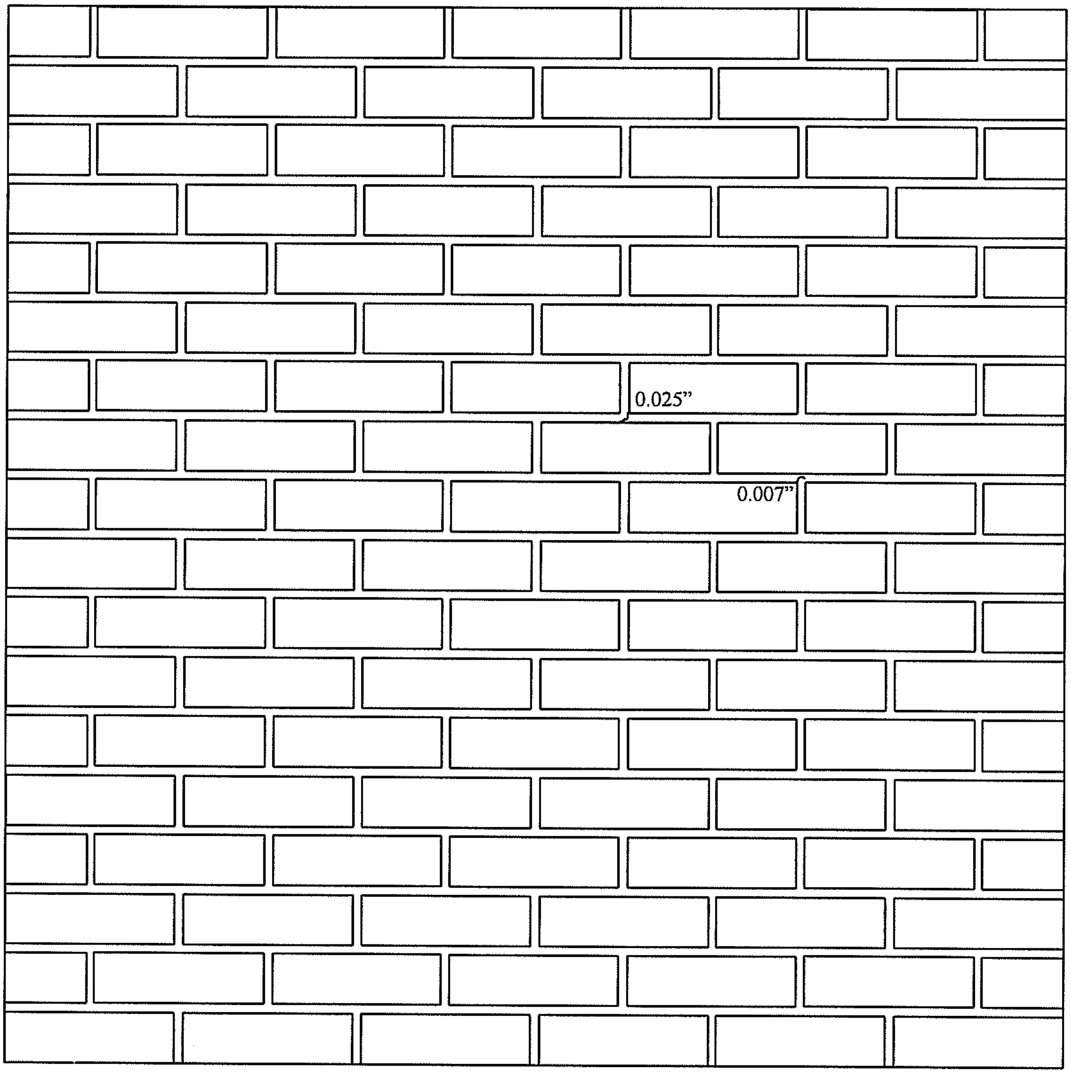
WALL: MC1N DATE: 12/13/94

SIDE: south



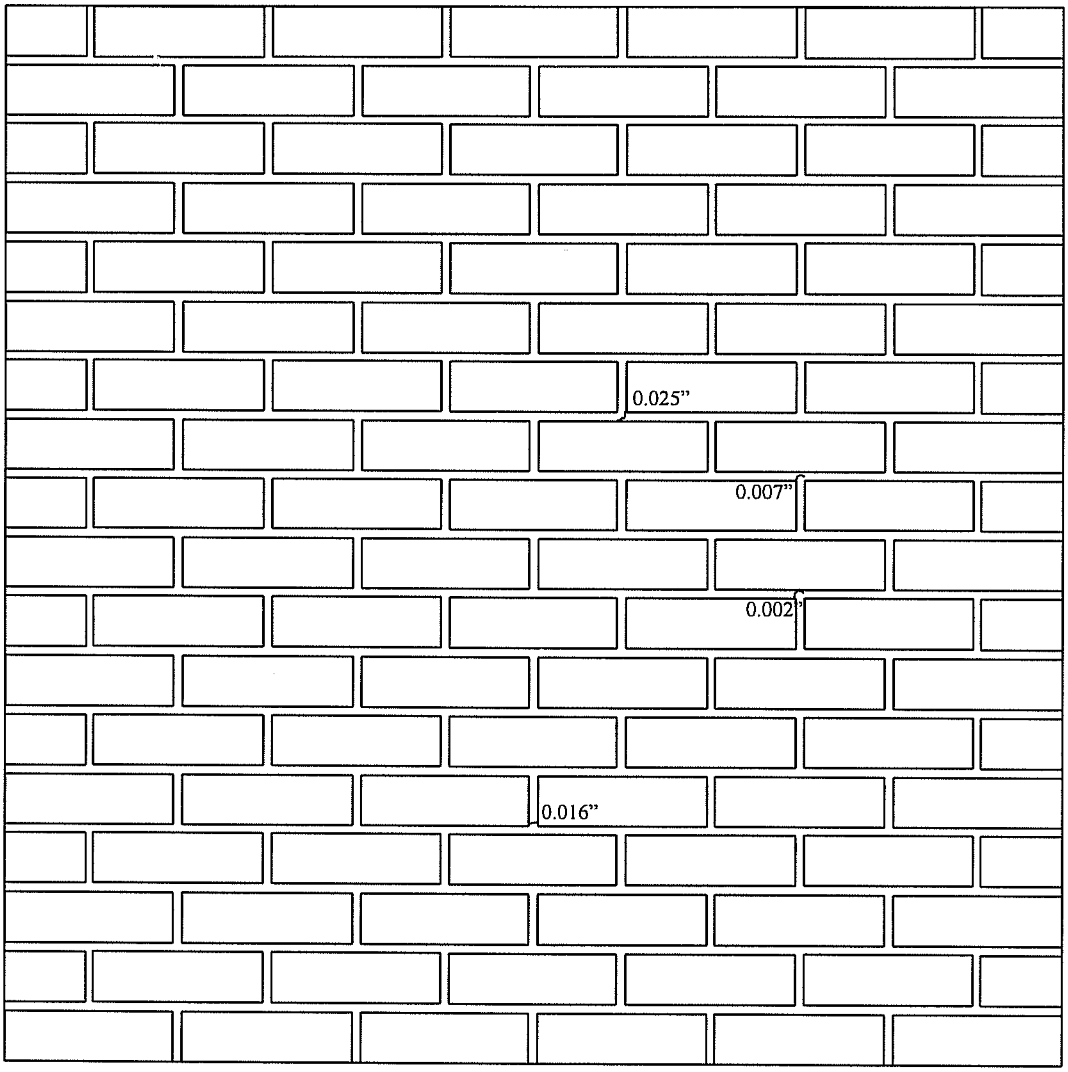
WALL: MC1N DATE: 12/22/94

SIDE: south



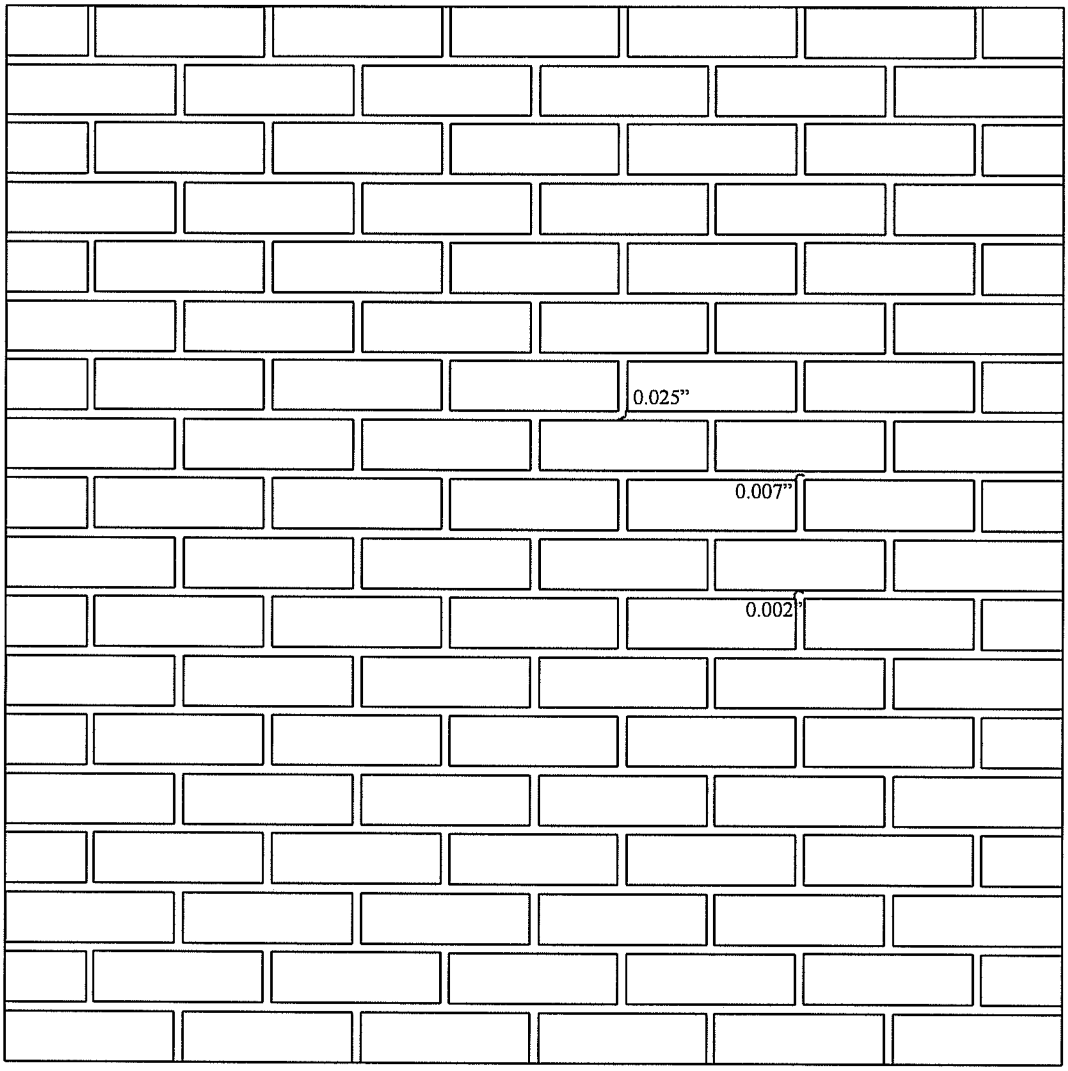
WALL: MC1N DATE: 1/4/95

SIDE: south



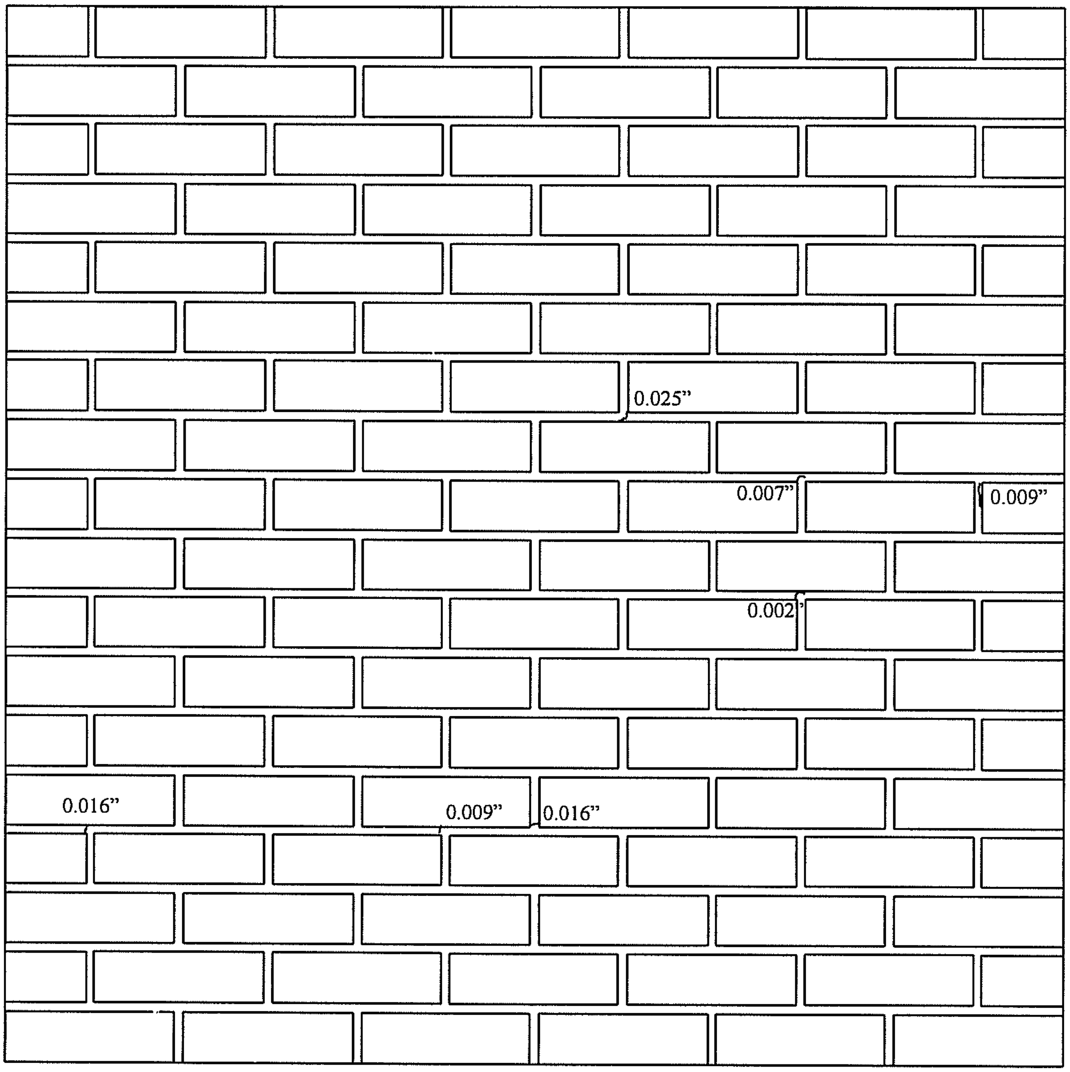
WALL: MC1N DATE: 1/2/95

SIDE: south



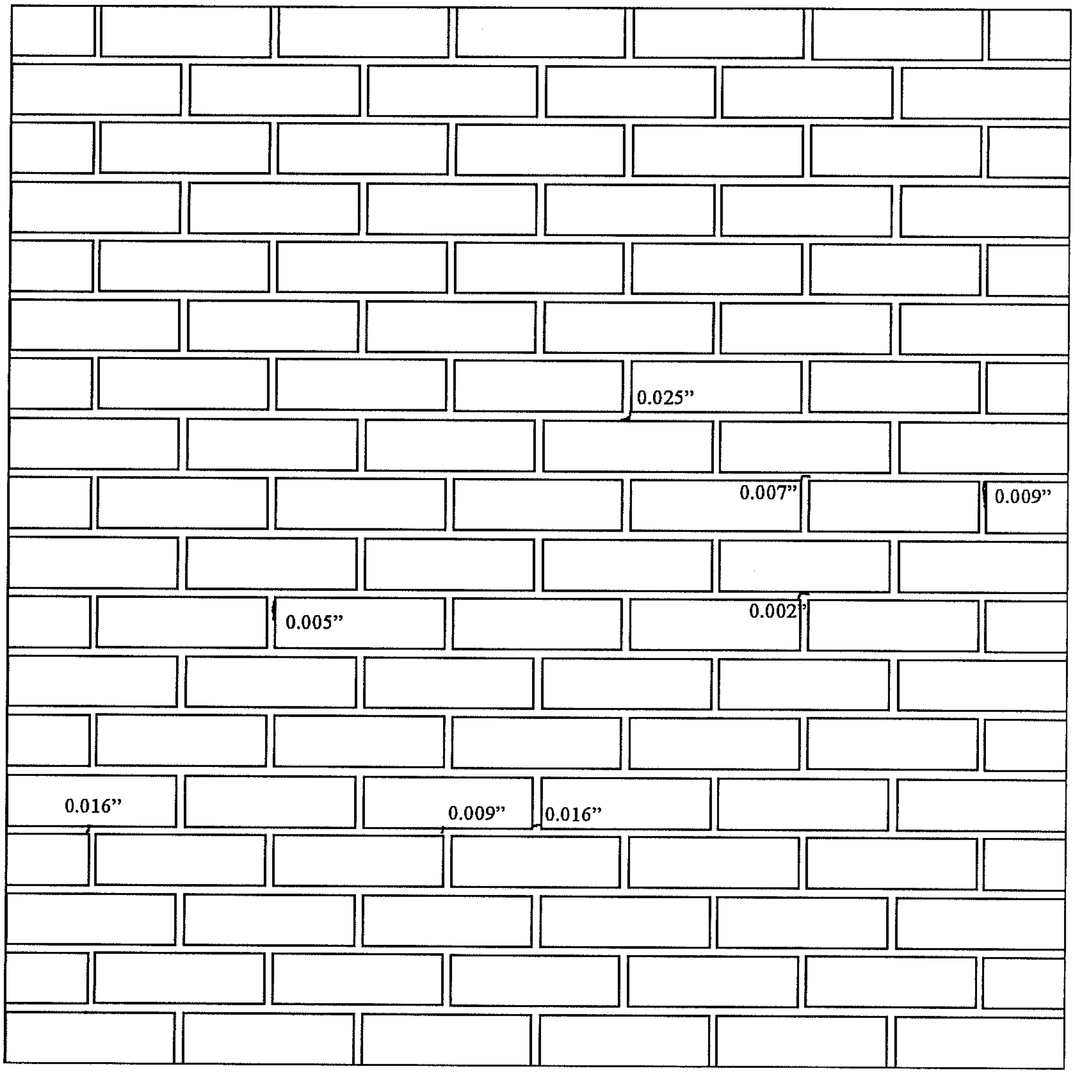
WALL: MC1N DATE: 1/13/95

SIDE: south



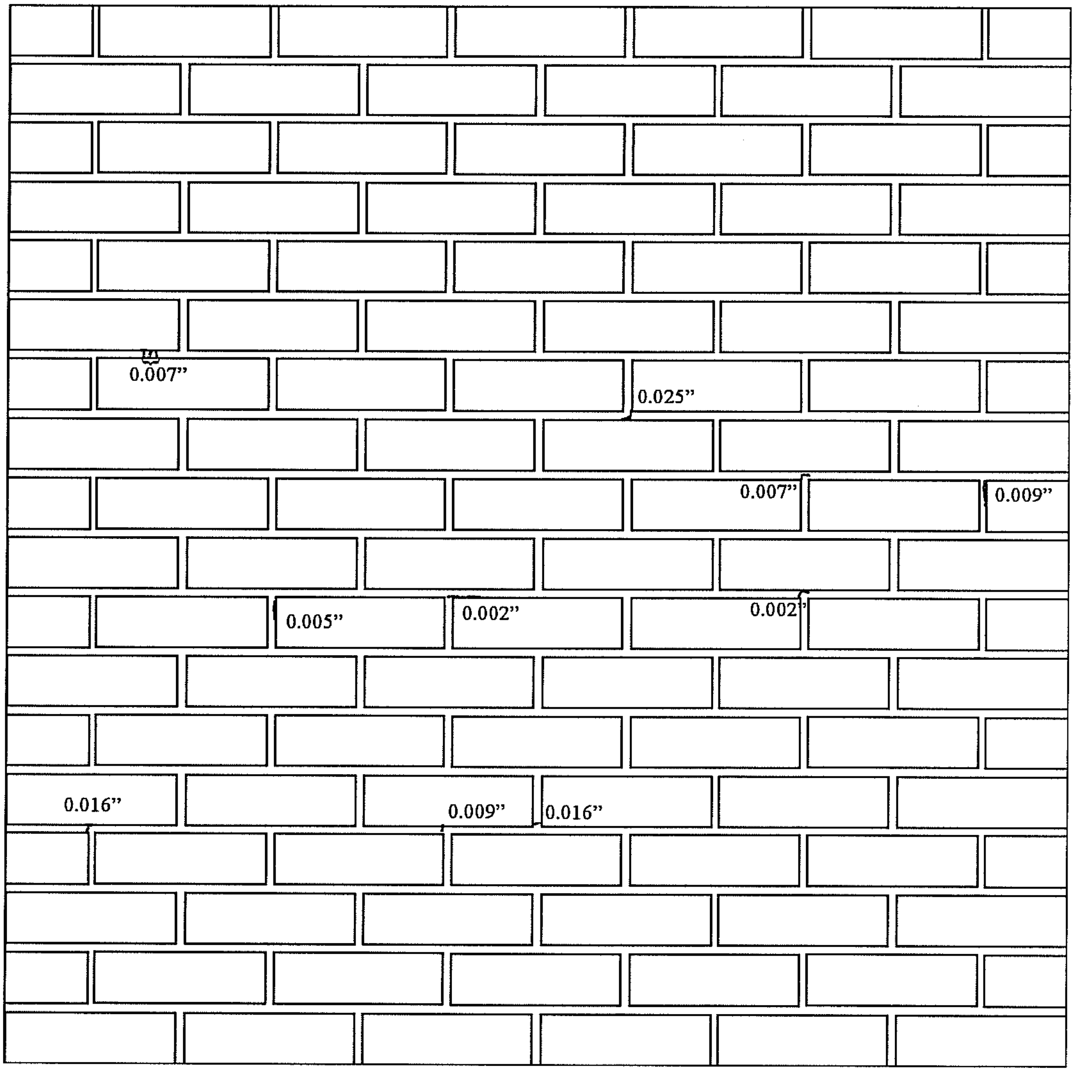
WALL: MC1N DATE: 1/17/95

SIDE: south



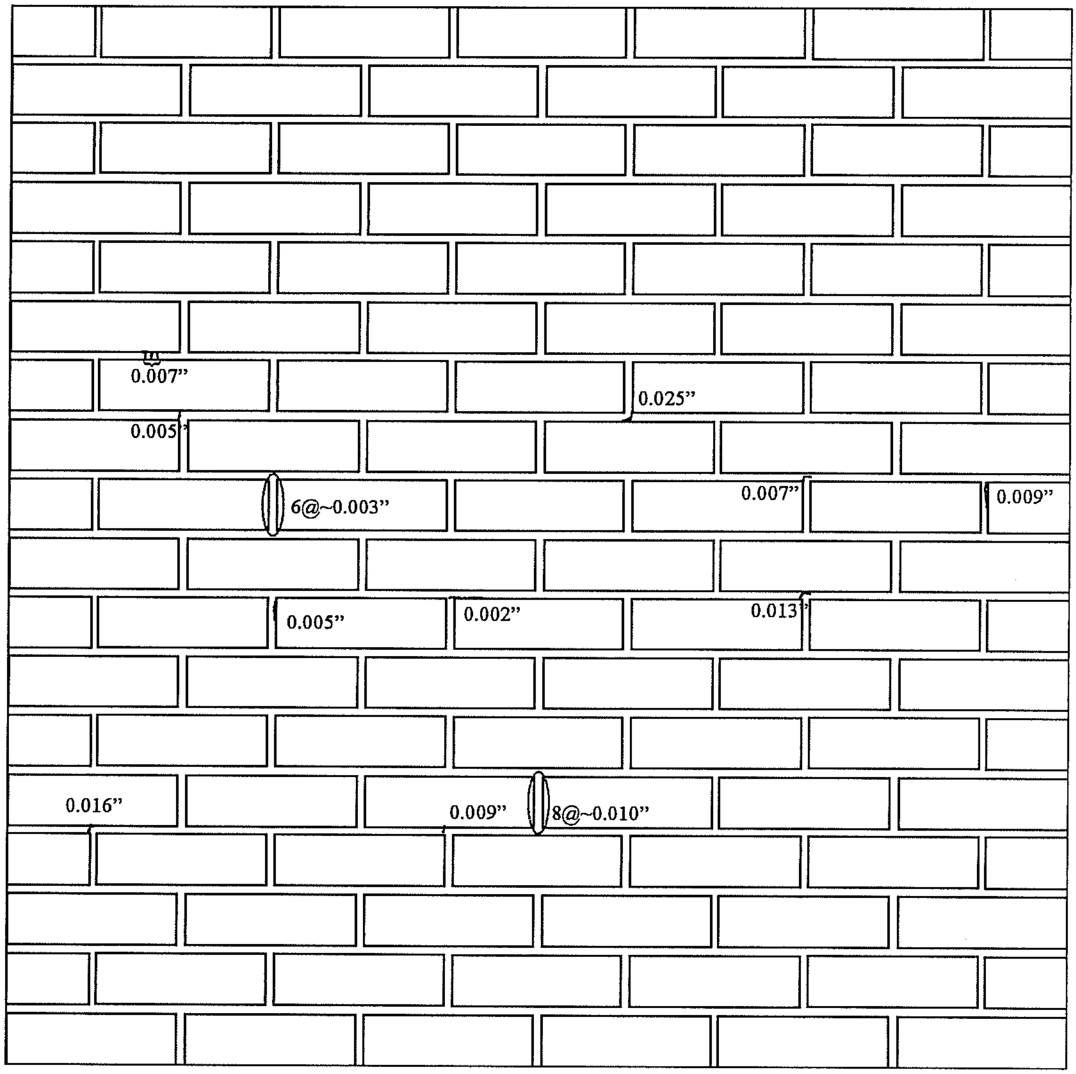
WALL: MC1N DATE: 1/20/95

SIDE: south



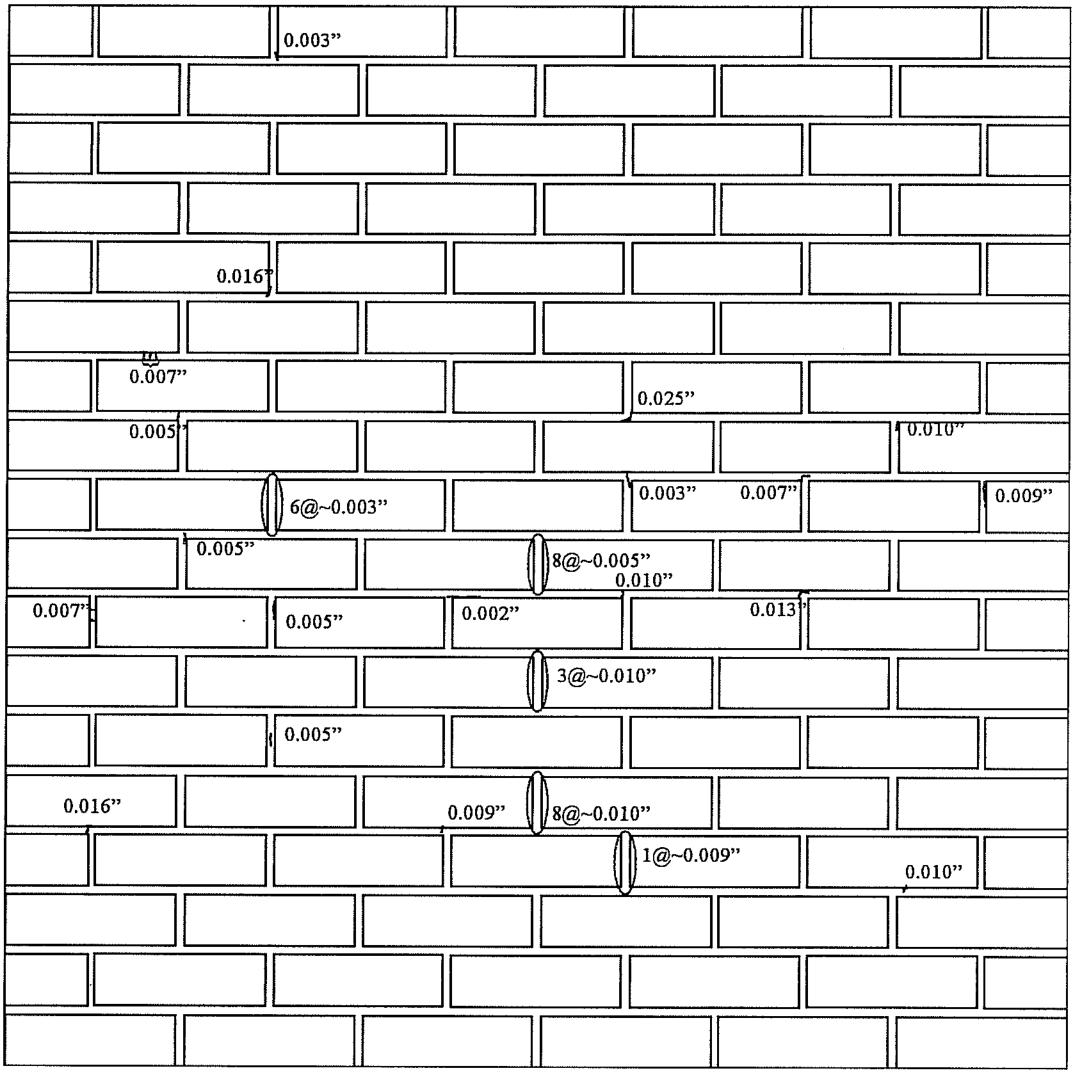
WALL: MC1N DATE: 1/23/95

SIDE: south



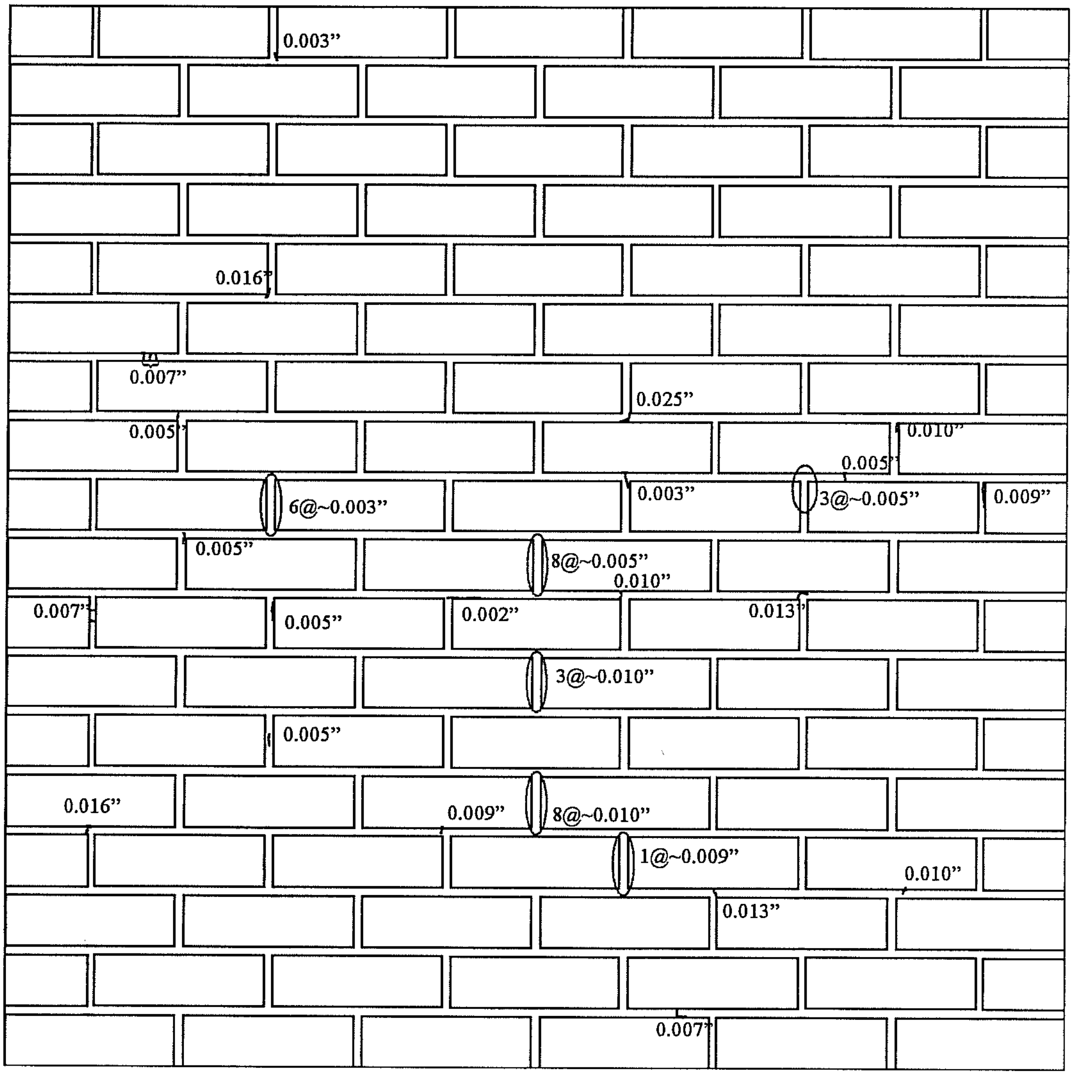
WALL: MC1N DATE: 1/26/95

SIDE: south



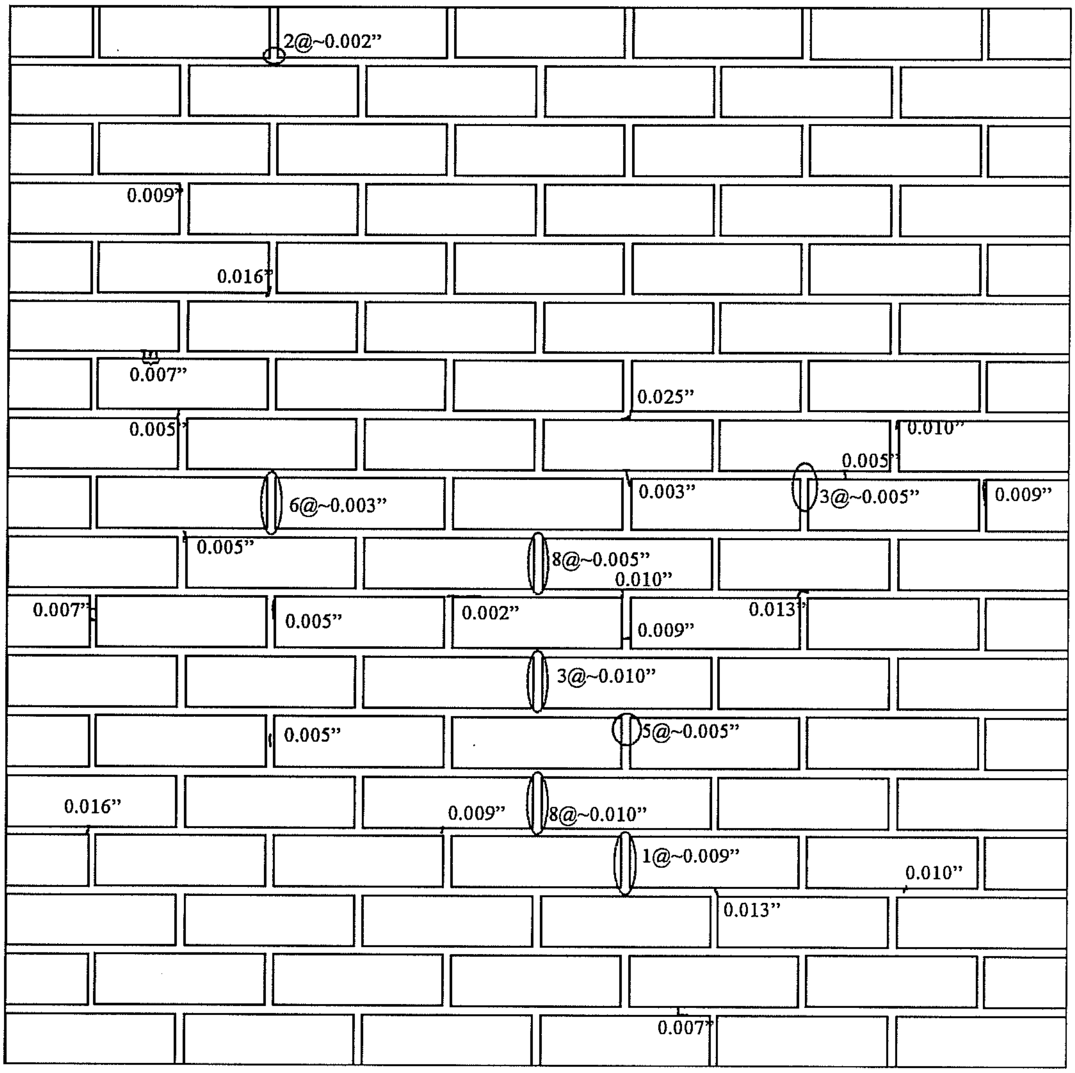
WALL: MC1N DATE: 1/31/95

SIDE: south



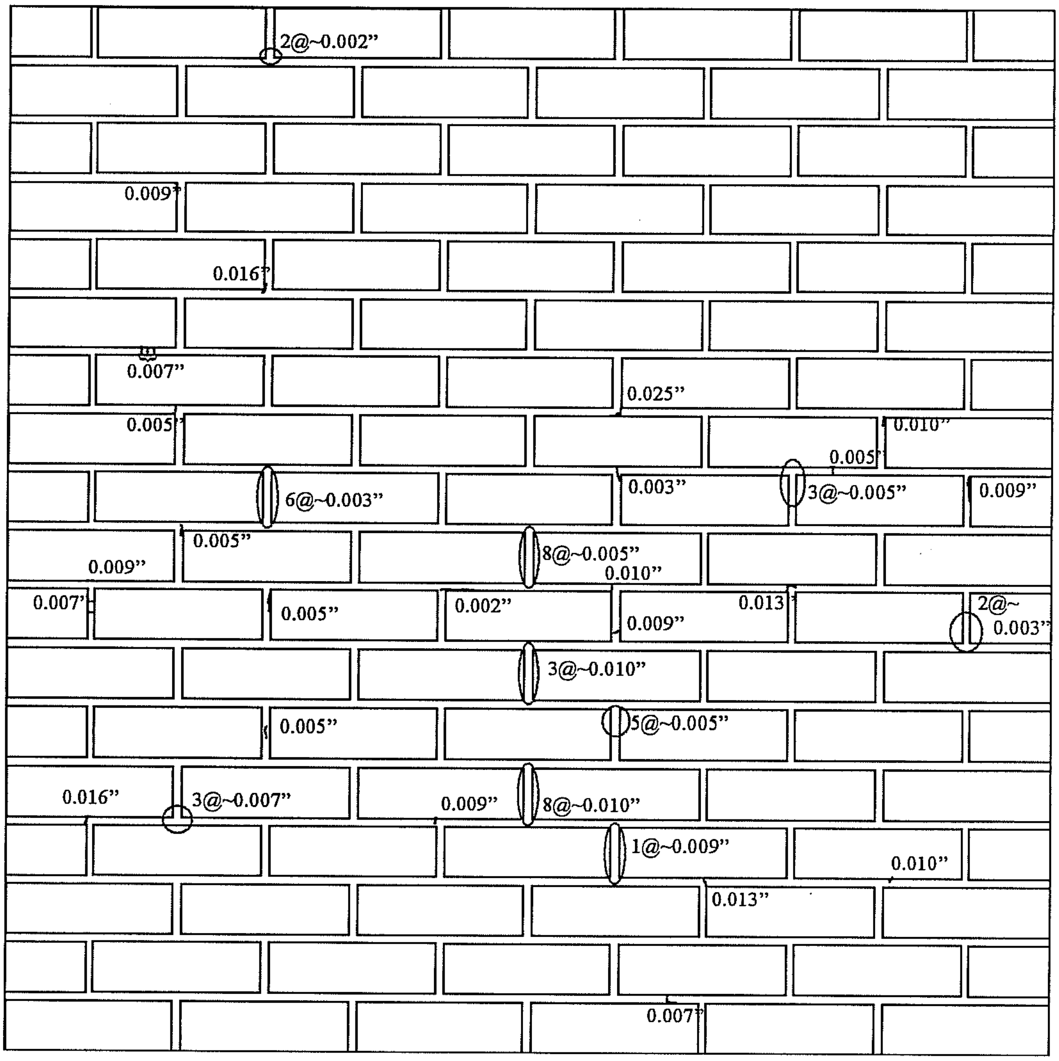
WALL: MC1N DATE: 2/5/95

SIDE: south



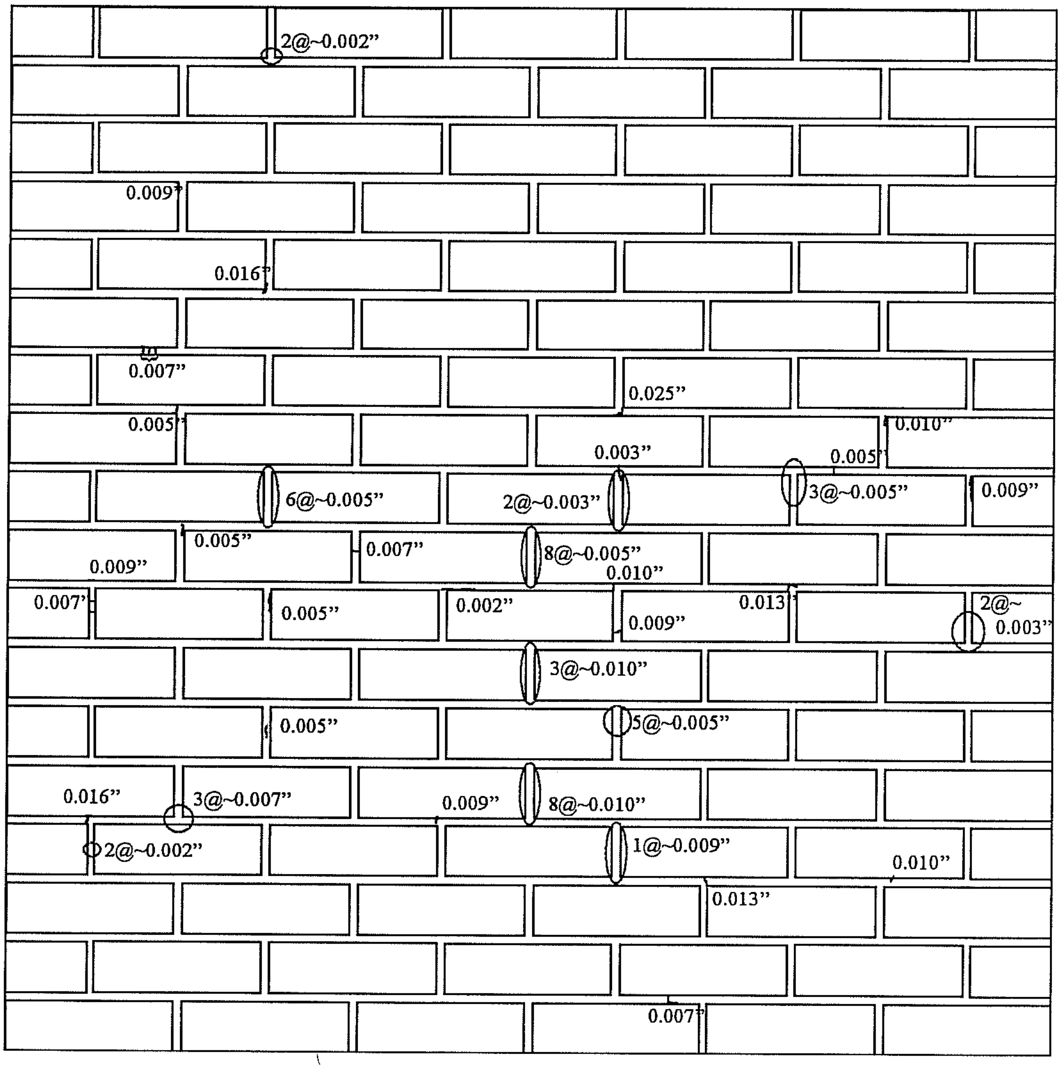
WALL: MC1N DATE: 2/10/95

SIDE: south



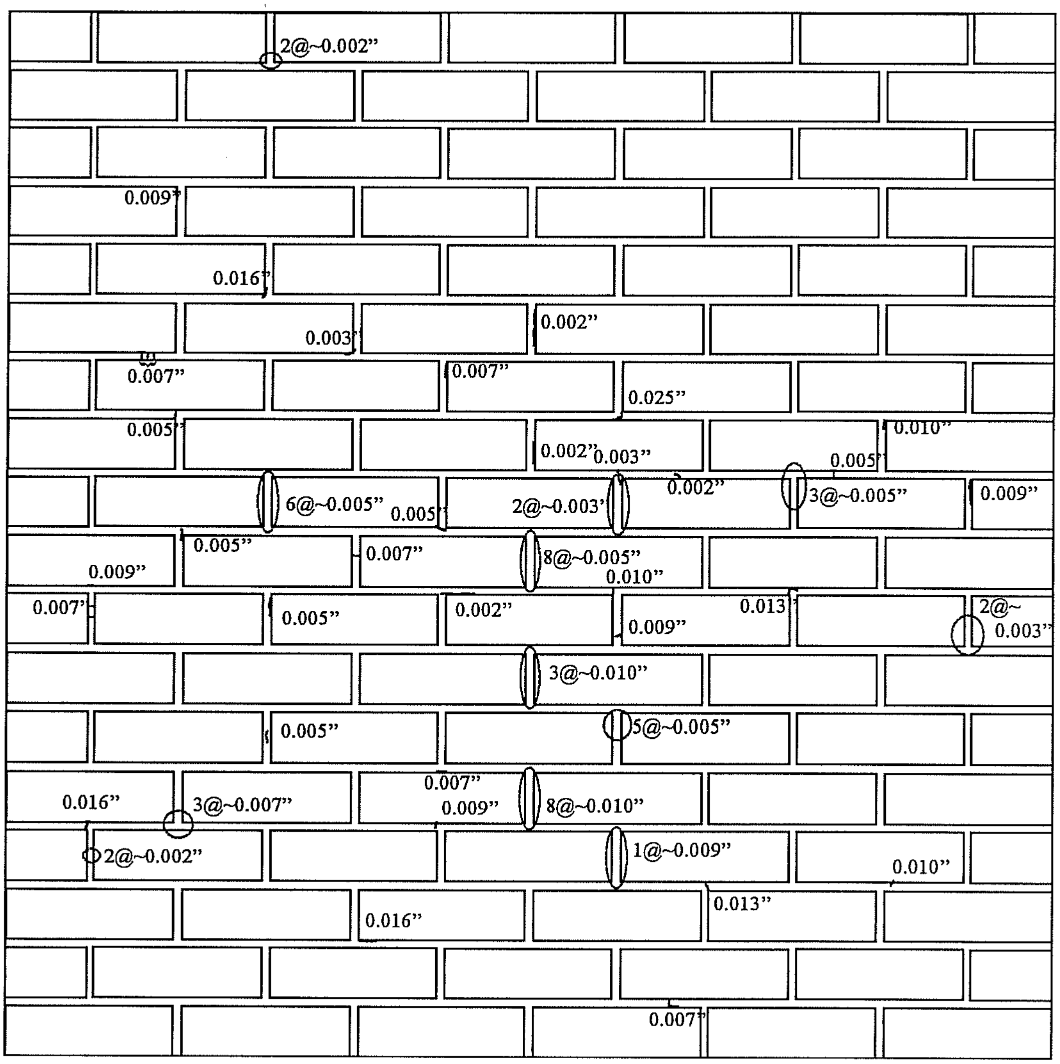
WALL: MC1N DATE: 2/21/95

SIDE: south



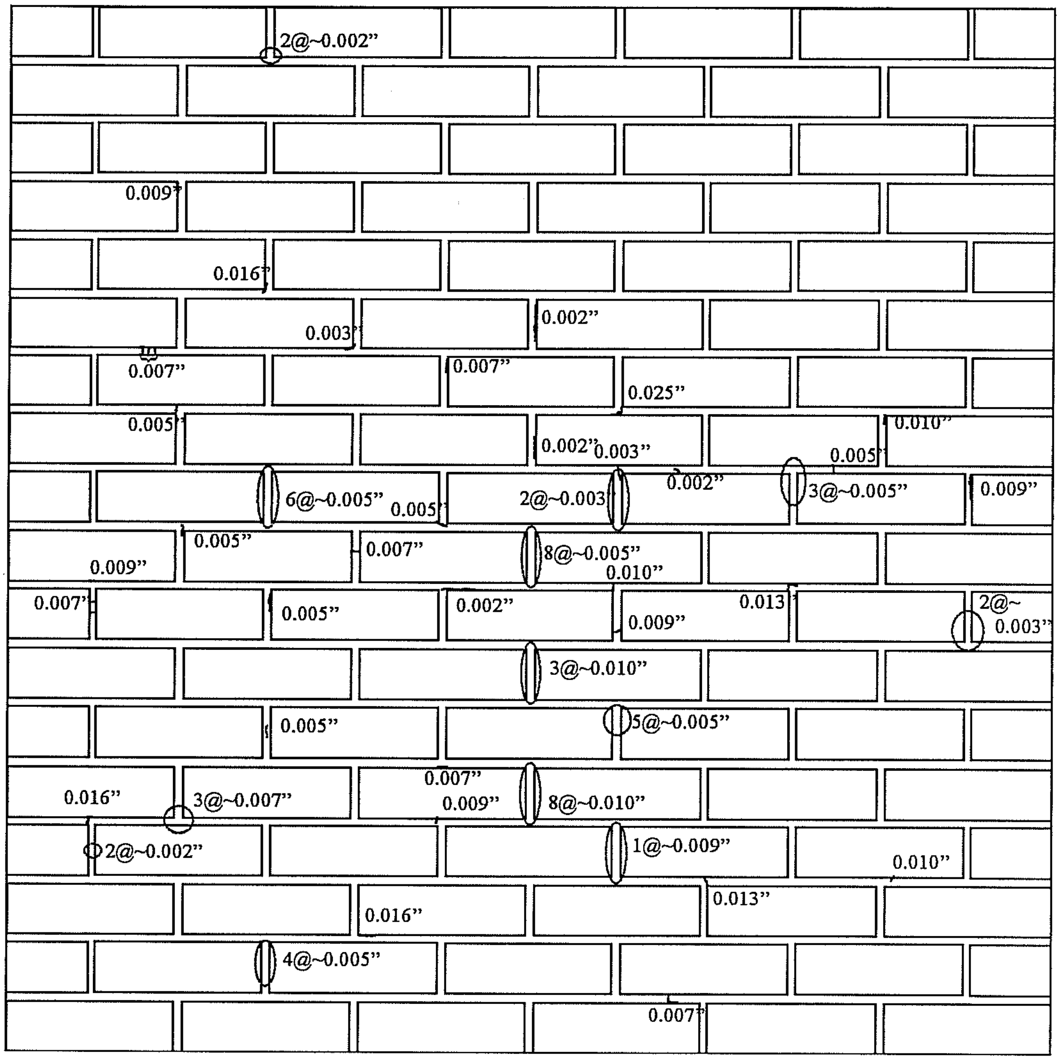
WALL: MC1N DATE: 2/27/95

SIDE: south



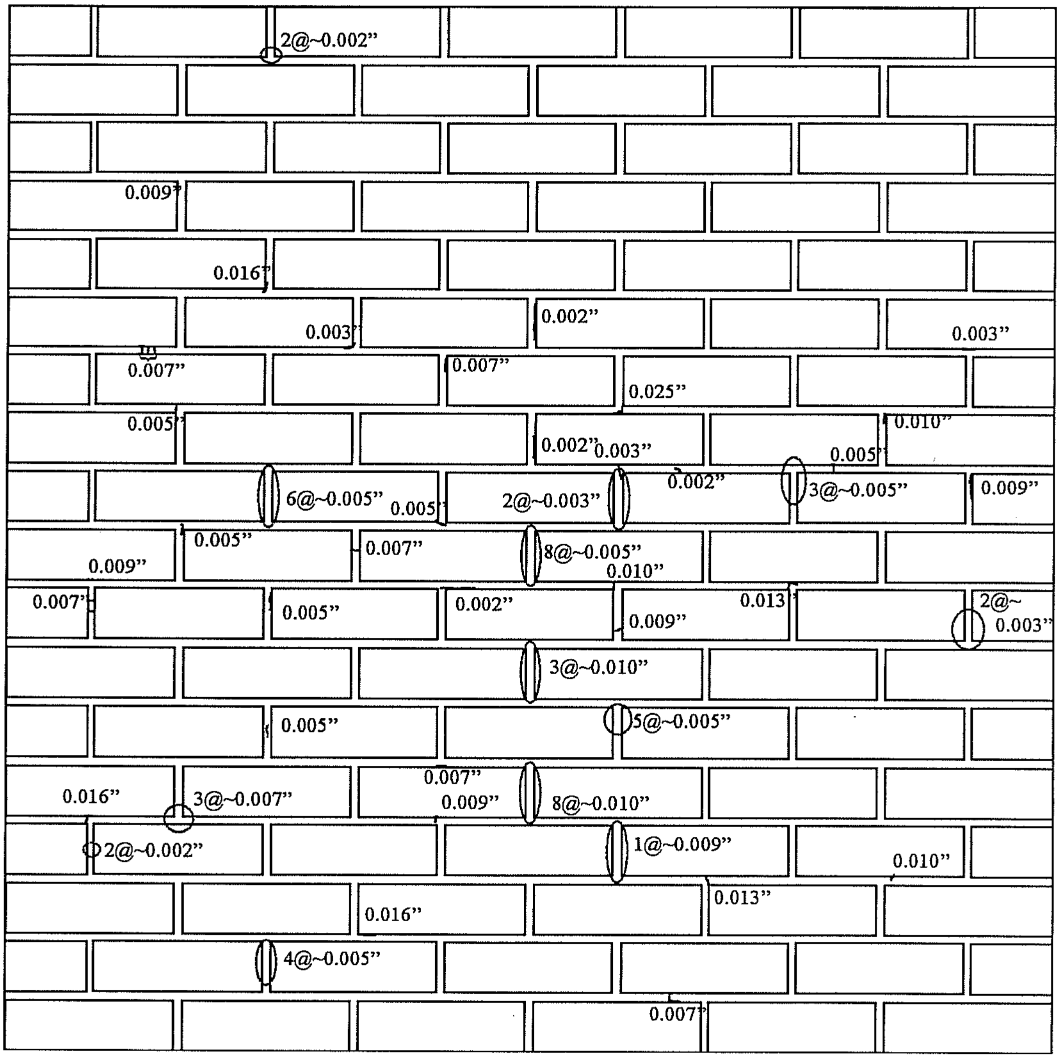
WALL: MC1N DATE: 3/7/95

SIDE: south



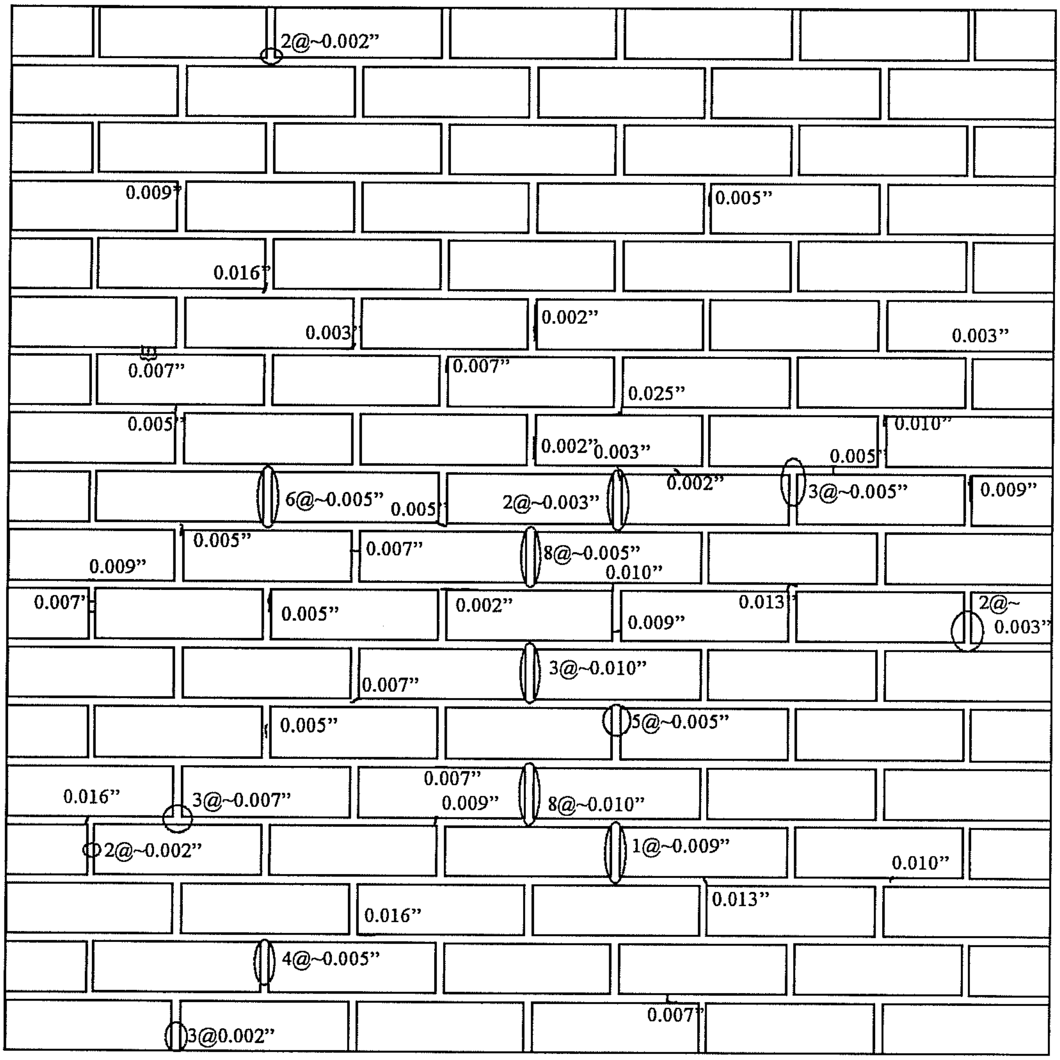
WALL: MC1N DATE: 3/20/95

SIDE: south



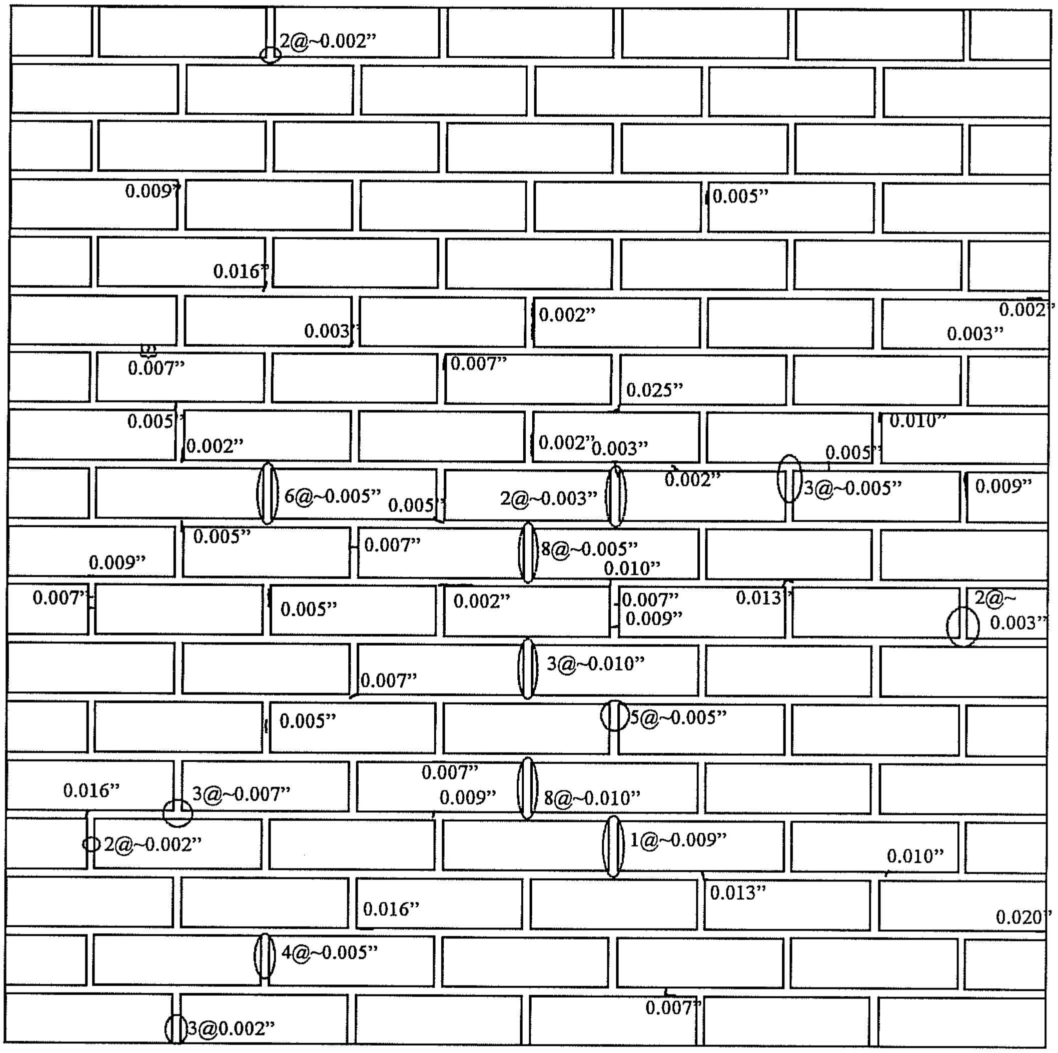
WALL: MC1N DATE: 3/27/95

SIDE: south



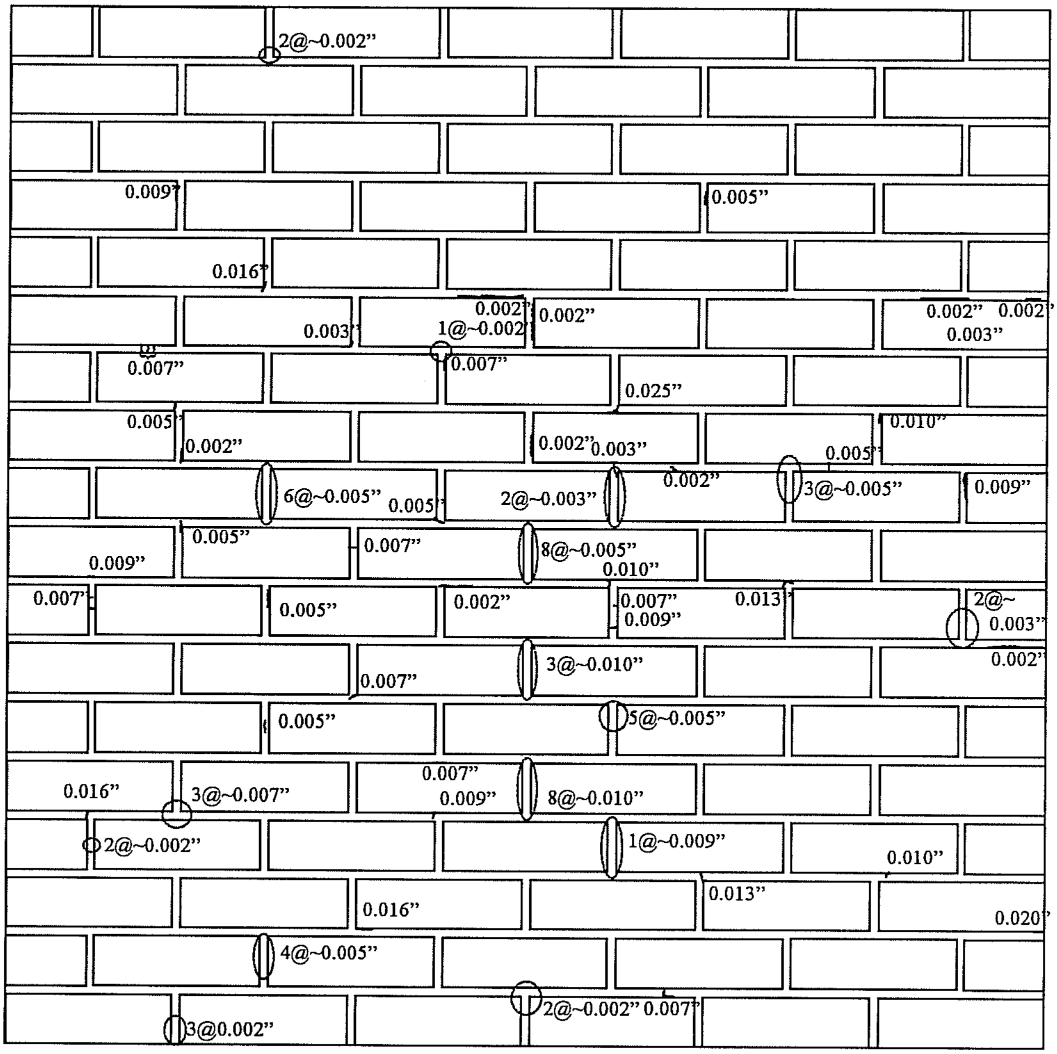
WALL: MC1N DATE: 4/3/95

SIDE: south

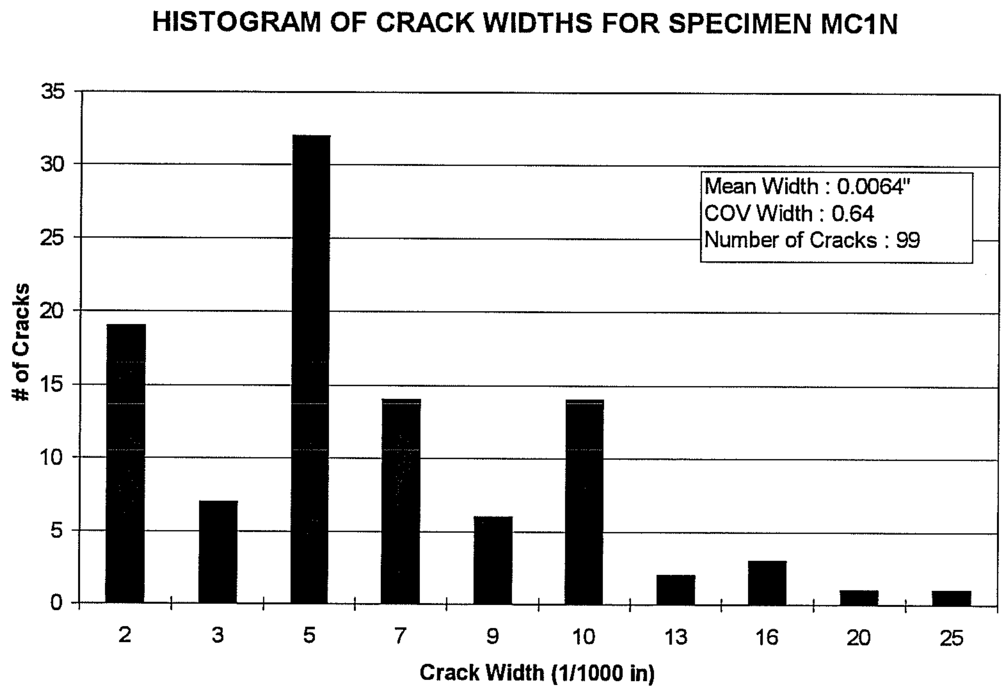


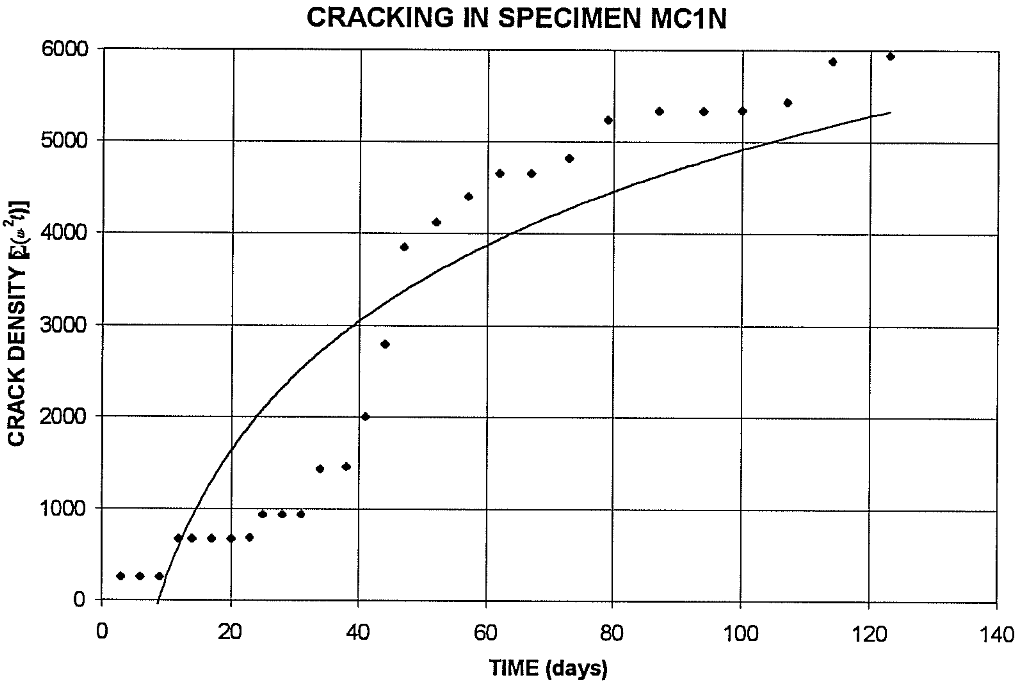
WALL: MC1N DATE: 4/12/95

SIDE: south



10.3.3 Histogram of Crack Widths and Cracking vs. Time for MC1N





10.4 Cracking in Specimen MC2S

Dates on which no changes were observed:

2/27

10.4.1 Quantitative Data for MC2S

1/15/95				
#	CRACK WIDTH	CRACK LENGTH	w^2l	
	(1/1000 in)	(joint widths)		
1	7	1	49	
1	7	1	49	
1	7	1	49	
1	13	1	169	
1	10	1	100	
1	9	1	81	
SUM			497	

1/17/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	7	1	49
1	7	1	49
1	7	1	49
1	13	1	169
1	10	1	100
1	9	1	81
1	16	2	512
1	2	2	8
SUM			1017

1/20/95				
#	CRACK WIDTH	CRACK LENGTH	w^2l	
	(1/1000 in)	(joint widths)		
1	7	1	49	
1	7	1	49	
1	7	1	49	
1	13	1	169	
1	10	1	100	
1	9	1	81	
1	16	2	512	
1	2	2	8	
1	3	1	9	
1	3	1	9	
2	5	1	50	
1	3	2	18	
1	2	1	4	
SUM			1107	

1/23/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	9	1	81
1	13	1	169
1	10	1	100
1	9	1	81
1	16	2	512
1	2	2	8
1	5	1	25
1	3	1	9
2	5	1	50
1	3	2	18
1	2	1	4
1	13	1	169
1	13	1	169
SUM			1395

1/26/95				
#	CRACK WIDTH	CRACK LENGTH	w^2l	
	(1/1000 in)	(joint widths)		
1	13	1	169	
2	10	1	200	
1	10	1	100	
1	9	1	81	
1	16	2	512	
1	2	2	8	
1	5	1	25	
1	3	1	9	
2	5	1	50	
1	5	2	50	
1	2	1	4	
1	13	1	169	
1	13	1	169	
1	30	1	900	
1	3	1	9	
2	13	1	338	
1	13	1	169	
2	9	1	162	
SUM			3124	

1/31/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	13	1	169
2	10	1	200
1	10	1	100
1	9	1	81
1	16	2	512
1	2	2	8
1	5	1	25
1	3	1	9
2	5	1	50
1	5	3	75
1	2	1	4
1	13	1	169
1	13	1	169
1	3	1	9
2	13	1	338
1	13	1	169
2	9	1	162
1	7	1	49
1	7	1	49
SUM			2347

2/5/95				
#	CRACK WIDTH	CRACK LENGTH	w^2l	
	(1/1000 in)	(joint widths)		
1	13	1	169	
2	10	1	200	
1	10	2	200	
1	9	1	81	
1	16	2	512	
1	2	2	8	
1	5	1	25	
1	3	1	9	
2	5	1	50	
1	5	3	75	
1	2	1	4	
1	13	1	169	
1	13	1	169	
1	3	1	9	
2	13	1	338	
1	13	1	169	
2	9	1	162	
1	7	1	49	
1	7	1	49	
SUM			2447	

2/10/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	13	1	169
2	10	1	200
1	10	2	200
1	9	1	81
1	16	2	512
1	2	2	8
1	5	1	25
1	3	1	9
2	5	1	50
1	5	3	75
1	2	1	4
1	13	1	169
1	13	1	169
1	3	1	9
2	13	1	338
1	13	1	169
2	9	1	162
1	7	1	49
1	7	1	49
1	2	10	40
SUM			2487

2/15/95				
#	CRACK WIDTH	CRACK LENGTH	w^2l	
	(1/1000 in)	(joint widths)		
1	13	1	169	
2	10	1	200	
1	10	2	200	
1	9	1	81	
1	16	2	512	
1	2	2	8	
1	5	1	25	
1	3	1	9	
2	5	1	50	
1	5	3	75	
1	2	1	4	
1	13	1	169	
1	13	1	169	
1	3	1	9	
2	13	1	338	
1	13	1	169	
2	9	1	162	
1	7	1	49	
1	7	1	49	
1	2	10	40	
1	3	1	9	
1	3	1	9	
1	7	1	49	
SUM			2554	

2/21/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	13	1	169
2	10	1	200
1	10	2	200
1	2	1	4
1	16	2	512
1	2	2	8
1	5	1	25
1	3	1	9
2	5	1	50
1	5	3	75
1	2	1	4
1	13	1	169
1	13	1	169
1	3	1	9
2	13	1	338
1	13	1	169
2	9	1	162
1	7	1	49
1	7	1	49
1	2	10	40
1	3	1	9
1	3	1	9
1	7	1	49
1	7	1	49
1	2	1	4
SUM			2530

3/7/95				
#	CRACK WIDTH	CRACK LENGTH	w^2l	
	(1/1000 in)	(joint widths)		
1	13	1	169	
2	10	1	200	
1	10	2	200	
1	2	1	4	
1	16	2	512	
1	2	2	8	
1	5	1	25	
1	3	1	9	
2	5	1	50	
1	5	3	75	
1	2	1	4	
1	13	1	169	
1	13	1	169	
1	3	1	9	
2	13	1	338	
1	13	1	169	
2	9	1	162	
1	7	1	49	
1	7	1	49	
1	2	10	40	
1	3	1	9	
1	3	1	9	
1	7	1	49	
1	7	1	49	
1	2	1	4	
1	5	1	25	
1	2	1	4	
SUM			2559	

3/14/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	13	1	169
2	10	1	200
1	10	2	200
1	2	1	4
1	16	2	512
1	2	2	8
1	5	1	25
1	3	1	9
2	5	1	50
1	5	3	75
1	2	1	4
1	13	1	169
1	13	1	169
1	3	1	9
2	13	1	338
1	13	1	169
2	9	1	162
1	7	1	49
1	7	1	49
1	2	10	40
1	3	1	9
1	3	1	9
1	7	1	49
1	7	1	49
1	2	1	4
1	5	1	25
1	2	1	4
1	3	1	9
1	7	1	49
1	2	6	24
1	2	6	24
SUM			2665

3/20/95			
#	CRACK WIDTH (1/1000 in)	CRACK LENGTH (joint widths)	w^2l
1	13	1	169
2	10	1	200
1	10	2	200
1	2	1	4
1	16	2	512
1	2	2	8
1	5	1	25
1	3	1	9
2	5	1	50
1	7	2	98
1	2	1	4
1	13	1	169
1	13	1	169
1	3	1	9
2	13	1	338
1	13	1	169
2	9	1	162
1	7	1	49
1	7	1	49
1	2	10	40
1	3	1	9
1	3	1	9
1	7	1	49
1	7	1	49
1	2	1	4
1	5	1	25
1	2	1	4
1	3	1	9
1	7	1	49
1	2	6	24
1	2	6	24
1	2	1	4
1	5	1	25
1	16	1	256
1	2	9	36
1	2	1	4
SUM			3013

3/27/95			
#	CRACK WIDTH (1/1000 in)	CRACK LENGTH (joint widths)	w^2l
1	13	1	169
2	10	1	200
1	10	2	200
1	2	1	4
1	16	2	512
1	2	2	8
1	5	1	25
1	3	1	9
2	5	1	50
1	7	2	98
1	2	1	4
1	13	1	169
1	13	1	169
1	3	1	9
2	13	1	338
1	13	1	169
2	9	1	162
1	7	1	49
1	7	1	49
1	2	10	40
1	3	1	9
1	3	1	9
1	7	1	49
1	7	1	49
1	2	1	4
1	5	1	25
1	2	1	4
1	3	1	9
1	7	1	49
1	2	6	24
1	2	6	24
1	2	1	4
1	5	1	25
1	16	1	256
1	2	9	36
1	2	1	4
2	3	1	18
1	3	1	9
1	2	1	4
SUM			3044

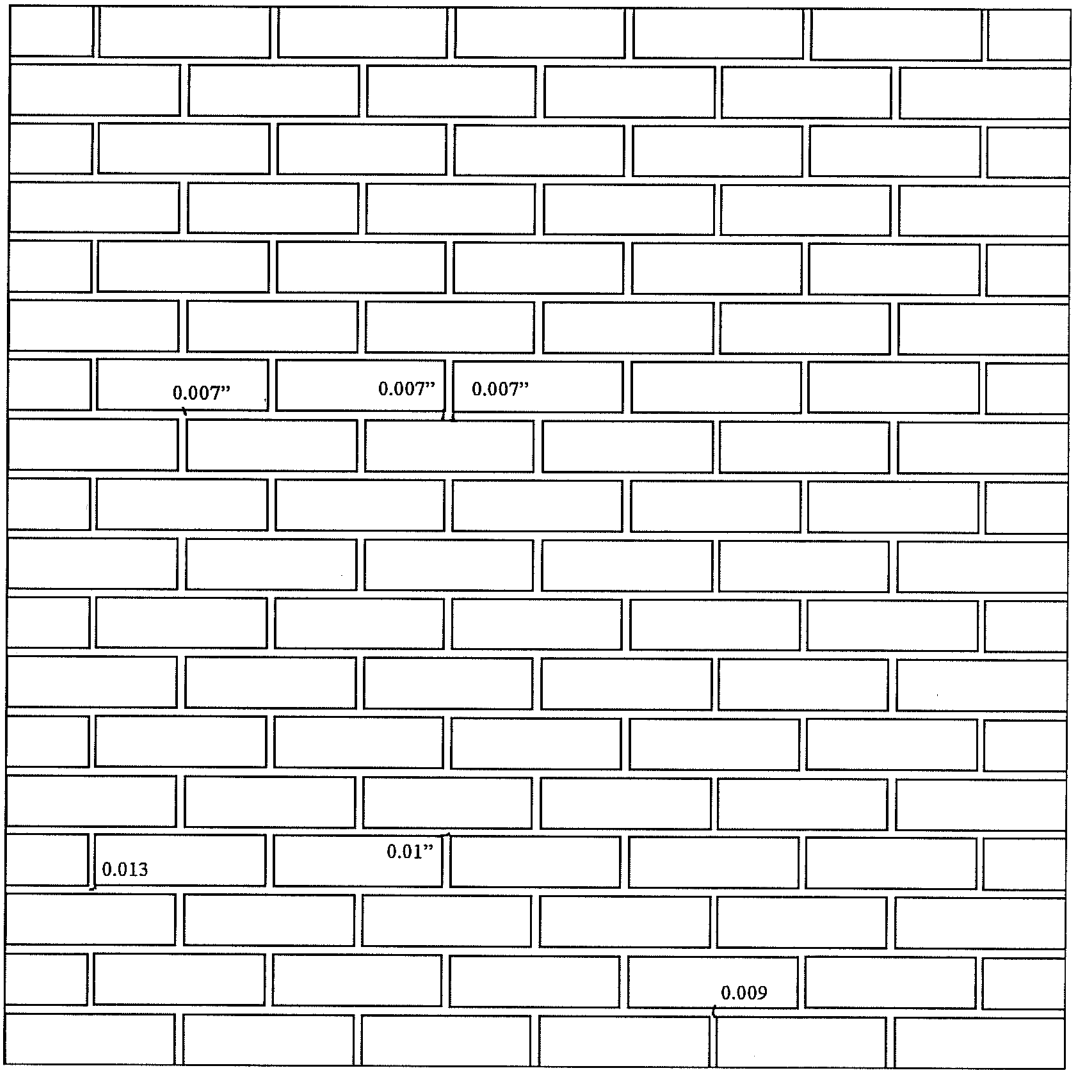
4/3/95			
#	CRACK WIDTH (1/1000 in)	CRACK LENGTH (joint widths)	w^2l
1	13	1	169
2	10	1	200
1	10	2	200
1	2	1	4
1	16	2	512
1	2	2	8
1	5	1	25
1	3	1	9
2	5	1	50
1	7	2	98
1	2	1	4
1	13	1	169
1	13	1	169
1	3	1	9
2	13	1	338
1	13	1	169
2	9	1	162
1	7	1	49
1	7	1	49
1	2	10	40
1	3	1	9
1	3	1	9
1	7	1	49
1	7	1	49
1	2	1	4
1	5	1	25
1	2	1	4
1	3	1	9
1	7	1	49
1	2	6	24
1	2	6	24
1	2	1	4
1	5	1	25
1	16	1	256
1	2	9	36
1	2	1	4
2	3	1	18
1	3	1	9
1	2	1	4
1	2	1	4
1	7	1	49
SUM			3097

4/12/95			
#	CRACK WIDTH (1/1000 in)	CRACK LENGTH (joint widths)	w^2l
1	13	1	169
2	10	1	200
1	10	2	200
1	2	1	4
1	16	2	512
1	2	2	8
1	5	1	25
1	3	1	9
2	5	1	50
1	7	2	98
1	2	1	4
1	13	1	169
1	13	1	169
1	3	1	9
2	13	1	338
1	13	1	169
2	9	1	162
1	7	1	49
1	7	1	49
1	2	10	40
1	3	1	9
1	3	1	9
1	7	1	49
1	7	1	49
1	2	1	4
1	5	1	25
1	2	1	4
1	3	1	9
1	7	1	49
1	2	6	24
1	2	6	24
1	2	1	4
1	5	1	25
1	16	1	256
1	2	9	36
1	2	1	4
2	3	1	18
1	3	1	9
1	2	1	4
1	2	1	4
1	7	1	49
1	2	1	4
1	7	1	49
SUM			3150

10.4.2 Panel Drawings for MC2S

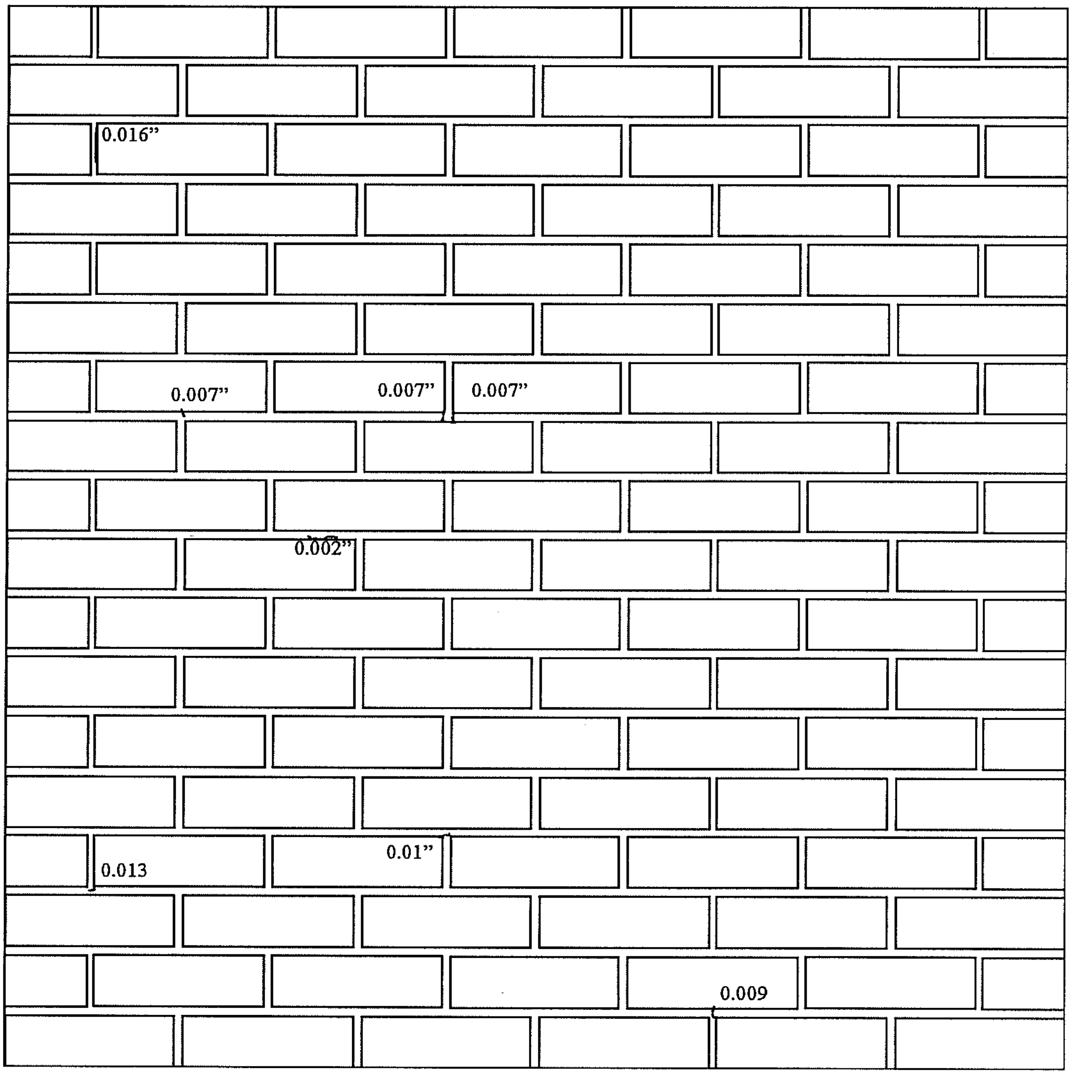
WALL: MC2S DATE: 1/15/95

SIDE: south



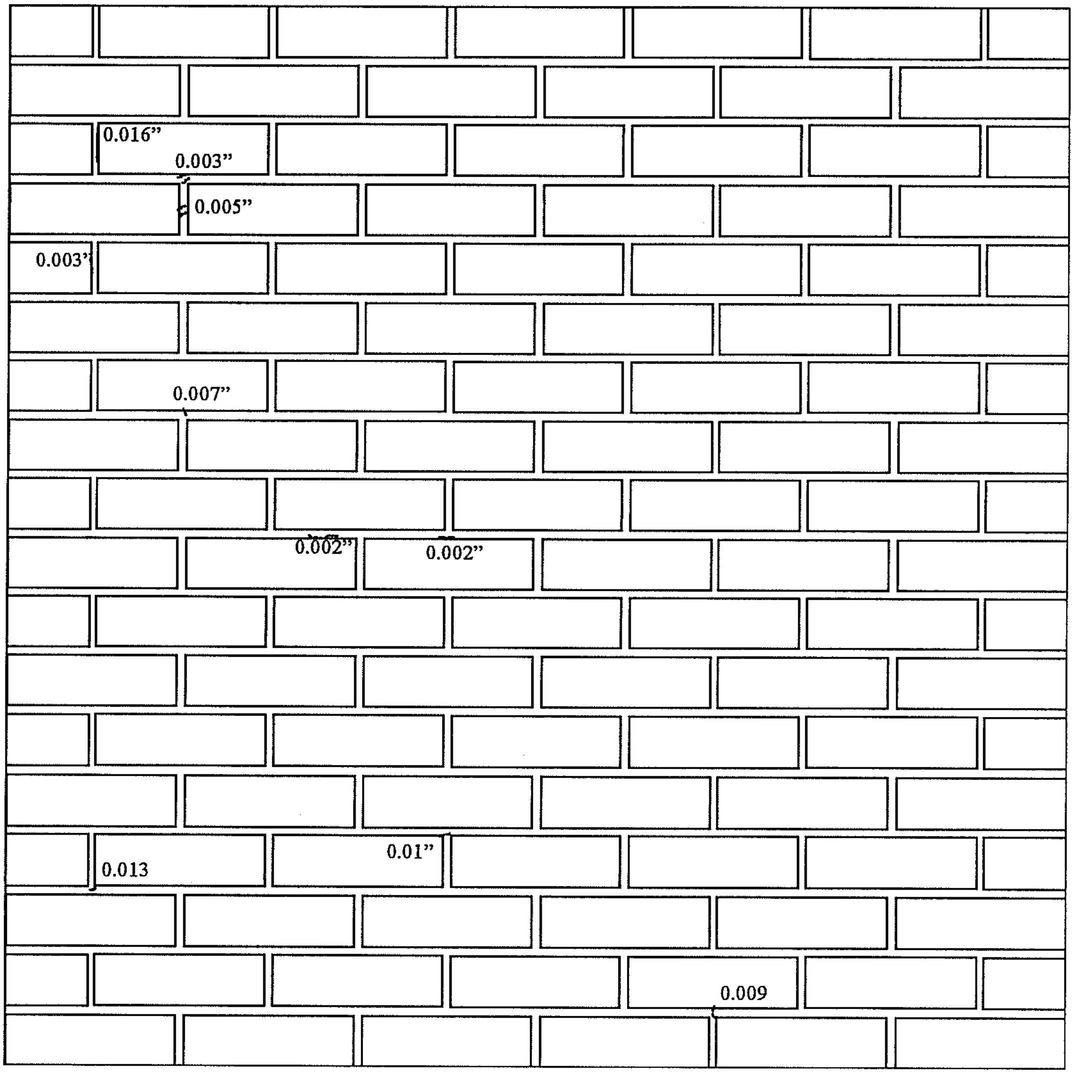
WALL: MC2S DATE: 1/17/95

SIDE: south



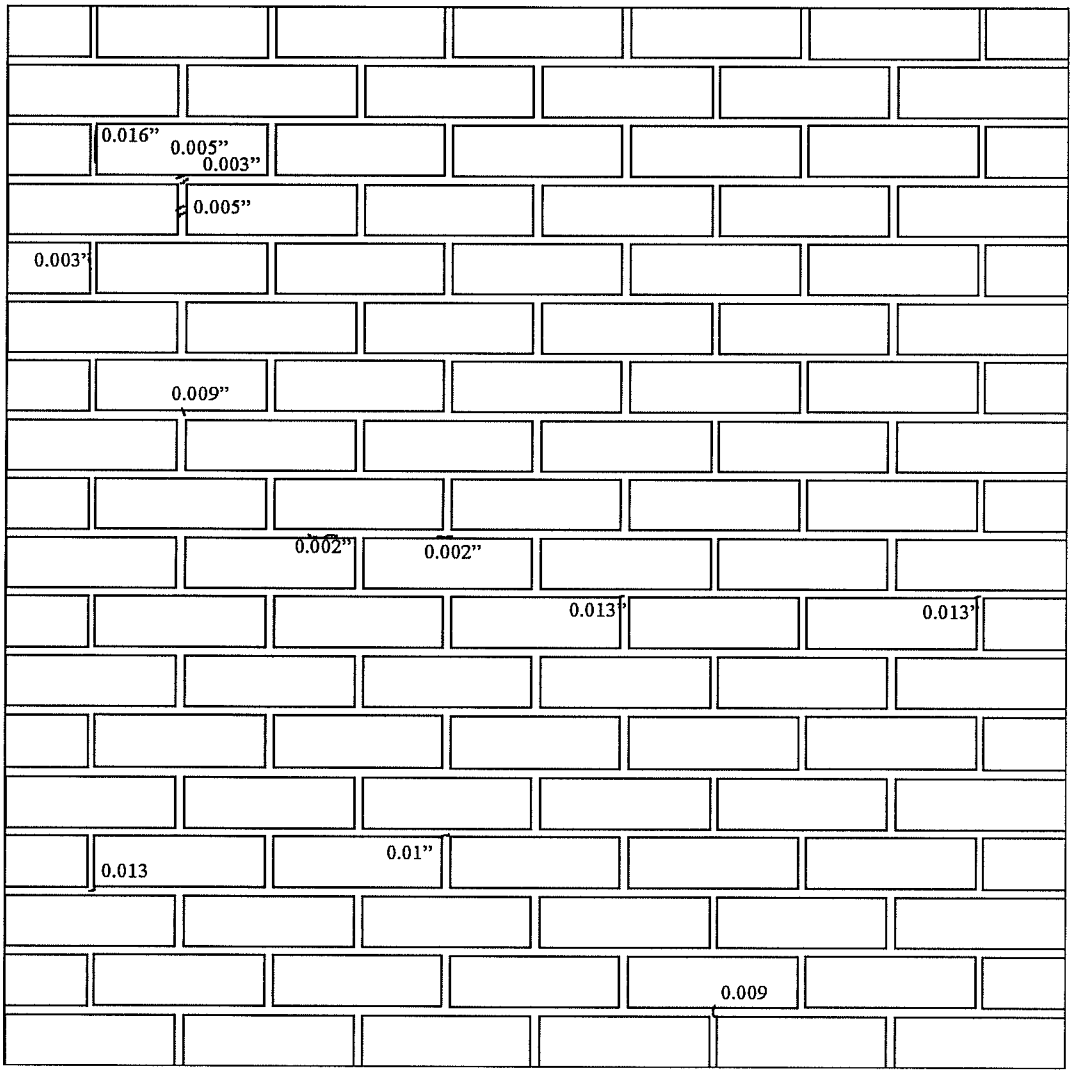
WALL: MC2S DATE: 1/20/95

SIDE: south



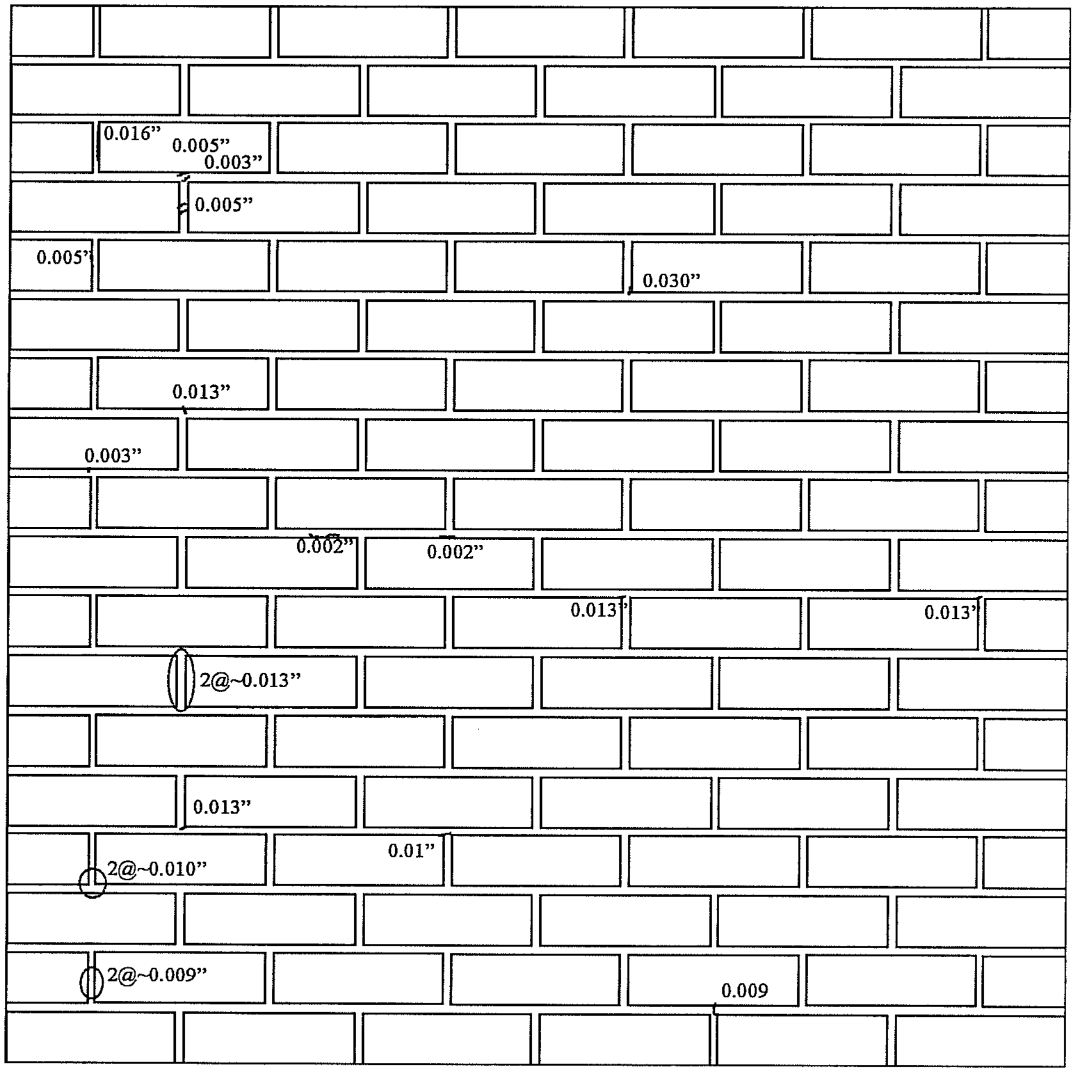
WALL: MC2S DATE: 1/23/95

SIDE: south



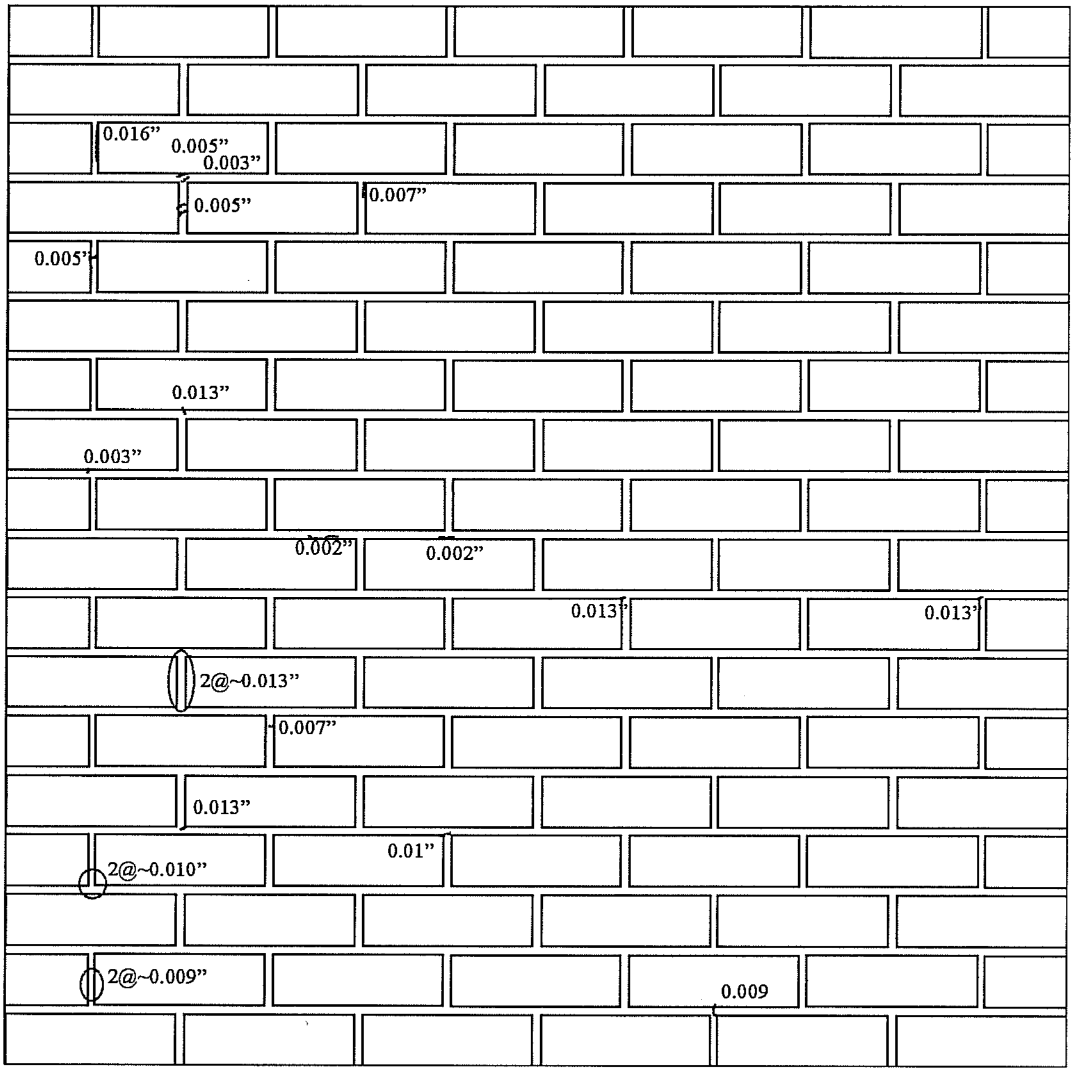
WALL: MC2S DATE: 1/26/95

SIDE: south



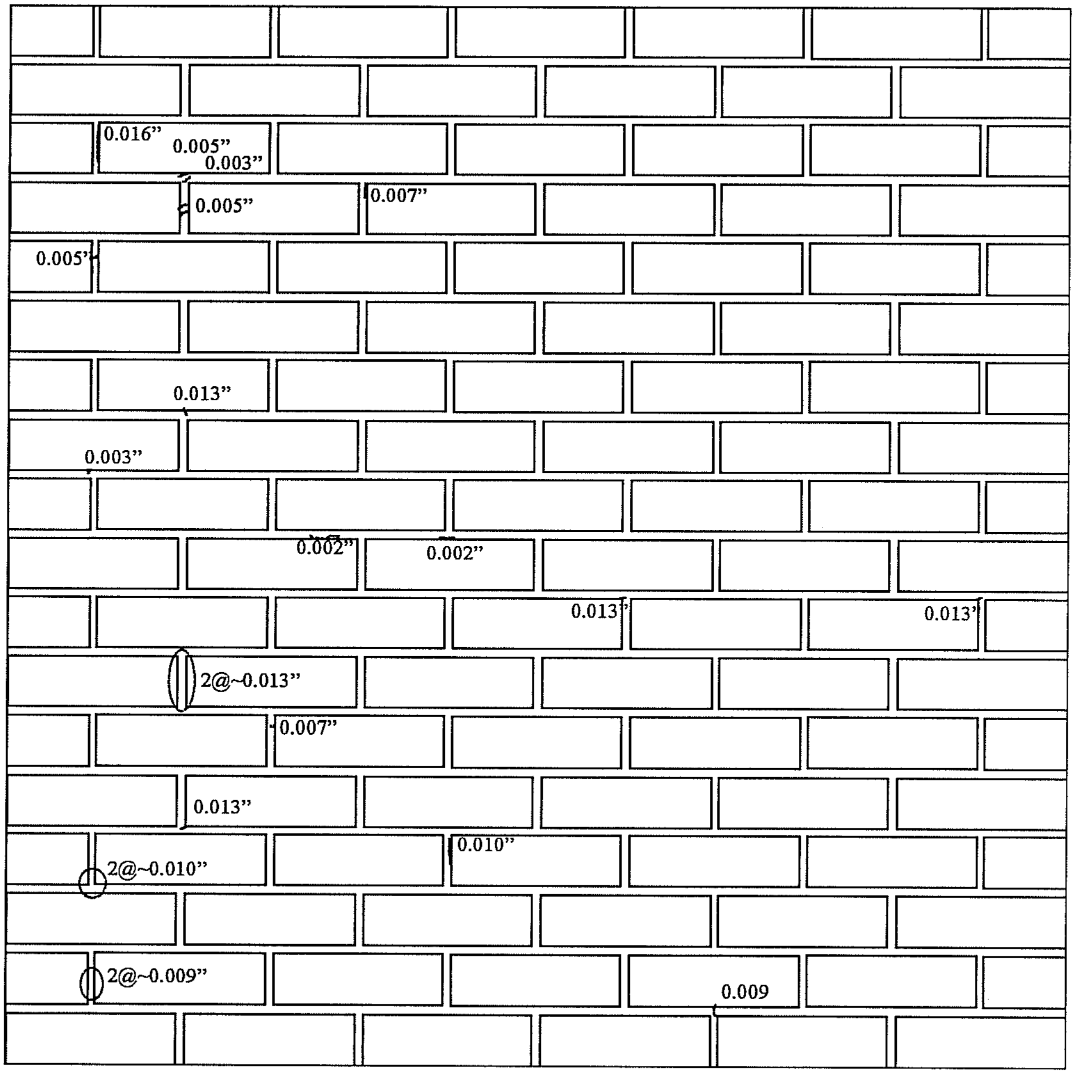
WALL: MC2S DATE: 1/31/95

SIDE: south



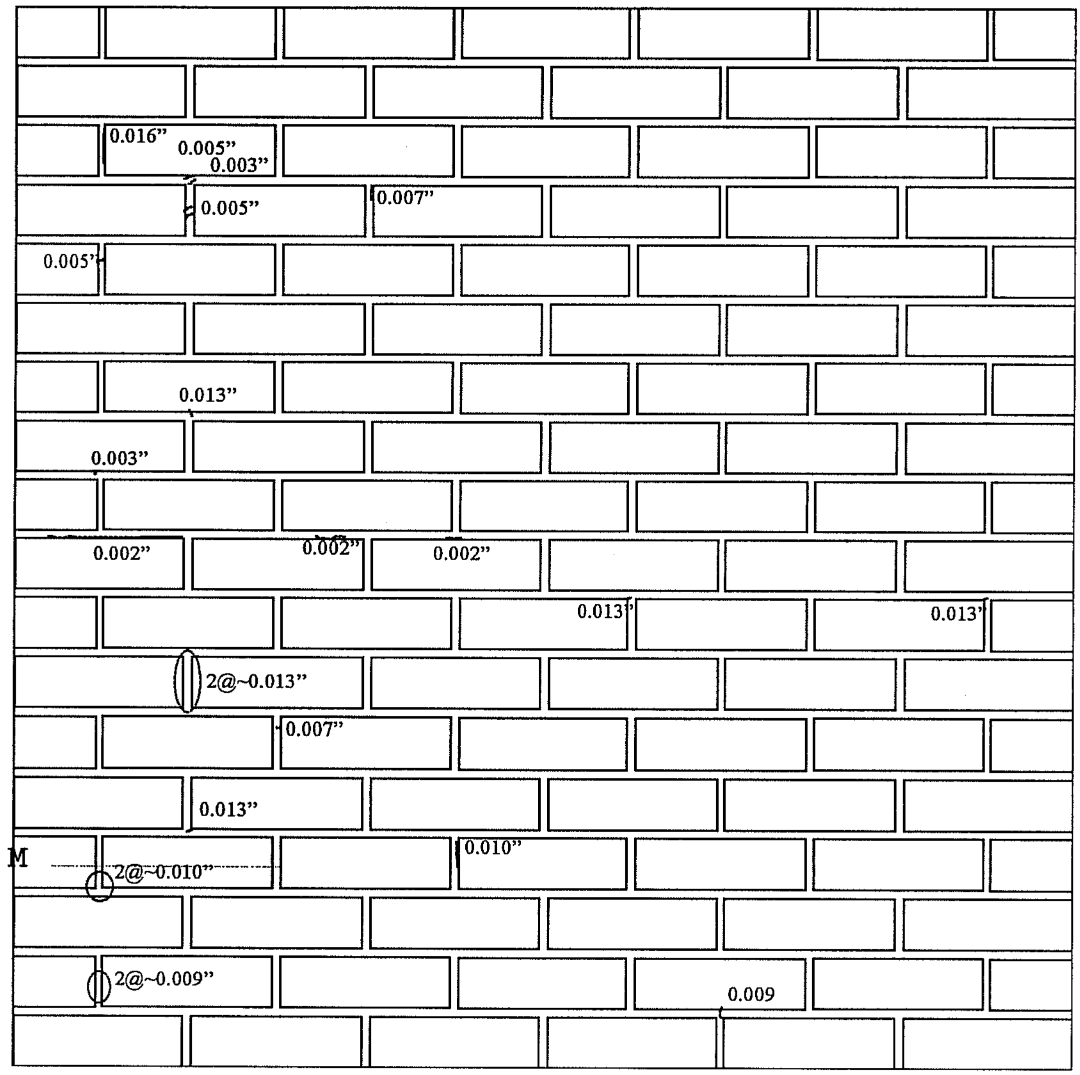
WALL: MC2S DATE: 2/5/95

SIDE: south



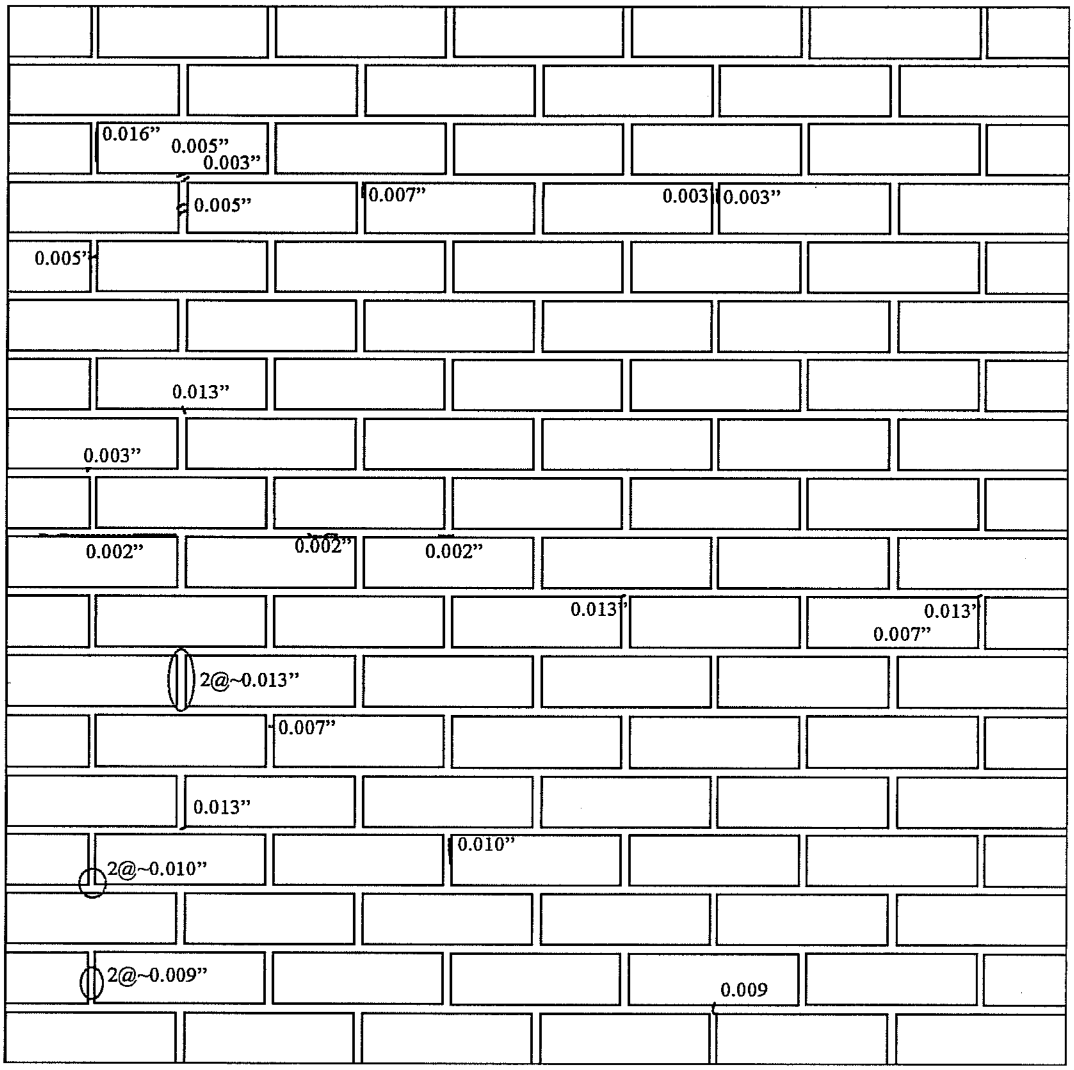
WALL: MC2S DATE: 2/10/95

SIDE: south



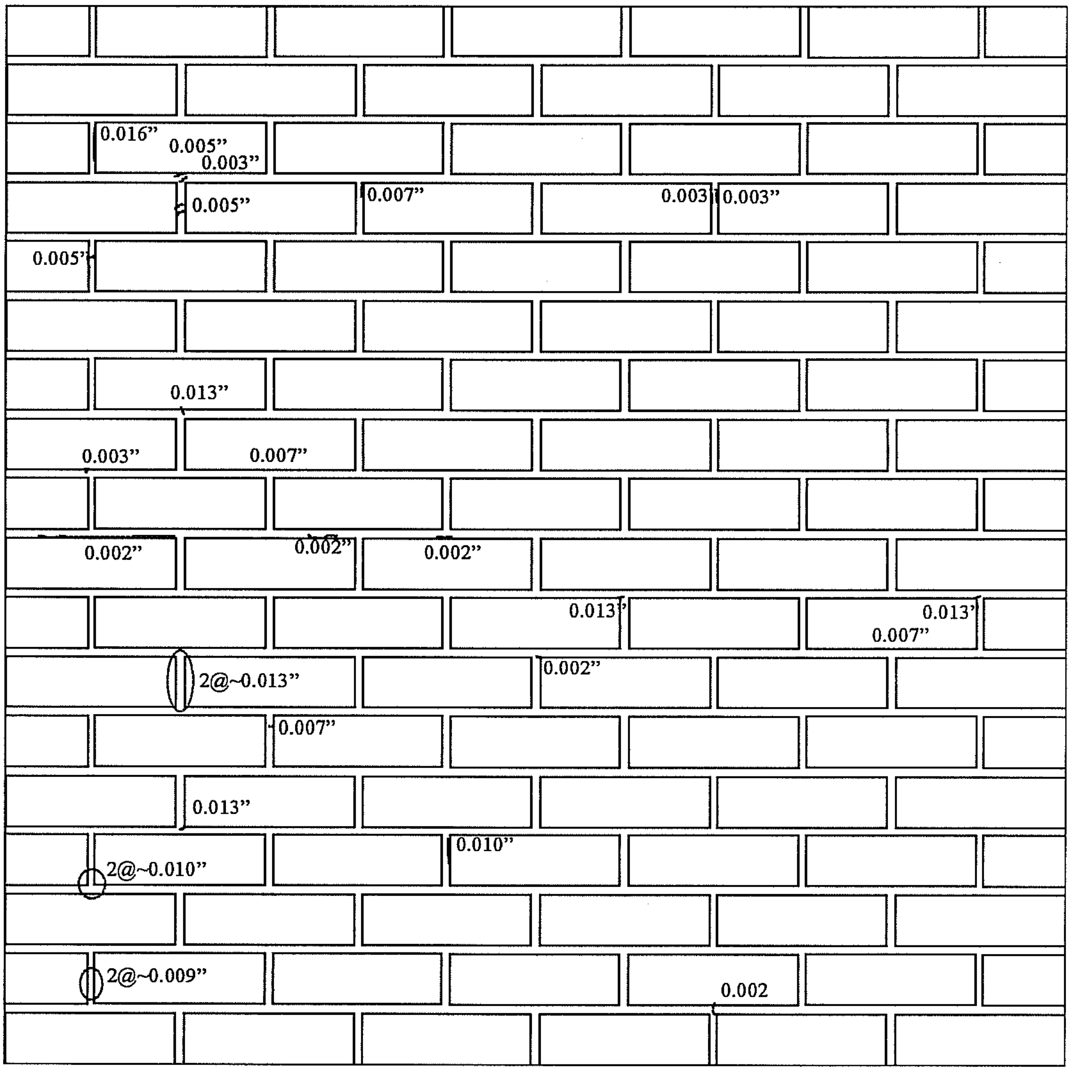
WALL: MC2S DATE: 2/15/95

SIDE: south



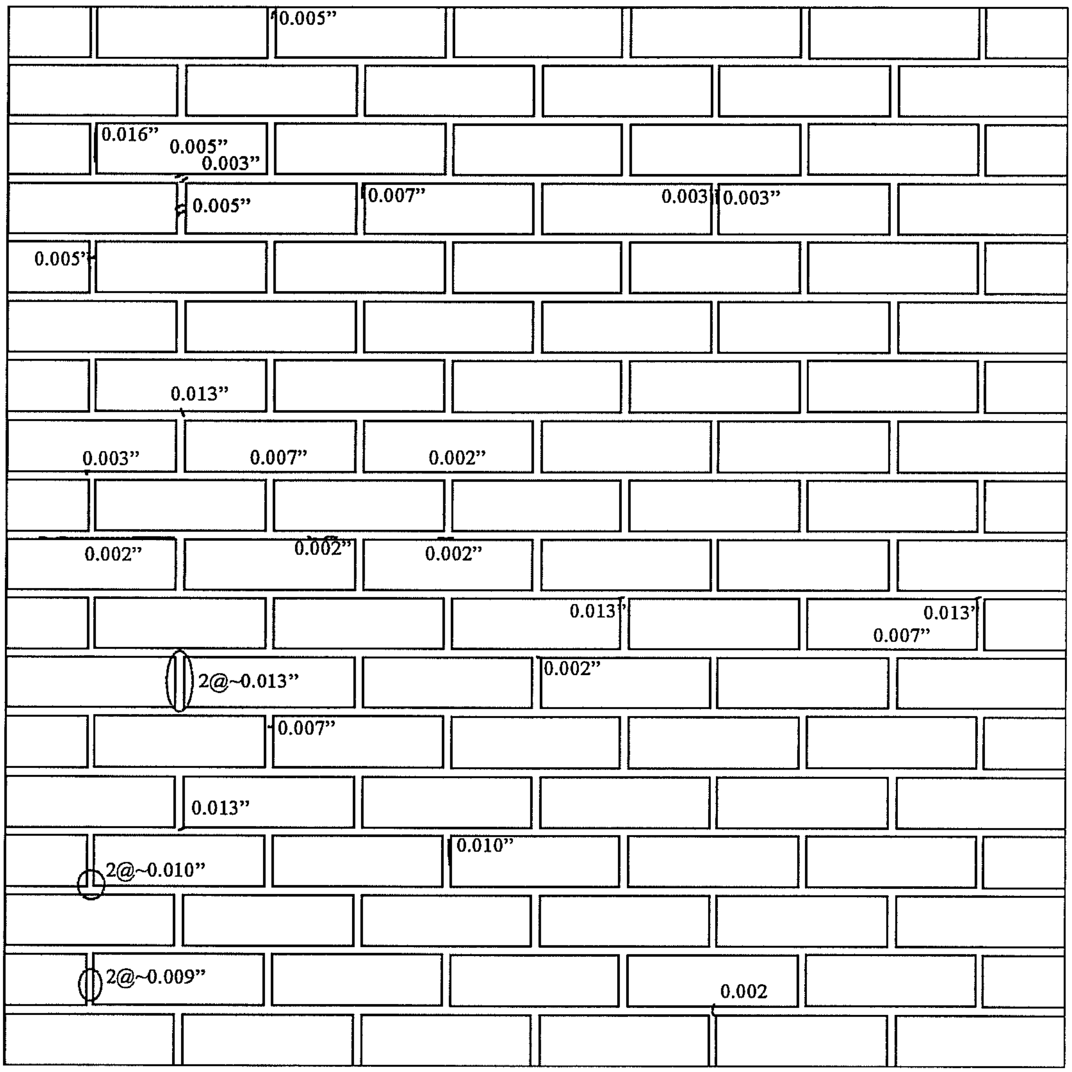
WALL: MC2S DATE: 2/21/95

SIDE: south



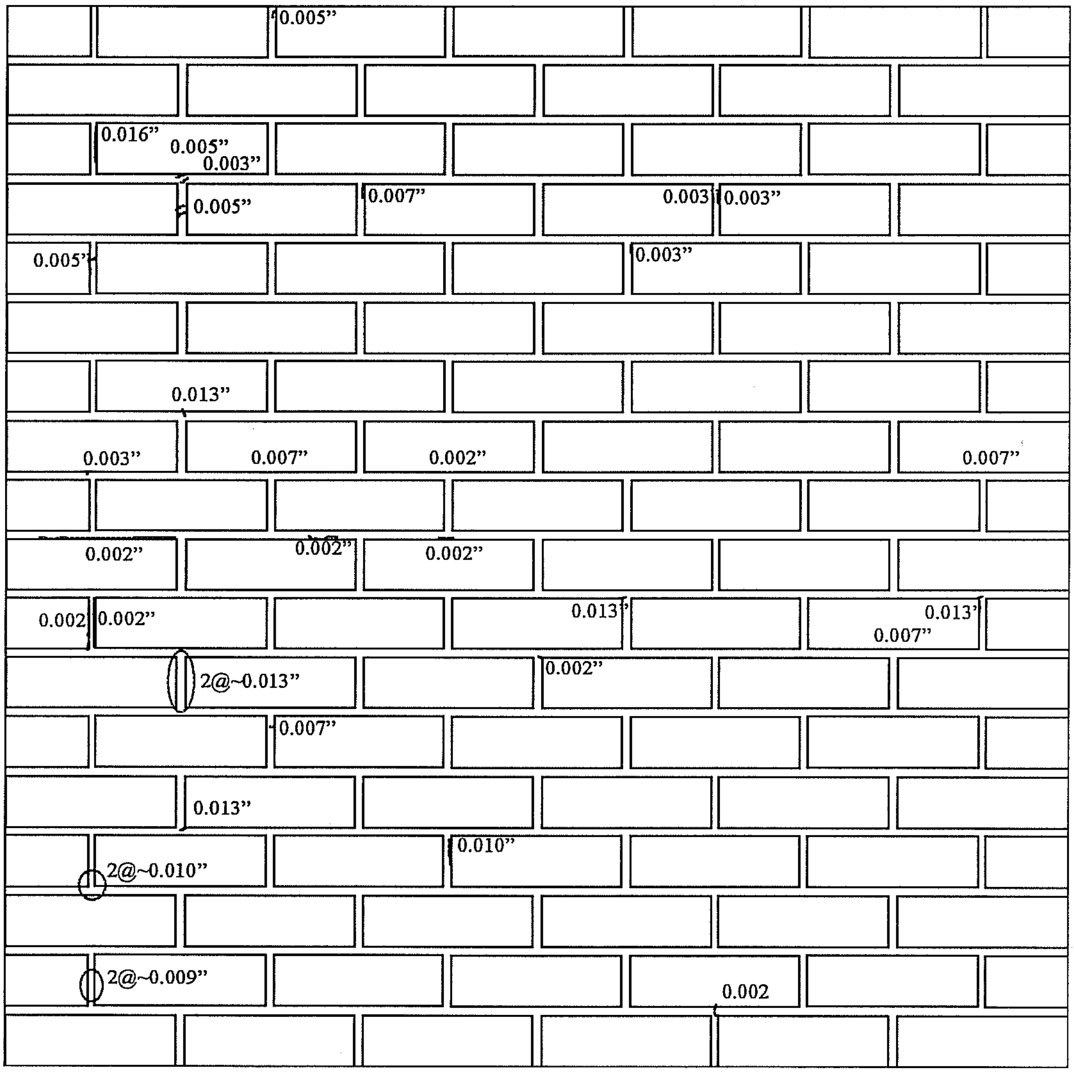
WALL: MC2S DATE: 3/7/95

SIDE: south



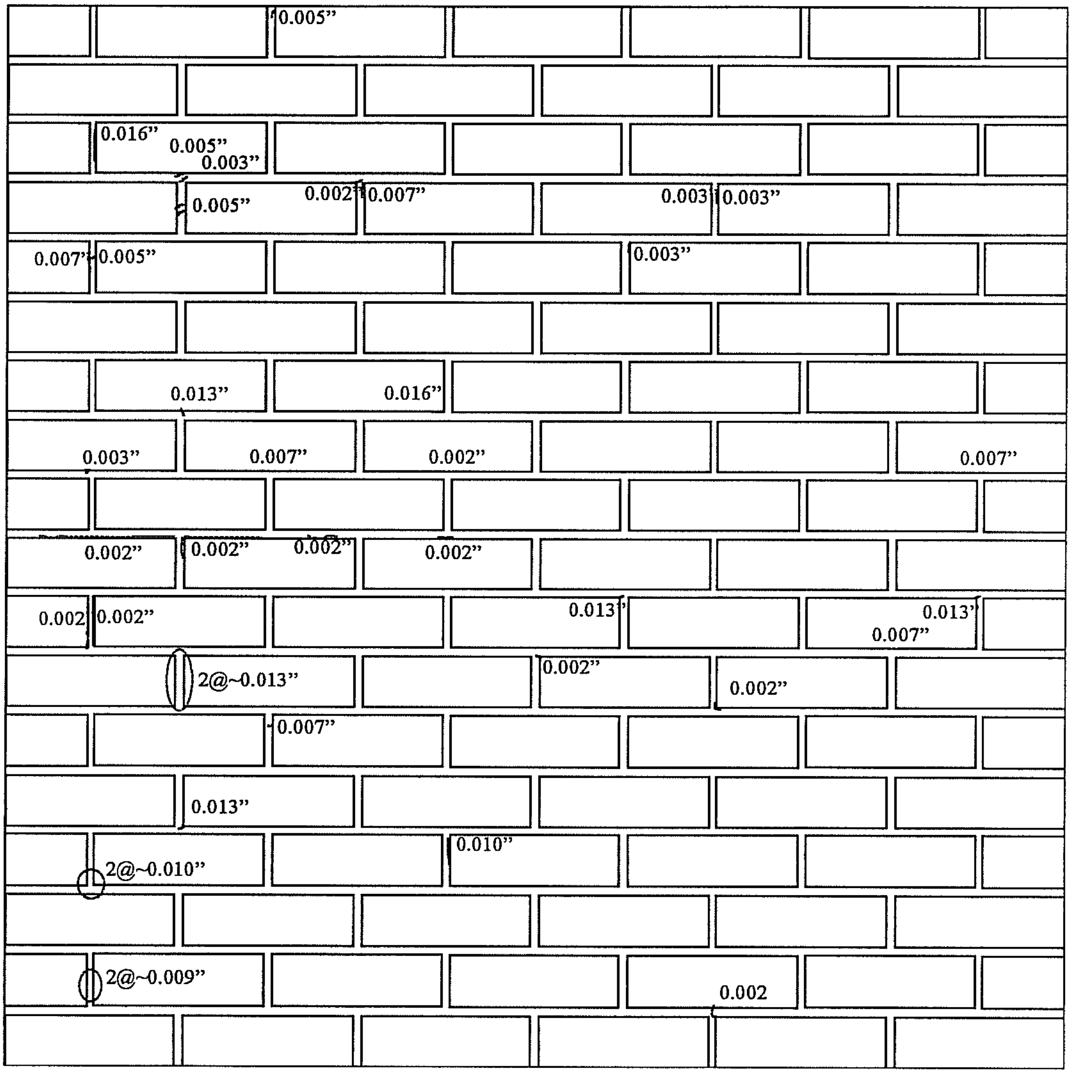
WALL: MC2S DATE: 3/14/95

SIDE: south



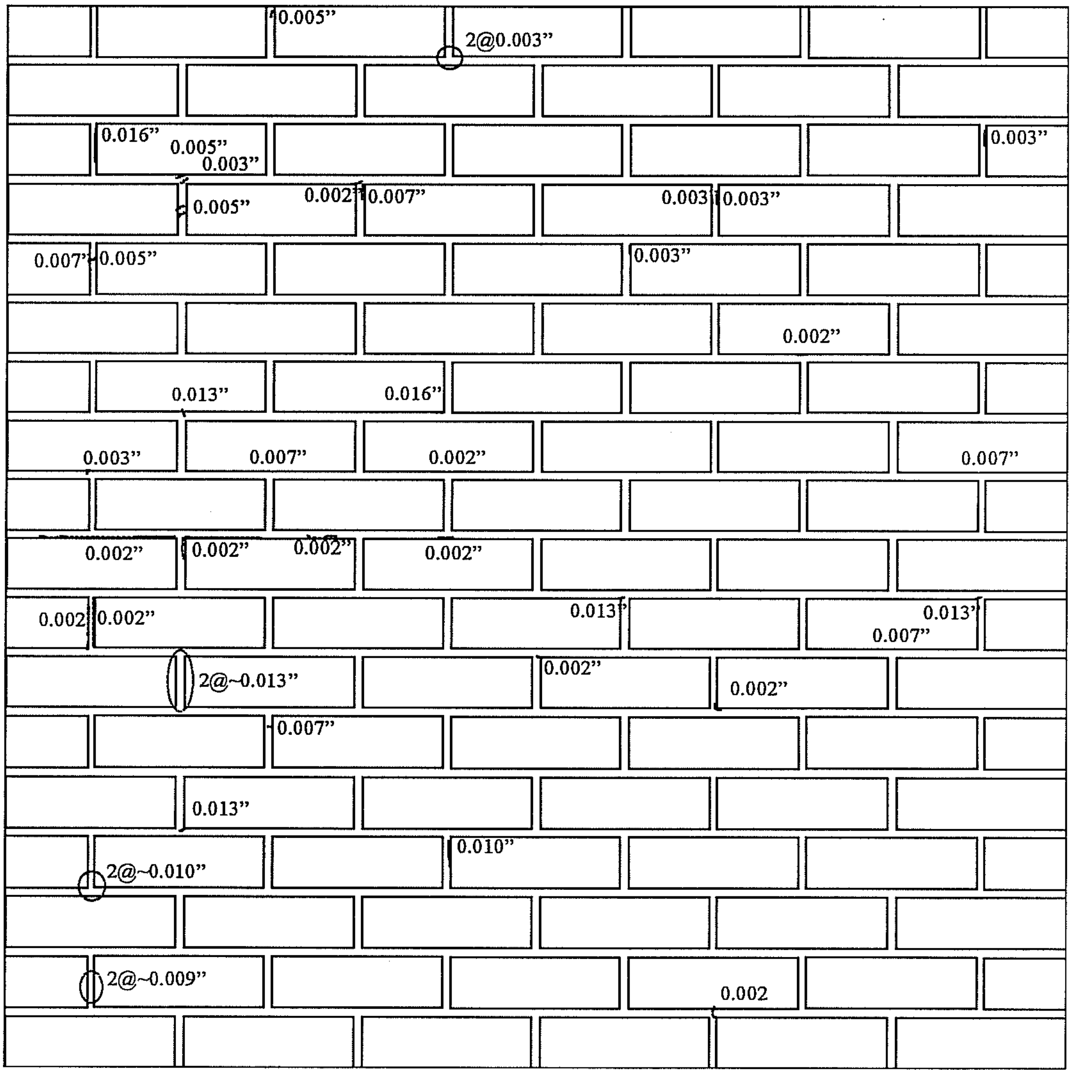
WALL: MC2S DATE: 3/20/95

SIDE: south



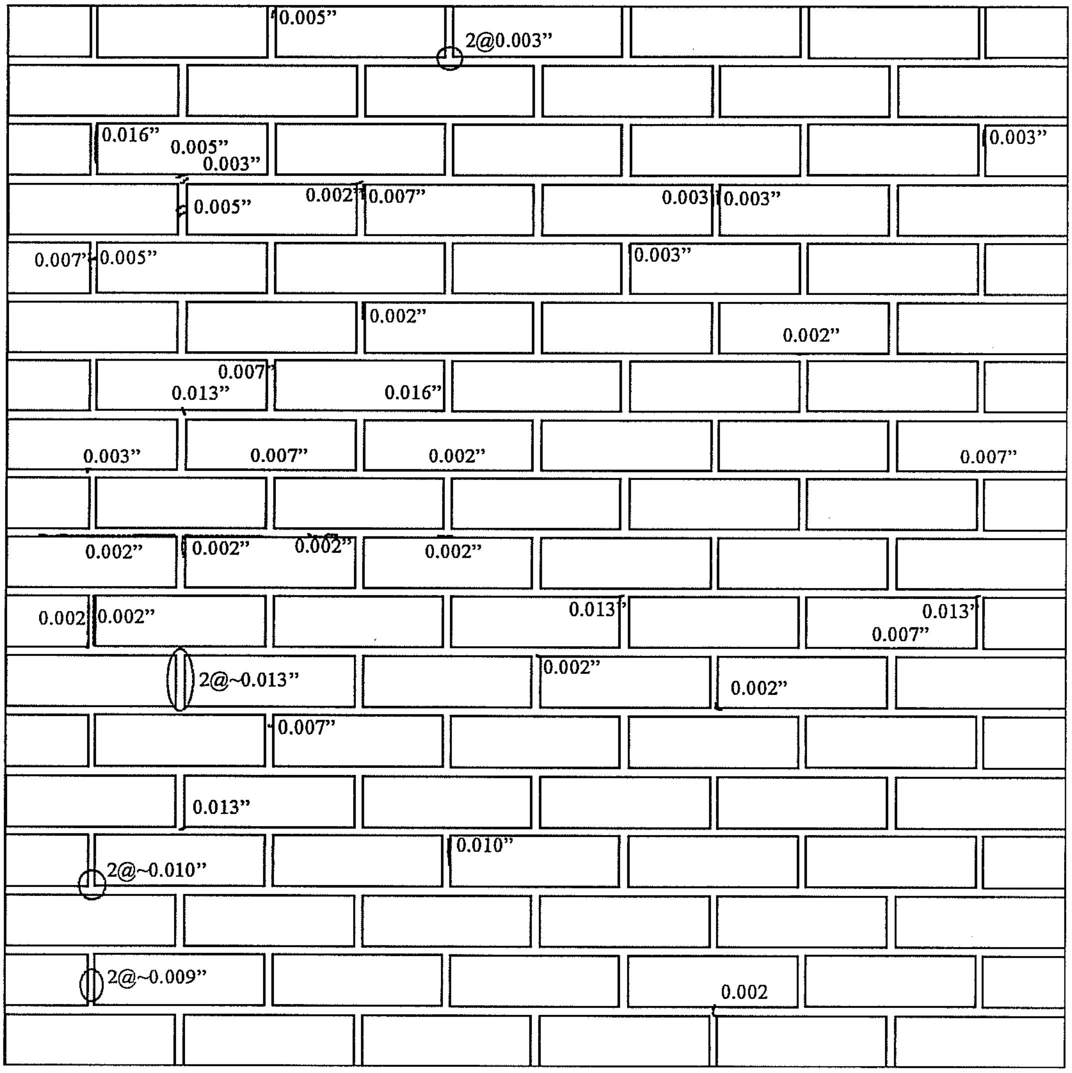
WALL: MC2S DATE: 3/27/95

SIDE: south



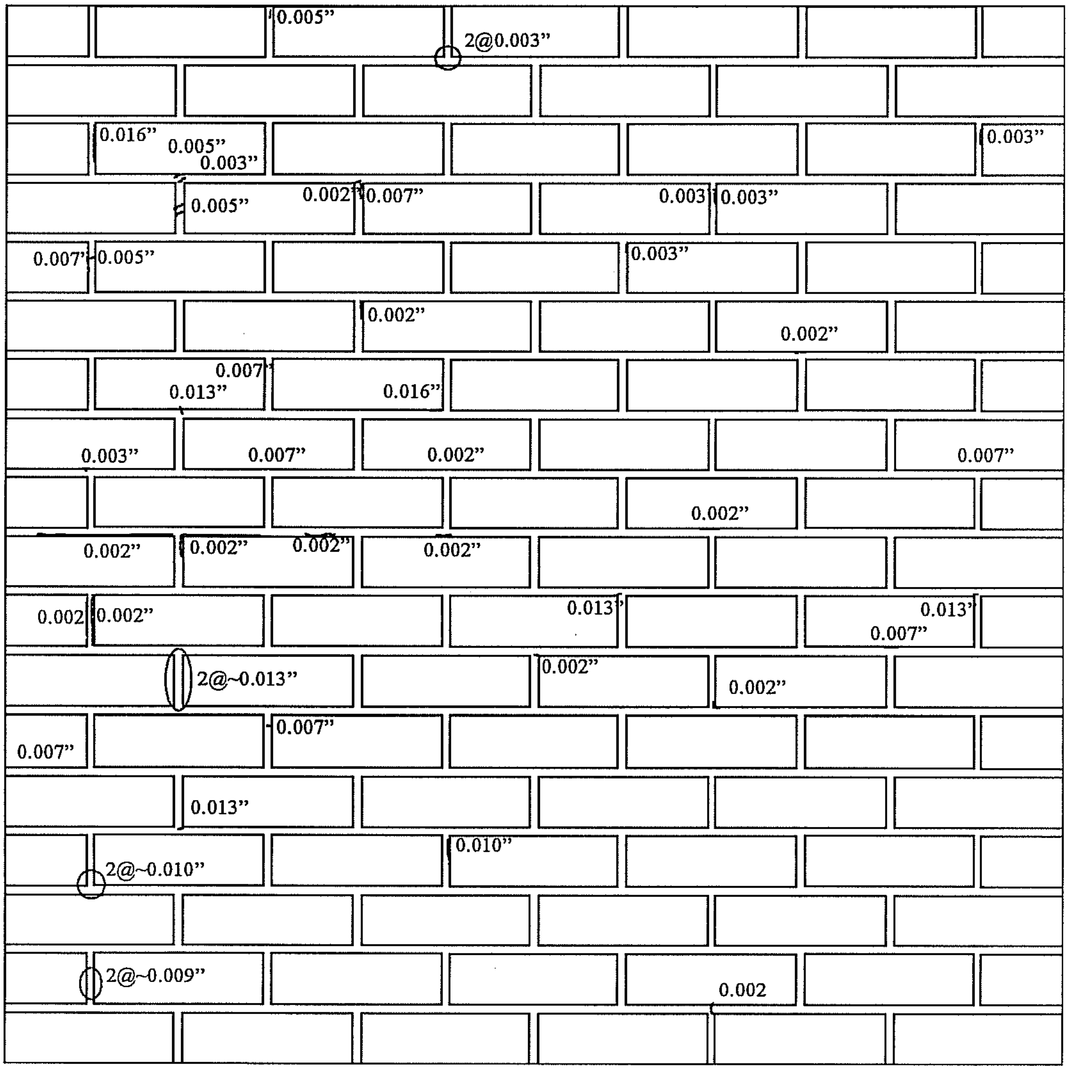
WALL: MC2S DATE: 4/3/95

SIDE: south

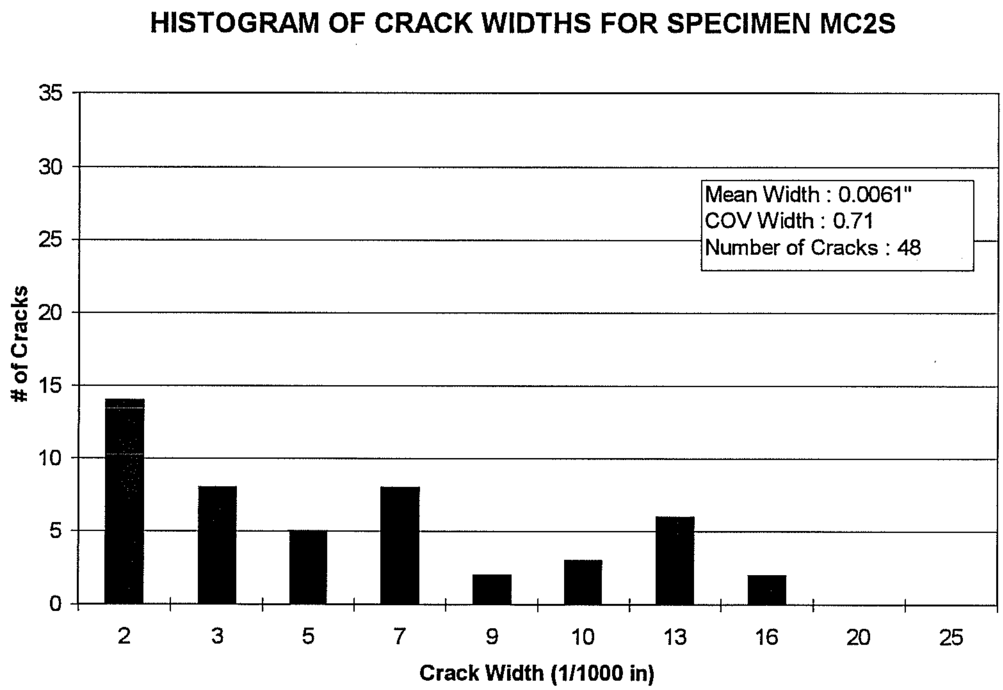


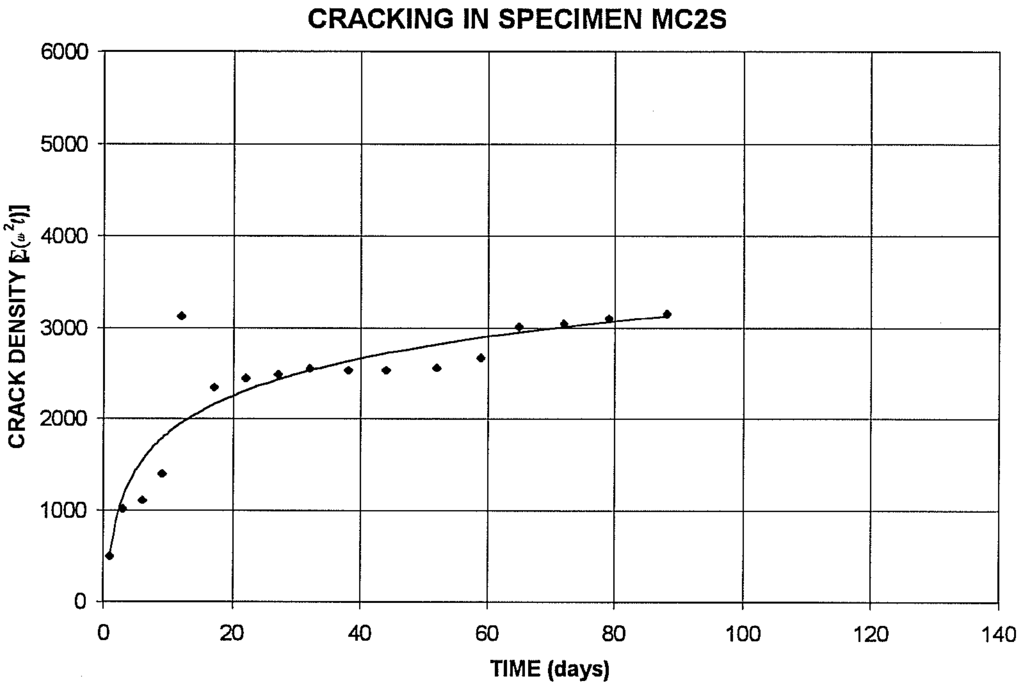
WALL: MC2S DATE: 4/12/95

SIDE: south



10.4.3 Histogram of Crack Widths and Cracking vs. Time for MC2S





10.5 Cracking in Specimen MC2N

Dates on which no changes were observed:

none

10.5.1 Quantitative Data for MC2N

1/15/95					1/17/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l		#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)				(1/1000 in)	(joint widths)	
1	7	1	49		1	7	1	49
SUM			49		1	9	1	81
					1	5	3	75
					SUM			205

1/20/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	7	1	49
1	9	1	81
1	5	3	75
1	9	1	81
1	7	1	49
1	5	1	25
SUM			360

1/23/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	7	1	49
1	9	1	81
1	5	3	75
1	9	1	81
1	7	1	49
2	9	1	162
1	5	1	25
2	5	1	50
1	9	2	162
1	9	1	81
SUM			815

1/26/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	7	1	49
1	9	1	81
1	5	3	75
1	9	1	81
1	7	1	49
2	9	1	162
1	5	1	25
2	5	1	50
1	9	2	162
1	9	1	81
2	13	1	338
1	9	1	81
1	3	1	9
2	13	1	338
SUM			1581

1/31/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	7	1	49
1	9	1	81
1	5	3	75
1	9	1	81
1	7	1	49
2	9	1	162
1	5	1	25
2	5	1	50
1	9	2	162
1	9	1	81
2	13	1	338
1	9	1	81
1	3	1	9
2	13	1	338
1	7	1	49
1	5	1	25
1	7	1	49
SUM			1704

2/5/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	7	1	49
1	9	1	81
1	5	4	100
1	9	1	81
1	7	1	49
2	9	1	162
1	5	1	25
2	5	1	50
1	9	2	162
1	9	1	81
2	13	1	338
1	9	1	81
1	3	1	9
2	13	1	338
1	9	1	81
1	5	1	25
1	7	1	49
1	9	2	162
1	9	1	81
1	7	2	98
SUM			2102

2/10/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	7	1	49
1	9	1	81
1	5	4	100
1	9	1	81
1	7	1	49
2	9	1	162
1	5	1	25
2	5	1	50
1	9	2	162
1	9	1	81
2	13	1	338
1	9	1	81
1	3	1	9
2	13	1	338
1	9	1	81
1	5	1	25
1	7	1	49
1	9	2	162
1	9	1	81
1	7	2	98
1	16	1	256
1	10	1	100
1	9	1	81
SUM			2539

2/15/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	7	1	49
1	9	1	81
1	5	4	100
1	9	1	81
1	7	1	49
2	9	1	162
1	5	1	25
2	5	1	50
1	9	2	162
1	9	1	81
2	13	1	338
1	9	1	81
1	3	1	9
2	13	1	338
1	9	1	81
1	5	1	25
1	7	1	49
1	9	2	162
1	9	1	81
1	7	2	98
1	16	1	256
1	10	1	100
1	9	1	81
1	9	1	81
SUM			2620

2/21/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	7	1	49
1	10	1	100
1	5	4	100
1	9	1	81
1	7	1	49
2	3	1	18
1	5	1	25
2	5	1	50
1	9	2	162
1	9	1	81
2	13	1	338
1	9	1	81
1	3	1	9
2	13	1	338
1	9	1	81
1	5	1	25
1	3	1	9
1	9	2	162
1	9	1	81
1	7	2	98
1	16	1	256
1	10	1	100
1	9	1	81
1	9	1	81
1	10	1	100
1	5	1	25
1	9	1	81
2	9	1	162
1	5	2	50
1	3	1	9
1	5	1	25
SUM			2907

2/27/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	7	1	49
1	10	1	100
1	5	4	100
1	9	1	81
1	7	1	49
2	3	1	18
1	5	1	25
2	5	1	50
1	9	2	162
1	9	1	81
2	13	1	338
1	9	1	81
1	3	1	9
2	13	1	338
1	9	1	81
1	5	1	25
1	3	1	9
1	9	2	162
1	9	1	81
1	7	2	98
1	16	1	256
1	10	1	100
1	9	1	81
1	9	1	81
1	10	1	100
1	5	1	25
1	9	1	81
2	9	1	162
1	5	2	50
1	3	1	9
1	5	1	25
1	7	1	49
SUM			2956

3/7/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	7	1	49
1	10	1	100
1	5	4	100
1	9	1	81
1	7	1	49
2	3	1	18
1	5	1	25
2	5	1	50
1	9	2	162
1	9	1	81
2	13	1	338
1	9	1	81
1	3	1	9
2	13	1	338
1	9	1	81
1	5	1	25
1	3	1	9
1	9	2	162
1	9	1	81
1	7	2	98
1	16	1	256
1	10	1	100
1	9	1	81
1	9	1	81
1	10	1	100
1	5	1	25
1	9	1	81
2	9	1	162
1	5	2	50
1	3	1	9
1	5	1	25
1	7	1	49
1	3	1	9
1	7	1	49
1	10	1	100
SUM			3114

3/14/95					3/20/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l		#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)				(1/1000 in)	(joint widths)	
1	7	1	49		1	7	1	49
1	10	1	100		1	10	1	100
1	5	4	100		1	5	4	100
1	9	1	81		1	9	1	81
1	7	1	49		1	7	1	49
2	3	1	18		2	3	1	18
1	5	1	25		1	5	1	25
2	5	1	50		2	5	1	50
1	9	2	162		1	9	2	162
1	9	1	81		1	9	1	81
2	13	1	338		2	13	1	338
1	9	1	81		1	9	1	81
1	3	1	9		1	3	1	9
2	13	1	338		2	13	1	338
1	9	1	81		1	9	1	81
1	5	1	25		1	5	1	25
1	3	1	9		1	3	1	9
1	9	2	162		1	9	2	162
1	9	1	81		1	9	1	81
1	7	2	98		1	7	2	98
1	16	1	256		1	16	1	256
1	10	1	100		1	10	1	100
1	9	1	81		1	9	1	81
1	9	1	81		1	9	1	81
1	10	1	100		1	10	1	100
1	5	1	25		1	5	1	25
1	9	1	81		1	9	1	81
2	9	1	162		2	9	1	162
1	5	2	50		1	5	2	50
1	3	1	9		1	3	1	9
1	5	1	25		1	5	1	25
1	7	1	49		1	7	1	49
1	3	1	9		1	3	1	9
1	7	1	49		1	7	1	49
1	10	1	100		1	10	1	100
1	5	1	25		1	5	1	25
1	7	1	49		1	7	1	49
1	10	1	100		1	10	1	100
SUM			3288		1	13	1	169
					1	3	1	9
					SUM			3466

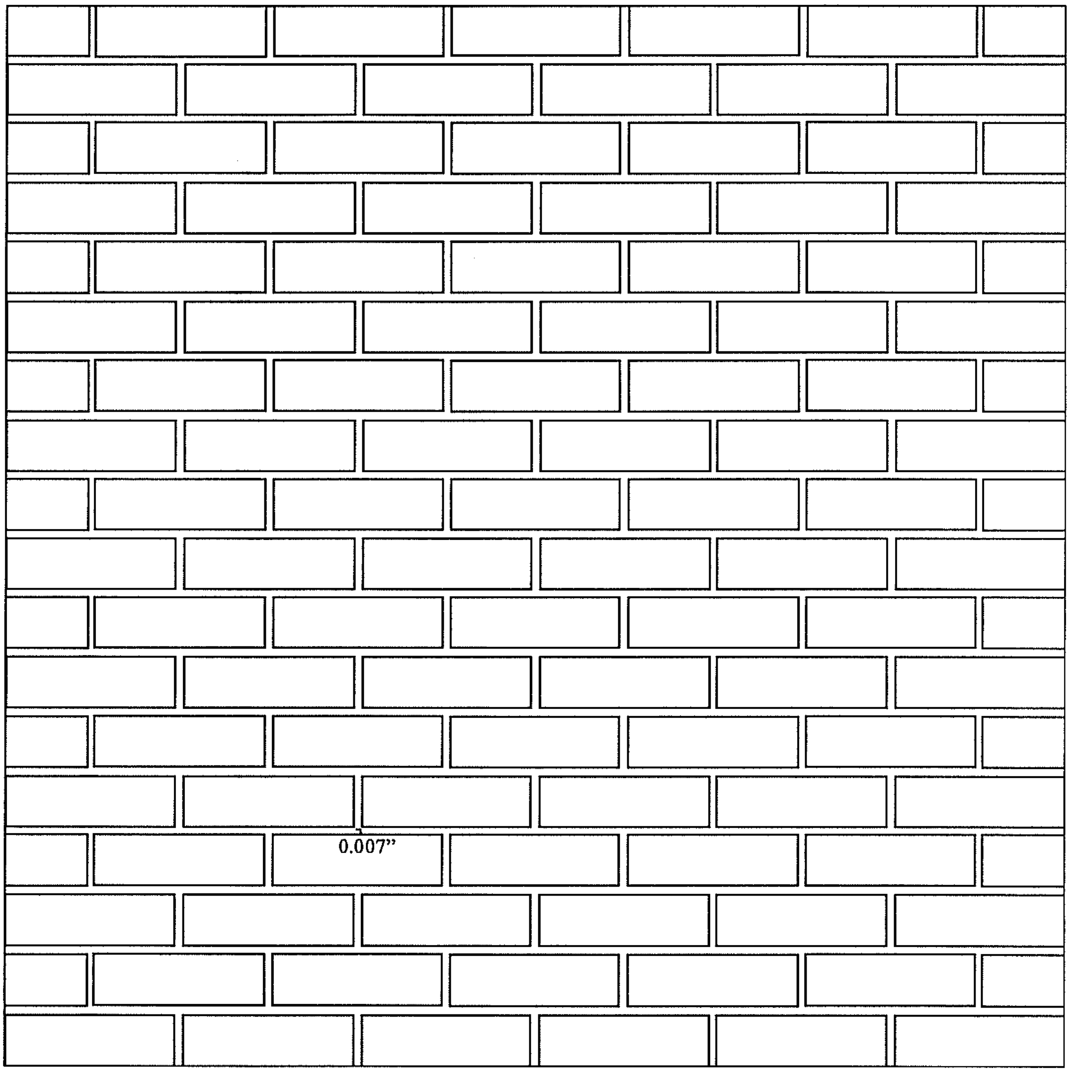
3/27/95					4/3/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l		#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)				(1/1000 in)	(joint widths)	
1	7	1	49		1	7	1	49
1	10	1	100		1	10	1	100
1	5	4	100		1	5	4	100
1	9	1	81		1	9	1	81
1	7	1	49		1	7	1	49
2	3	1	18		2	3	1	18
1	5	1	25		1	5	1	25
2	5	1	50		2	5	1	50
1	9	2	162		1	9	2	162
1	9	1	81		1	9	1	81
2	13	1	338		2	13	1	338
1	9	1	81		1	9	1	81
1	3	1	9		1	3	1	9
2	13	1	338		2	13	1	338
1	9	1	81		1	9	1	81
1	5	1	25		1	5	1	25
1	3	1	9		1	3	1	9
1	9	2	162		1	9	2	162
1	9	1	81		1	9	1	81
1	7	2	98		1	7	2	98
1	16	1	256		1	16	1	256
1	10	1	100		1	10	1	100
1	9	1	81		1	9	1	81
1	9	1	81		1	9	1	81
1	10	1	100		1	10	1	100
1	5	1	25		1	5	1	25
1	9	1	81		1	9	1	81
2	9	1	162		2	9	1	162
1	5	2	50		1	5	2	50
1	3	1	9		1	3	1	9
1	5	1	25		1	5	1	25
1	7	1	49		1	7	1	49
1	3	1	9		1	3	1	9
1	7	1	49		1	7	1	49
1	10	1	100		1	10	1	100
1	5	1	25		1	5	1	25
1	7	1	49		1	7	1	49
1	10	1	100		1	10	1	100
1	13	1	169		1	13	1	169
1	3	1	9		1	3	1	9
1	3	1	9		1	3	1	9
SUM			3475		1	3	1	9
					SUM			3484

4/12/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	7	1	49
1	10	1	100
1	5	4	100
1	9	1	81
1	7	1	49
2	3	1	18
1	5	1	25
2	5	1	50
1	9	2	162
1	9	1	81
2	13	1	338
1	9	1	81
1	3	1	9
2	13	1	338
1	9	1	81
1	5	1	25
1	3	1	9
1	9	2	162
1	9	1	81
1	7	2	98
1	16	1	256
1	10	1	100
1	9	1	81
1	9	1	81
1	10	1	100
1	5	1	25
1	9	1	81
2	9	1	162
1	5	2	50
1	3	1	9
1	5	1	25
1	7	1	49
1	3	1	9
1	7	1	49
1	10	1	100
1	5	1	25
1	7	1	49
1	10	1	100
1	13	1	169
1	3	1	9
1	3	1	9
1	3	1	9
1	9	3	243
1	2	1	4
2	3	1	18
SUM			3749

10.5.2 Panel Drawings for MC2N

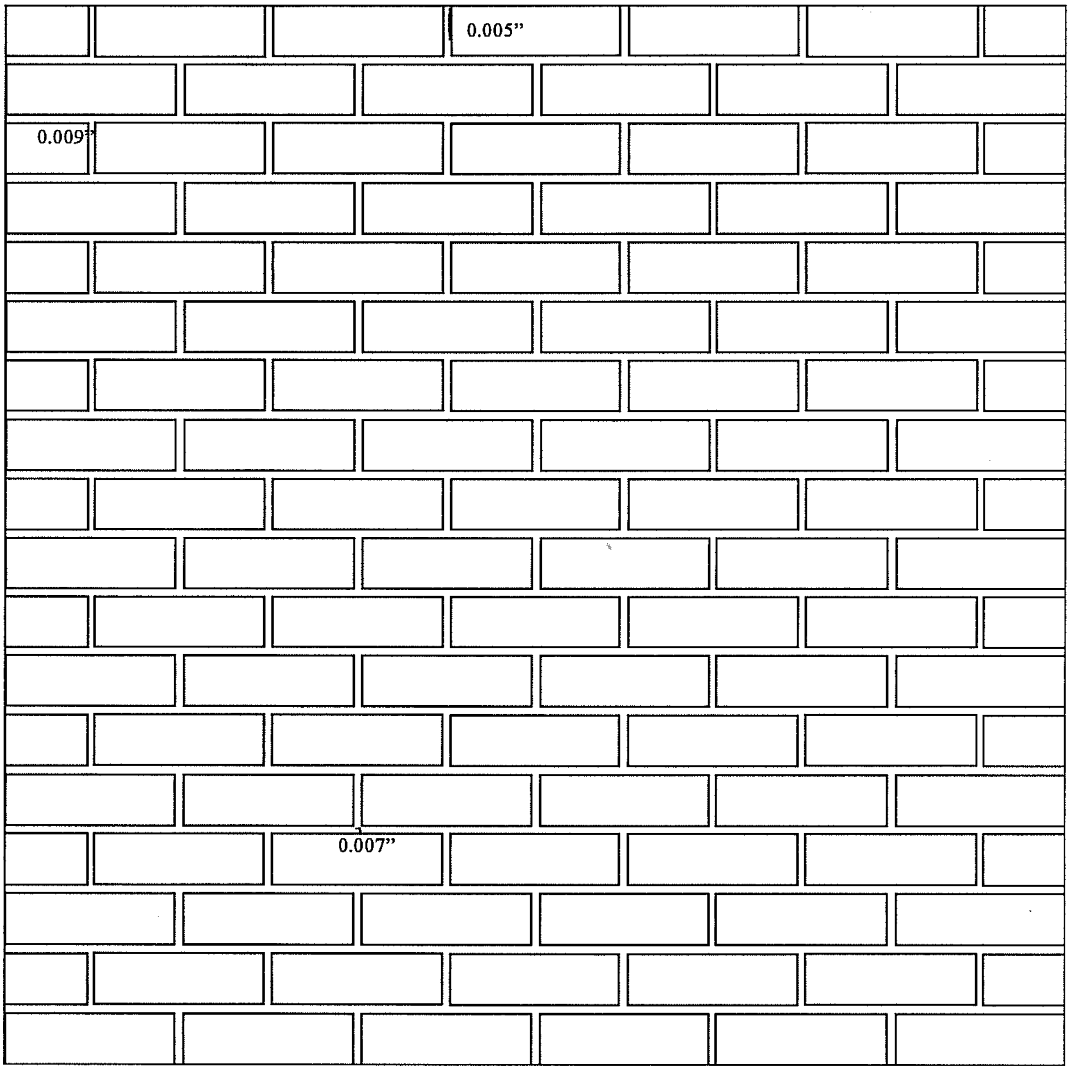
WALL: MC2N DATE: 1/15/95

SIDE: south



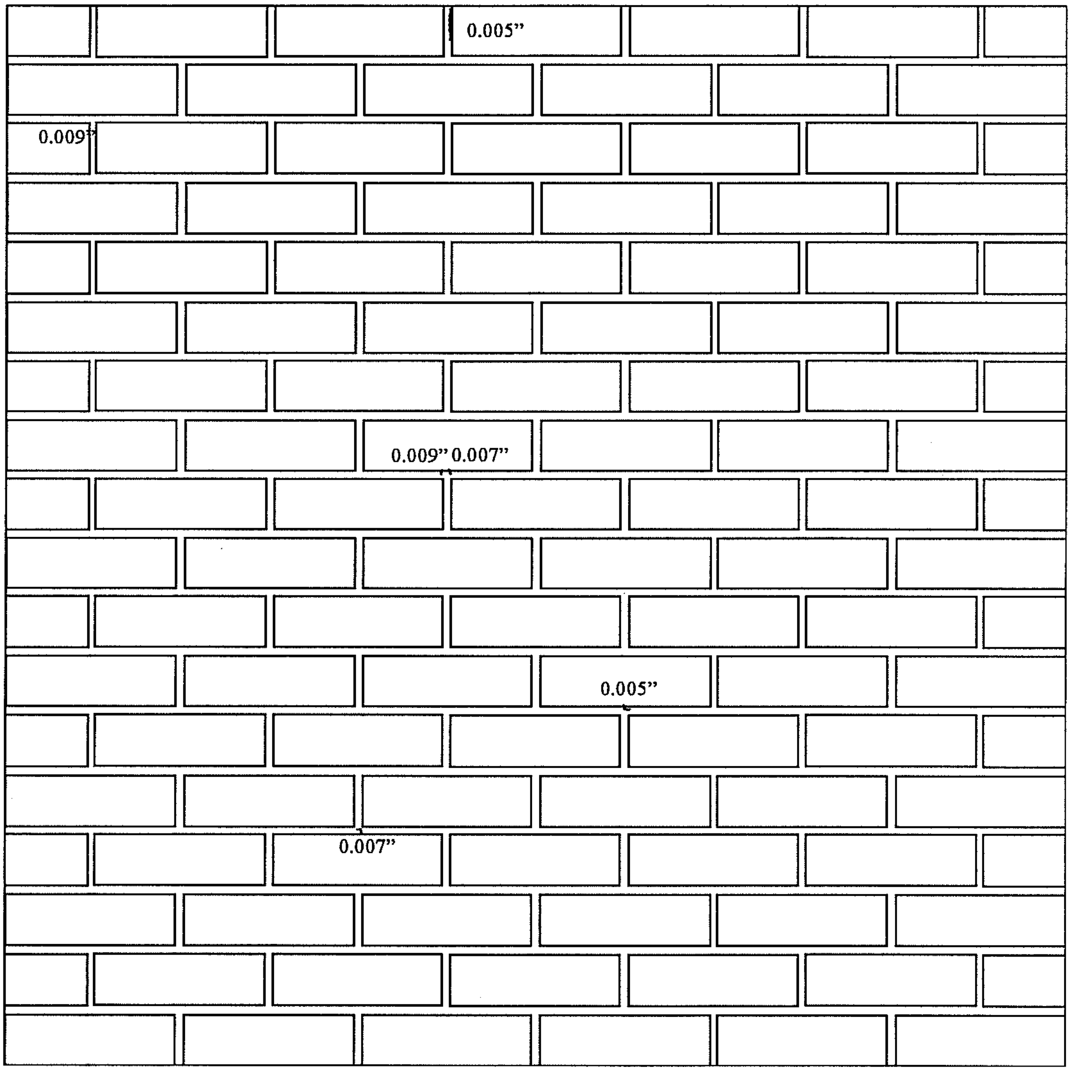
WALL: MC2N DATE: 1/17/95

SIDE: south



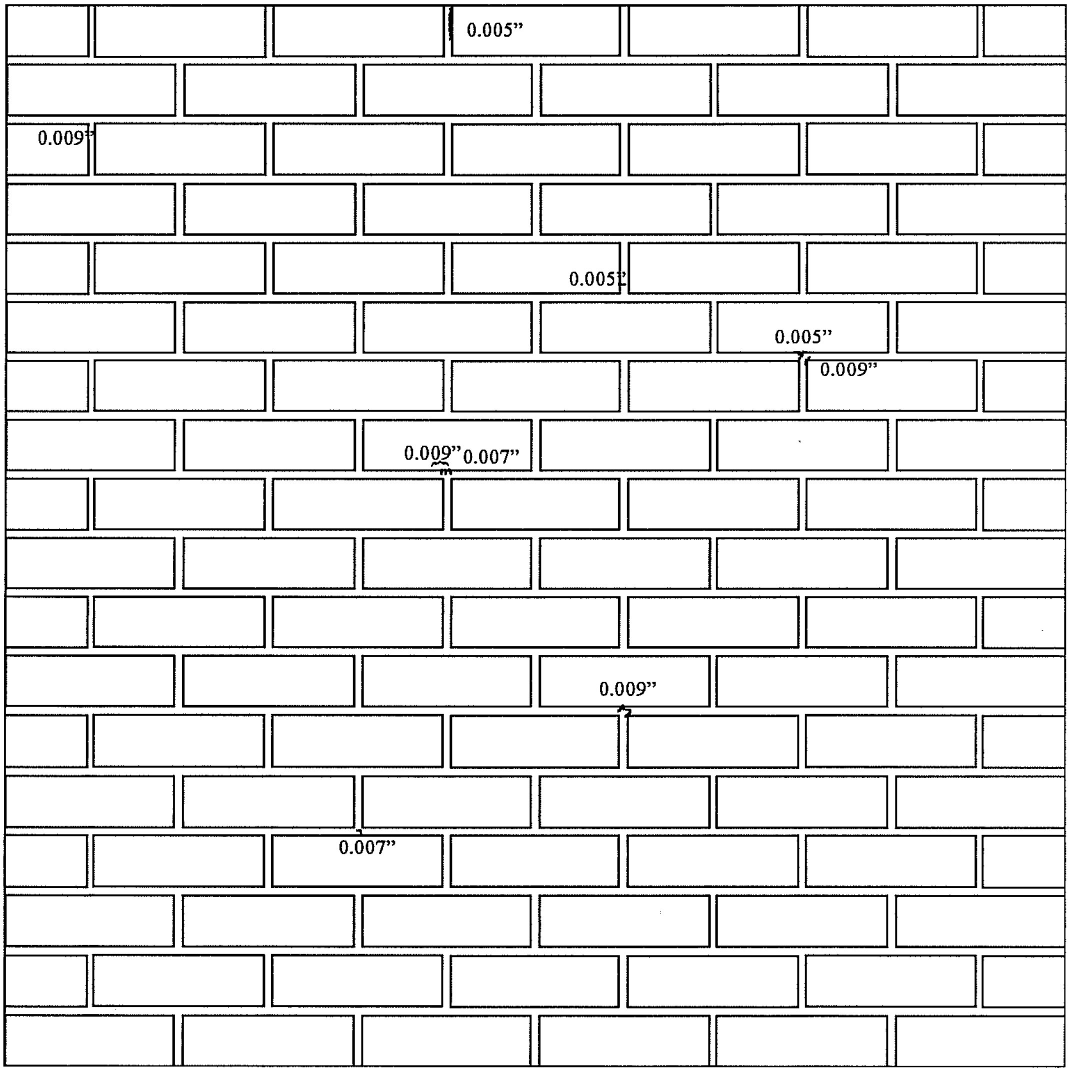
WALL: MC2N DATE: 1/20/95

SIDE: south



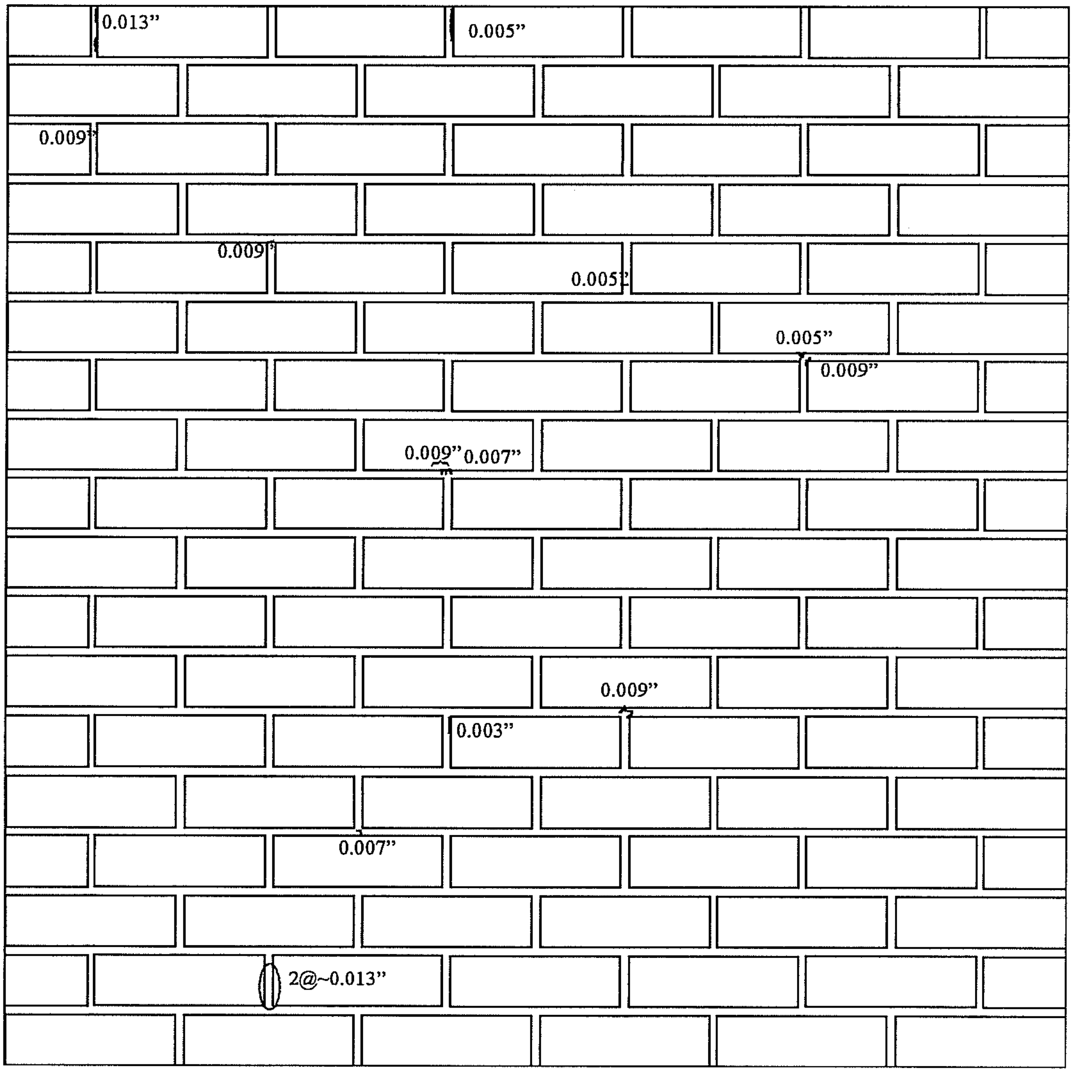
WALL: MC2N DATE: 1/23/95

SIDE: south



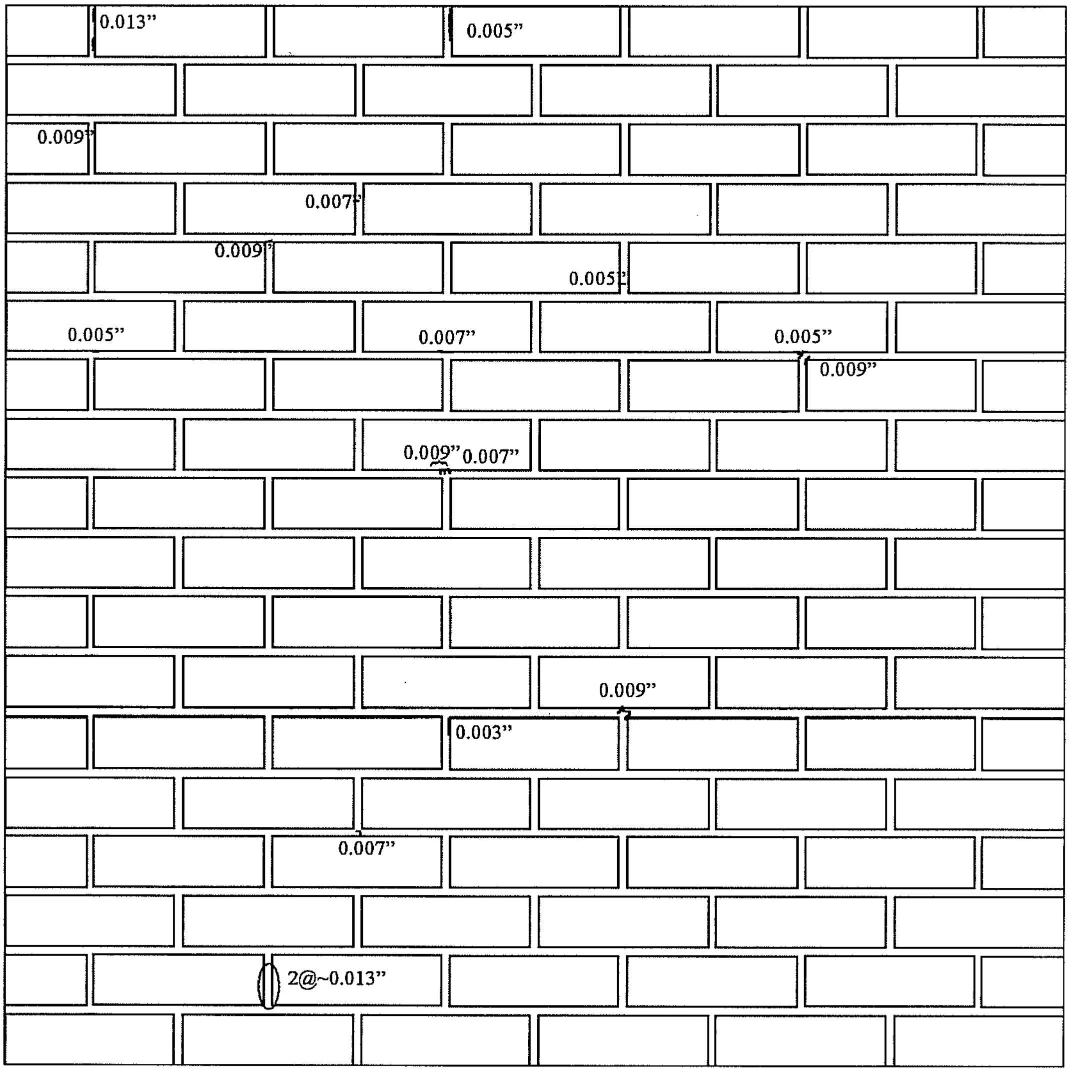
WALL: MC2N DATE: 1/26/95

SIDE: south



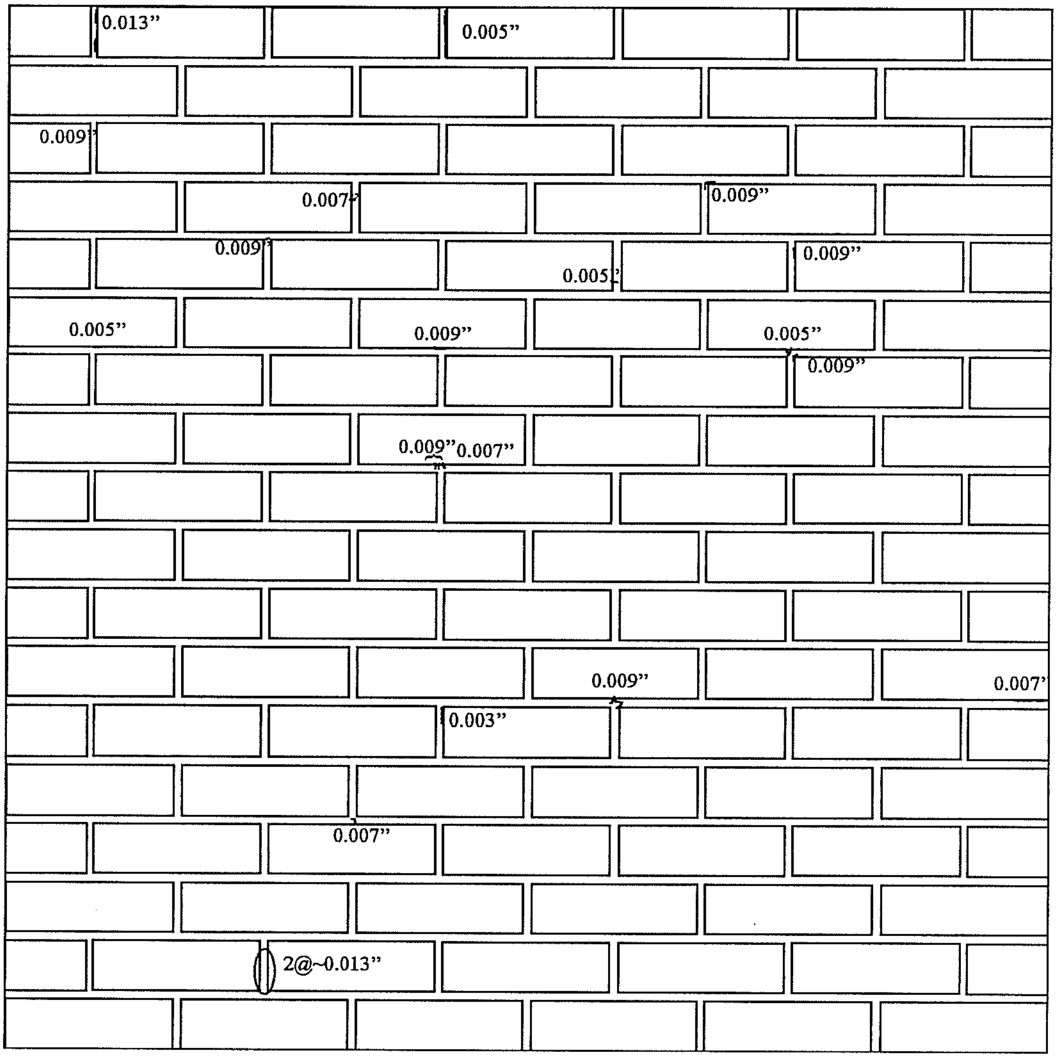
WALL: MC2N DATE: 1/31/95

SIDE: south



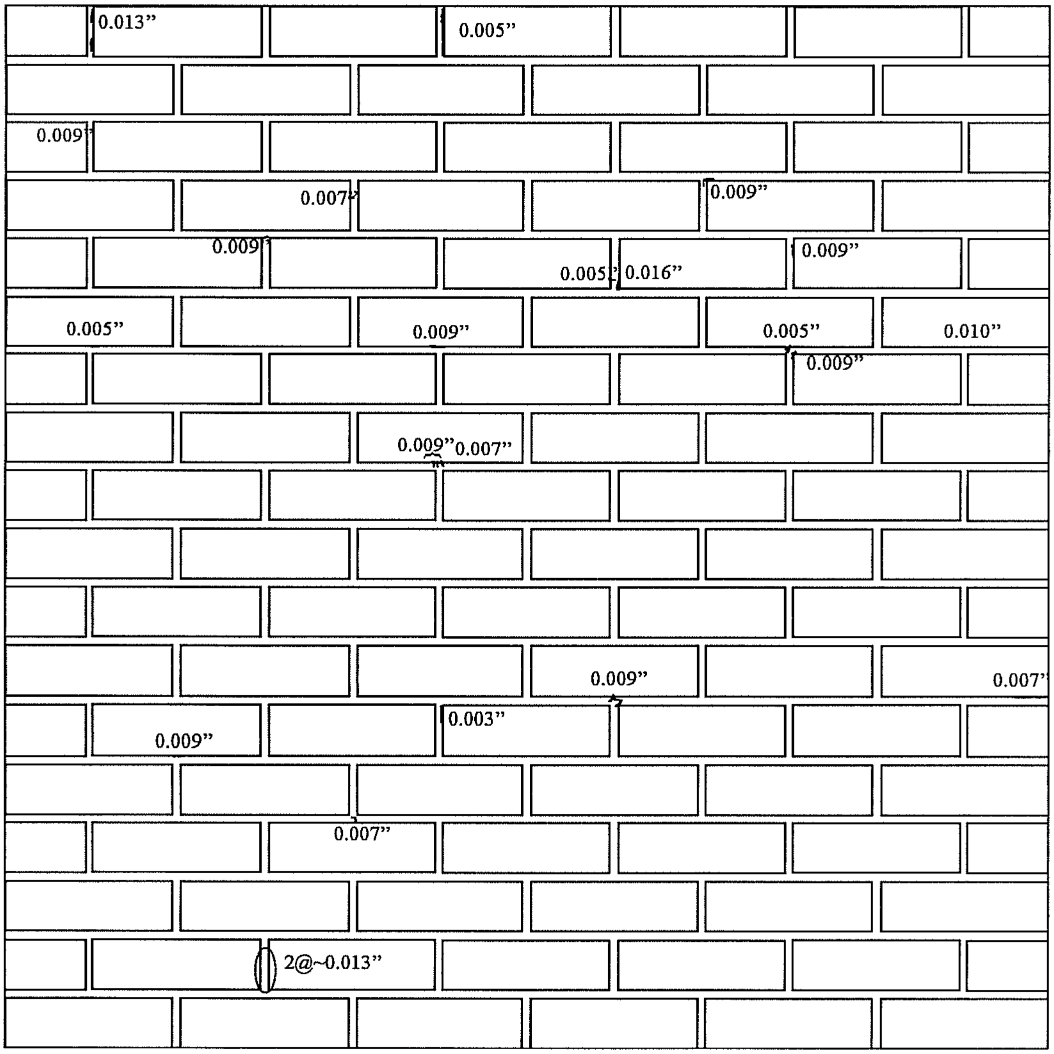
WALL: MC2N DATE: 2/5/95

SIDE: south



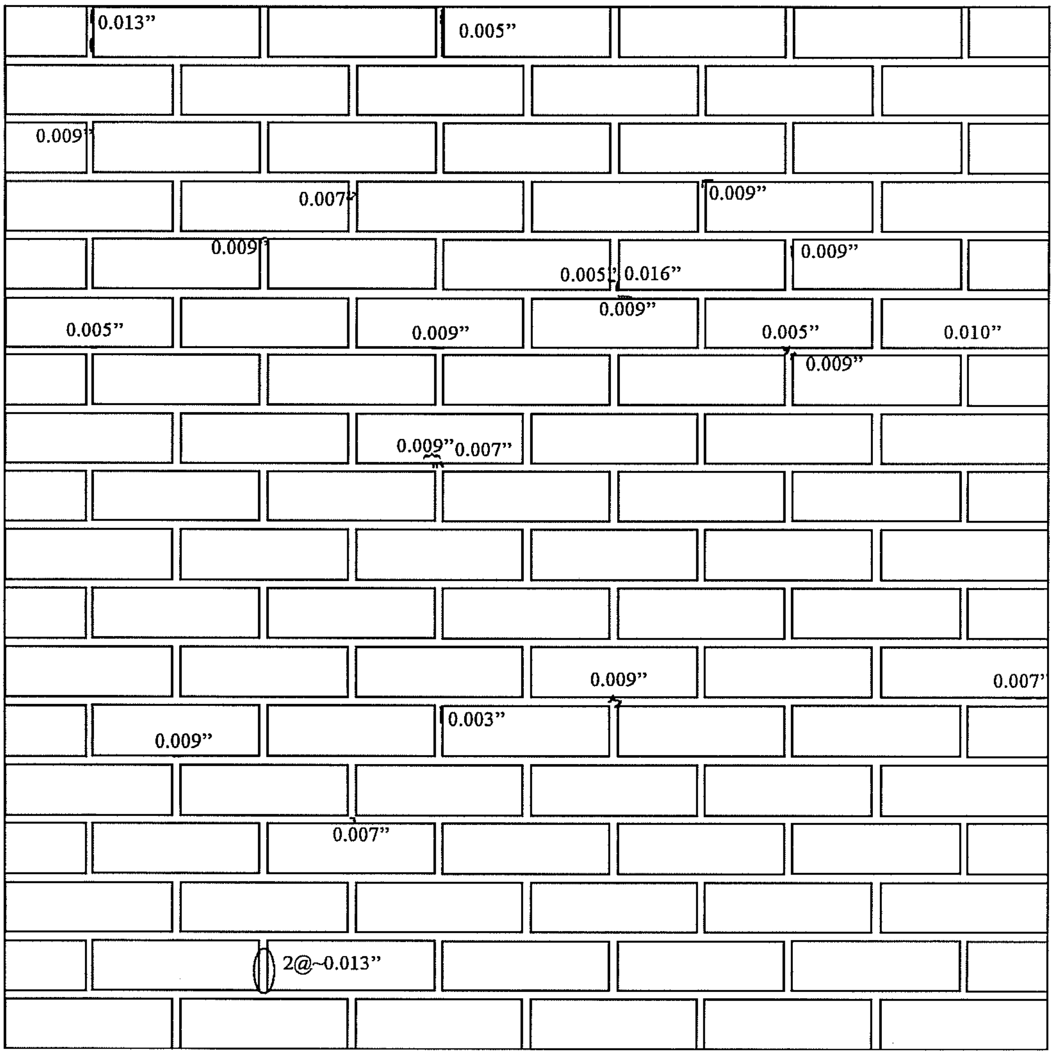
WALL: MC2N DATE: 2/10/95

SIDE: south



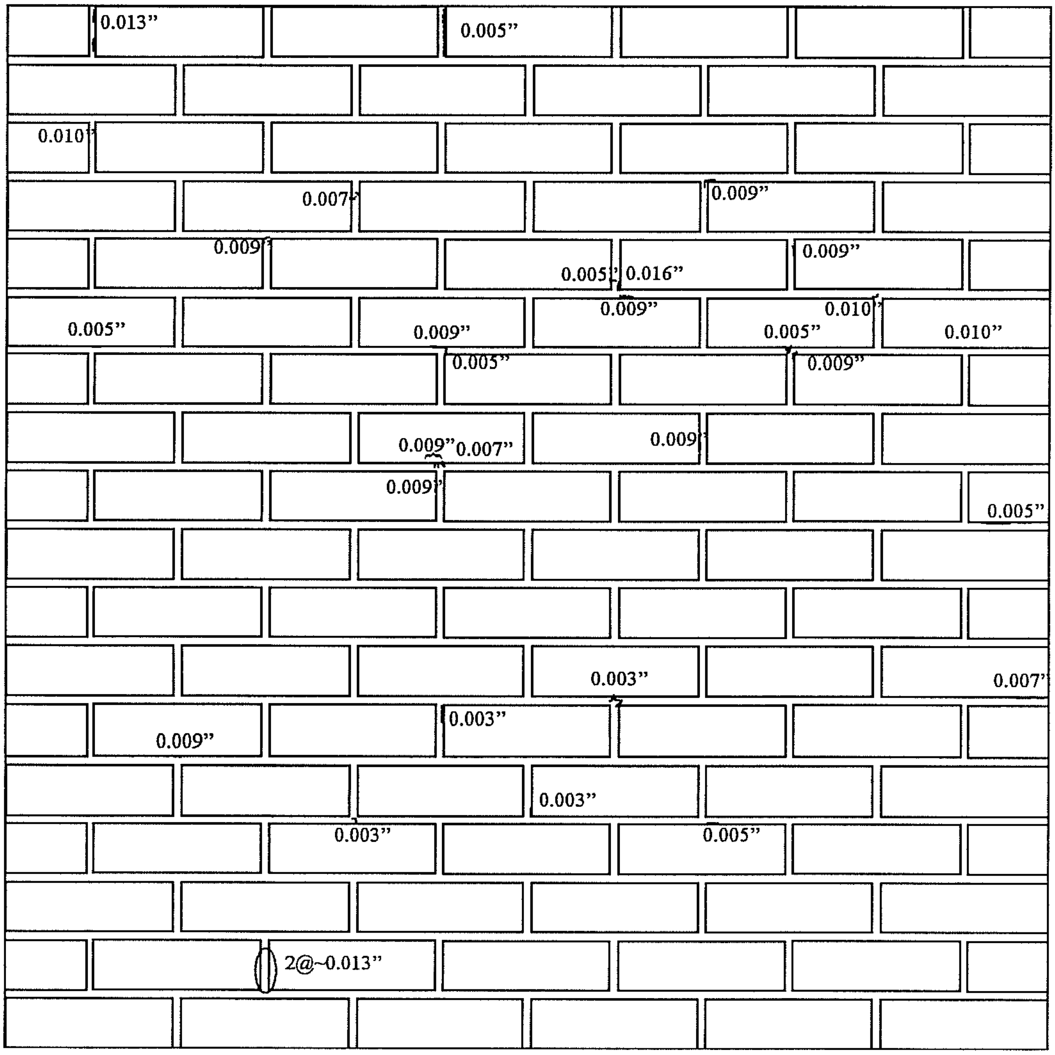
WALL: MC2N DATE: 2/15/95

SIDE: south



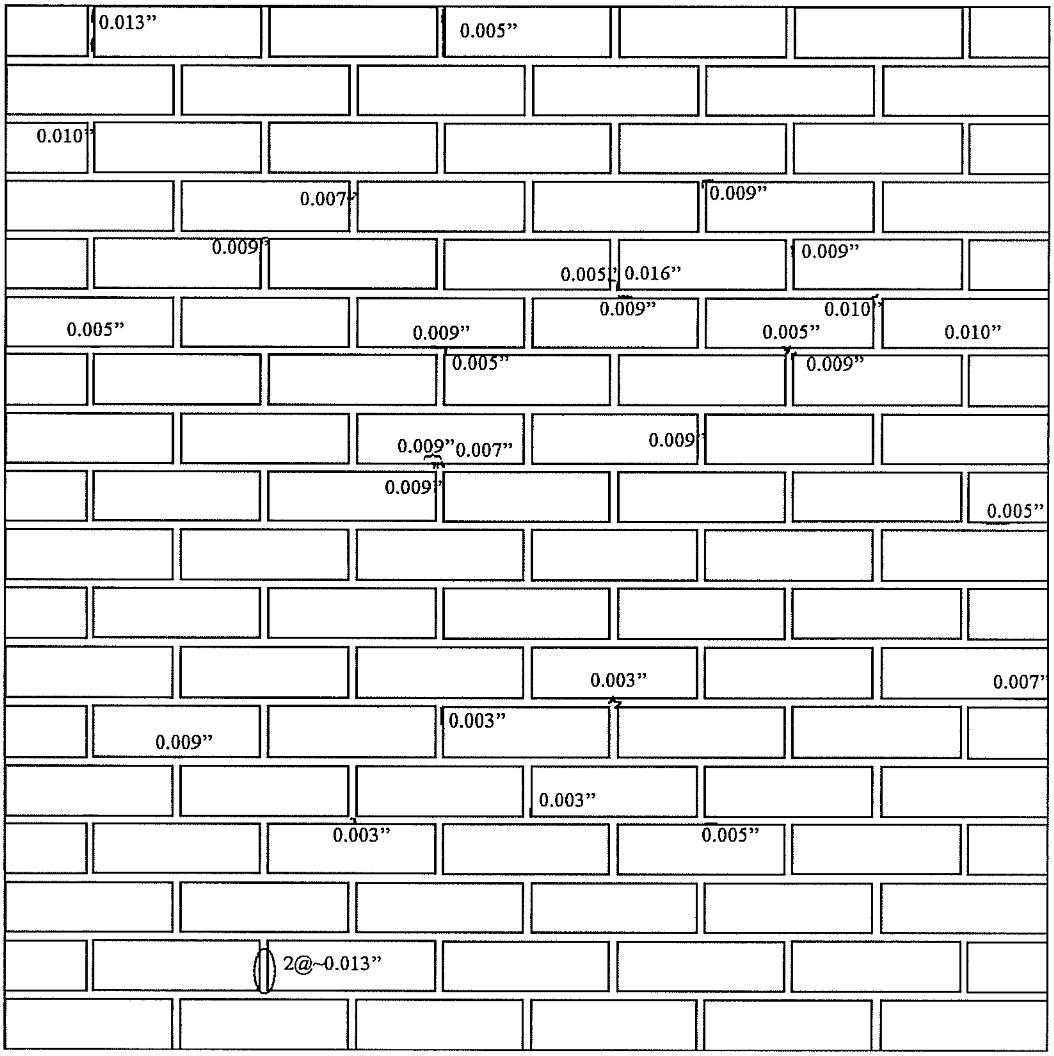
WALL: MC2N DATE: 2/21/95

SIDE: south



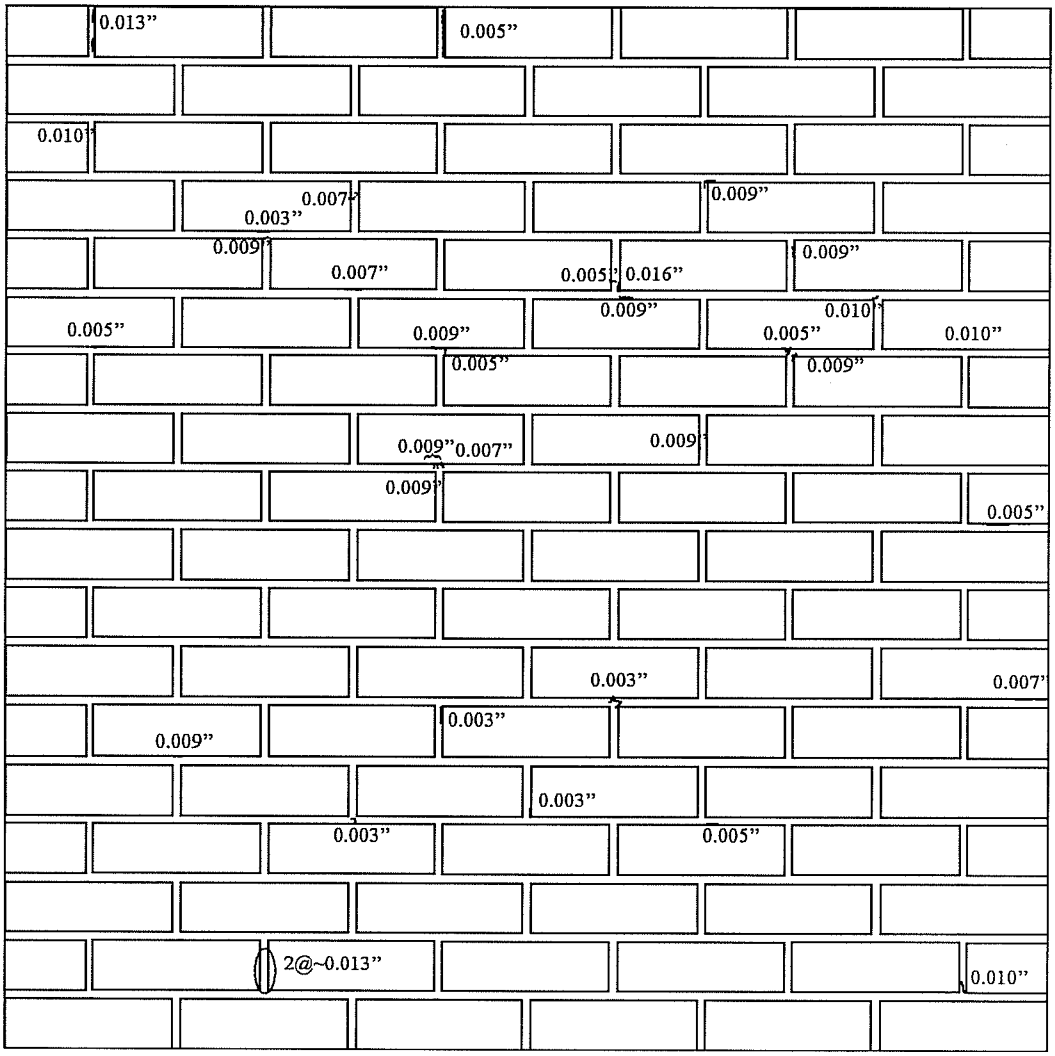
WALL: MC2N DATE: 2/27/95

SIDE: south



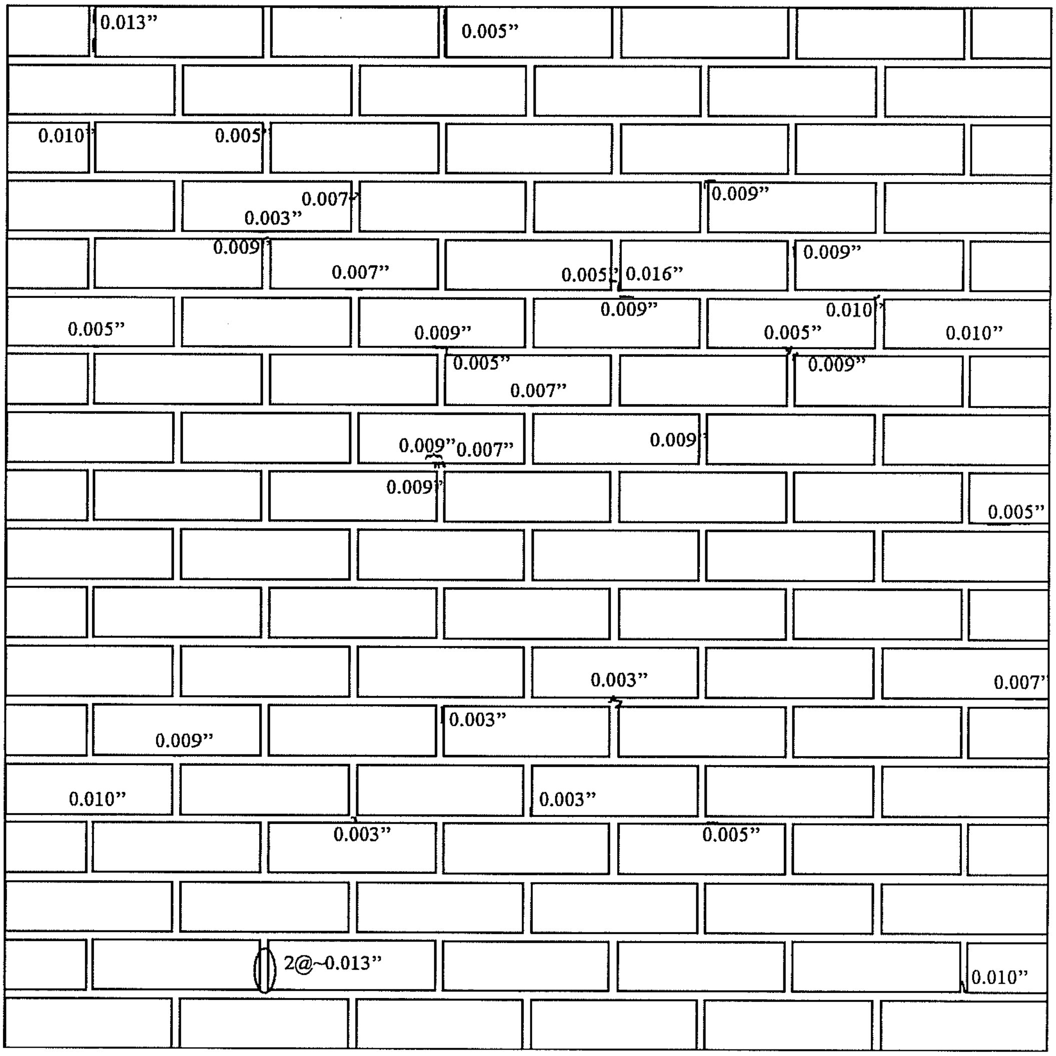
WALL: MC2N DATE: 3/7/95

SIDE: south



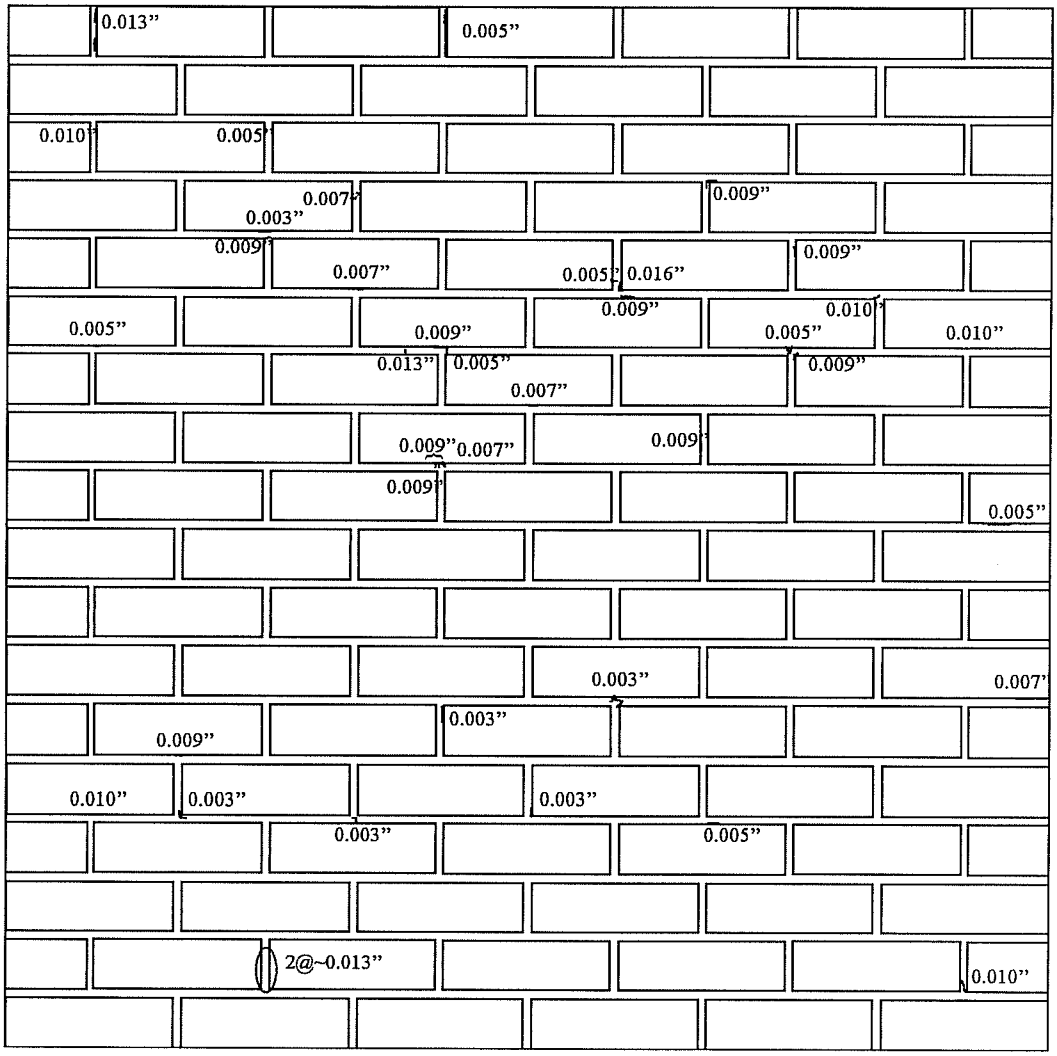
WALL: MC2N DATE: 3/14/95

SIDE: south



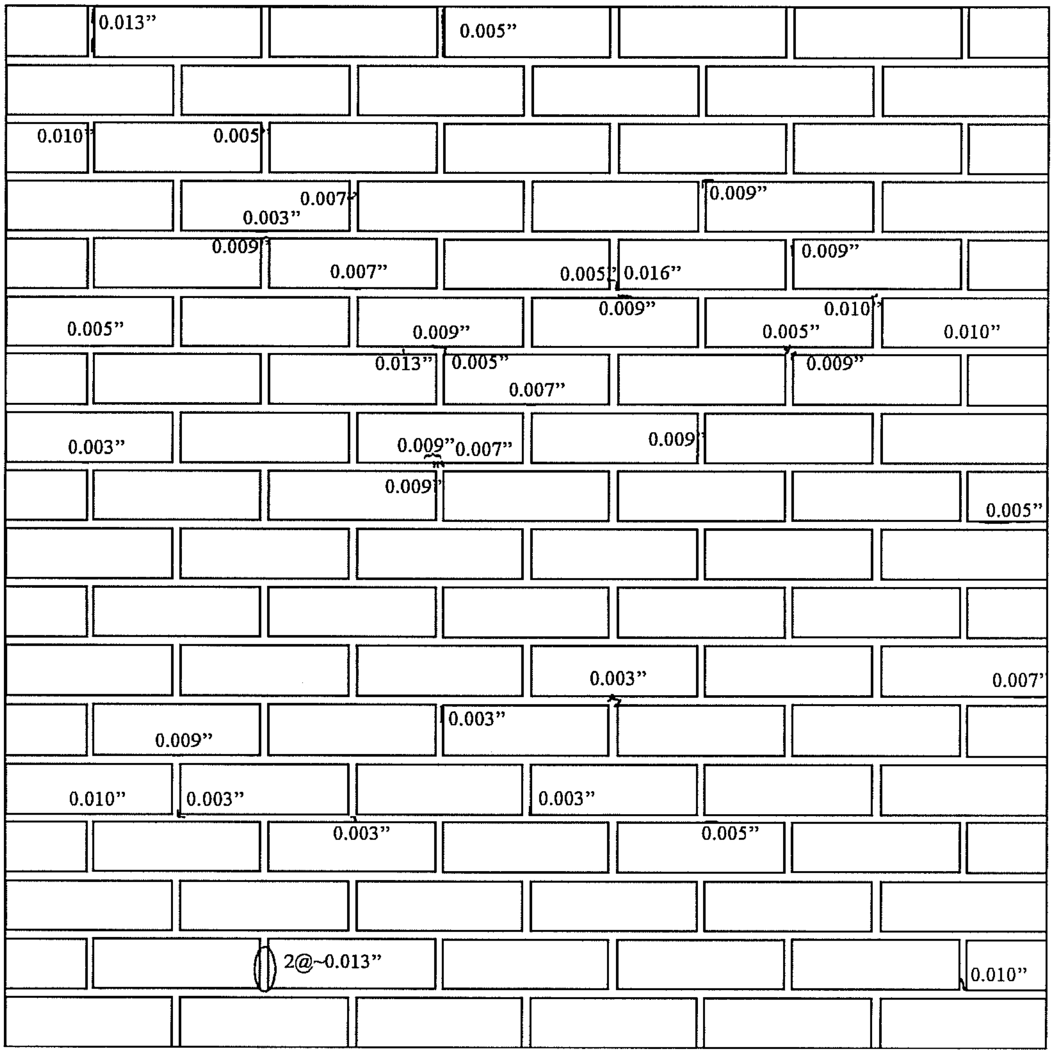
WALL: MC2N DATE: 3/20/95

SIDE: south



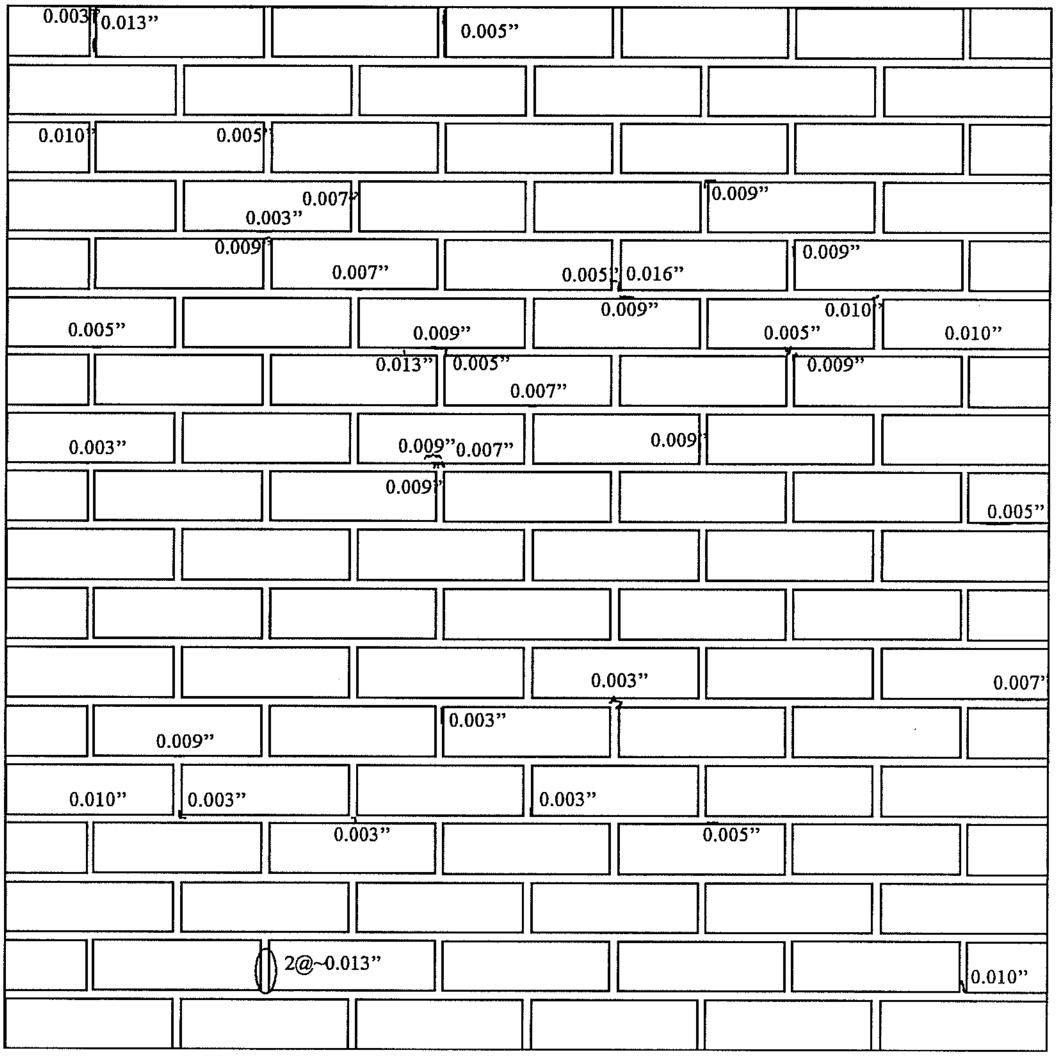
WALL: MC2N DATE: 3/27/95

SIDE: south



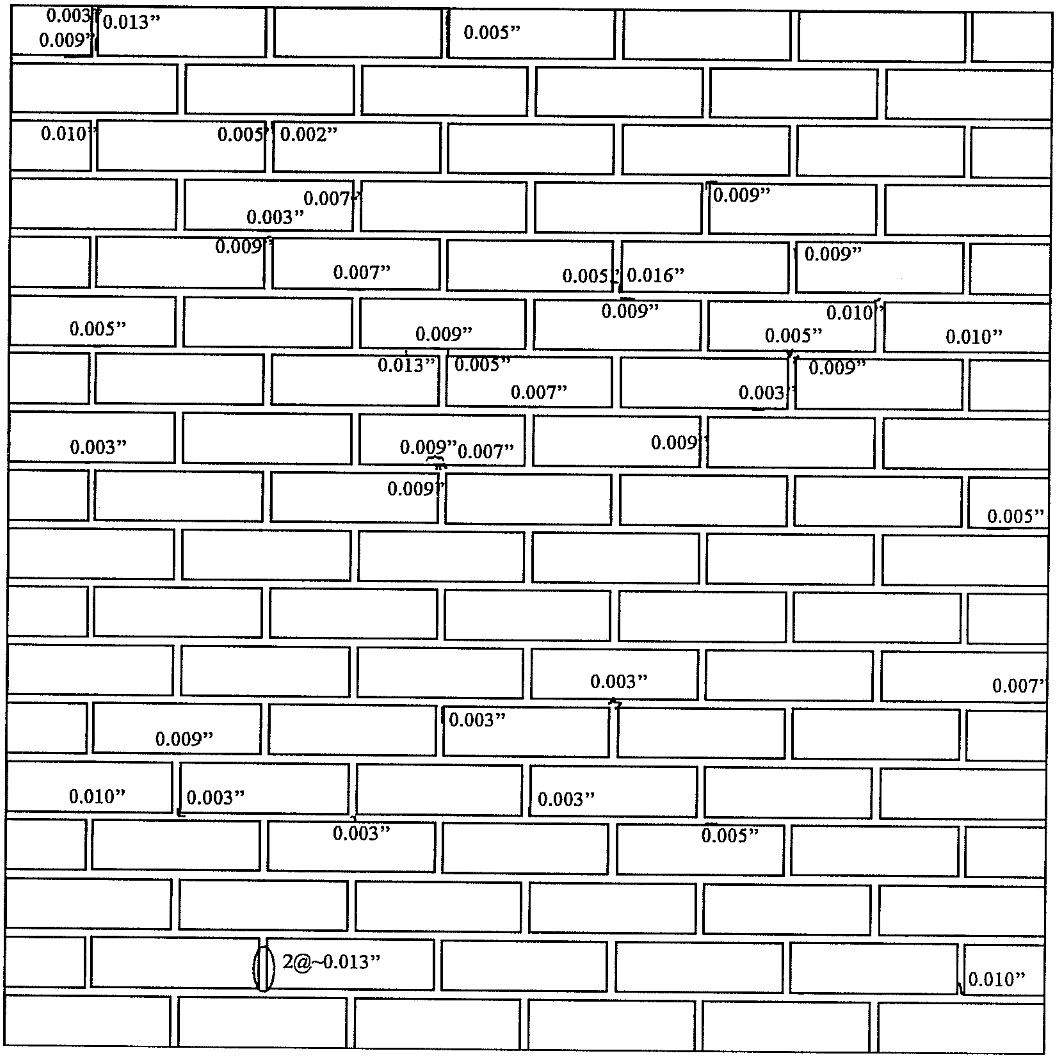
WALL: MC2N DATE: 4/3/95

SIDE: south

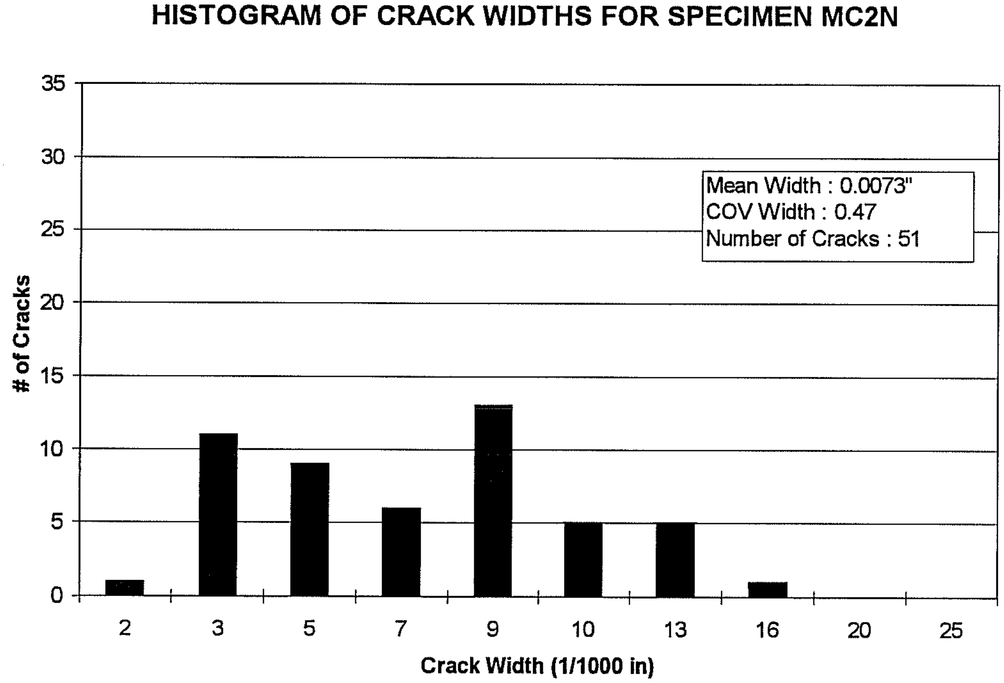


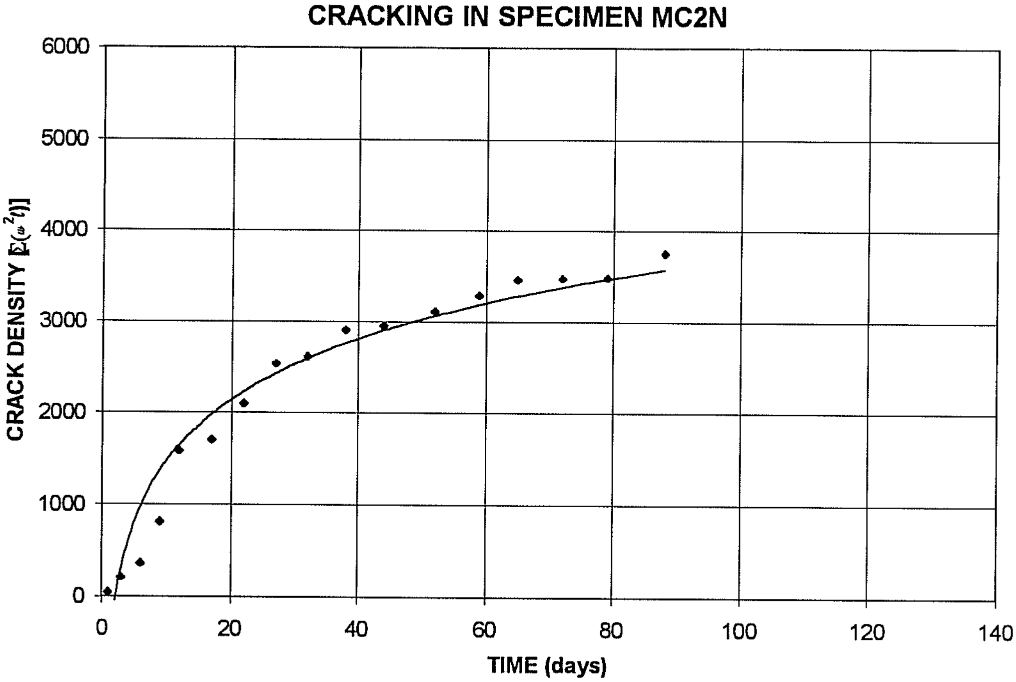
WALL: MC2N DATE: 4/12/95

SIDE: south



10.5.3 Histogram of Crack Widths and Cracking vs. Time for MC2N





10.6 Cracking in Specimen PCLM

Dates on which no changes were observed:

1/22, 2/27, 3/20, 3/27

10.6.1 Quantitative Data for PCLM

1/23/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	5	1	25
SUM			25

1/26/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	5	1	25
1	5	1	25
SUM			50

1/31/95				
#	CRACK WIDTH	CRACK LENGTH	w^2l	
	(1/1000 in)	(joint widths)		
1	5	1	25	
1	5	1	25	
1	9	1	81	
SUM			131	

2/5/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	5	1	25
1	5	1	25
1	13	1	169
1	9	1	81
1	7	1	49
1	7	1	49
1	10	1	100
SUM			498

2/10/95				
#	CRACK WIDTH	CRACK LENGTH	w^2l	
	(1/1000 in)	(joint widths)		
1	7	1	49	
1	5	1	25	
1	13	1	169	
1	9	1	81	
1	7	1	49	
1	7	1	49	
1	10	1	100	
SUM			522	

2/15/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	7	1	49
1	5	1	25
1	13	1	169
1	9	1	81
1	7	1	49
1	7	1	49
1	10	1	100
1	5	1	25
1	16	1	256
1	7	1	49
SUM			852

2/21/95				
#	CRACK WIDTH	CRACK LENGTH	w^2l	
	(1/1000 in)	(joint widths)		
1	7	1	49	
1	5	1	25	
1	13	1	169	
1	9	1	81	
1	7	1	49	
1	7	1	49	
1	10	1	100	
1	5	1	25	
1	16	1	256	
1	7	1	49	
2	7	1	98	
SUM			950	

3/7/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	7	1	49
1	5	1	25
1	13	1	169
1	9	1	81
1	7	1	49
1	7	1	49
1	10	1	100
1	5	1	25
1	16	1	256
1	7	1	49
2	7	1	98
1	3	1	9
1	9	1	81
SUM			1040

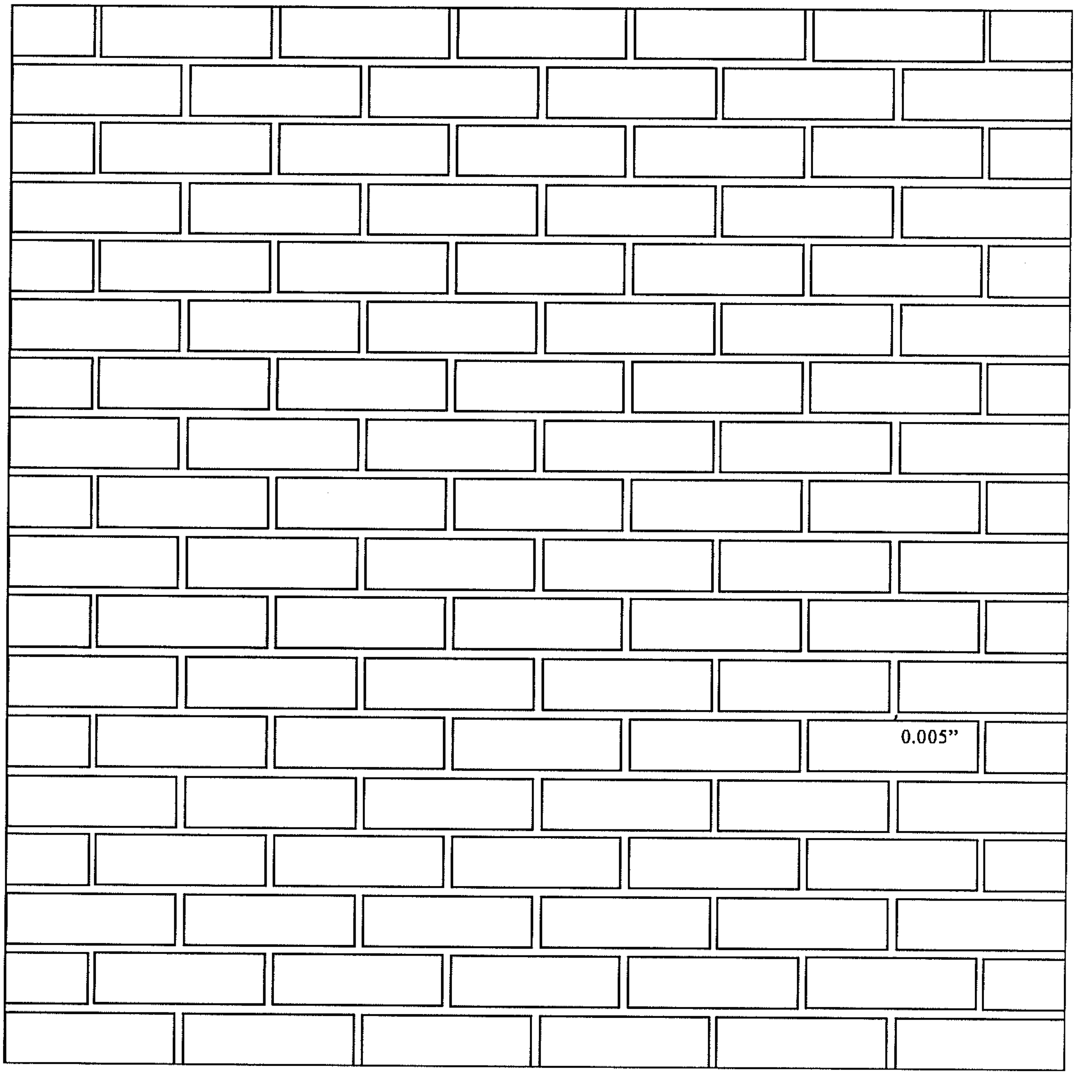
3/14/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	7	1	49
1	5	1	25
1	13	1	169
1	9	1	81
1	7	1	49
1	7	1	49
1	10	1	100
1	5	1	25
1	16	1	256
1	7	1	49
2	7	1	98
1	3	1	9
1	9	1	81
1	7	1	49
SUM			1089

4/12/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	7	1	49
1	5	1	25
1	13	1	169
1	9	1	81
1	7	1	49
1	7	1	49
1	10	1	100
1	5	1	25
1	16	1	256
1	7	1	49
2	7	1	98
1	3	1	9
1	9	1	81
1	7	1	49
2	2	1	8
SUM			1097

10.6.2 Panel Drawings for PCLM

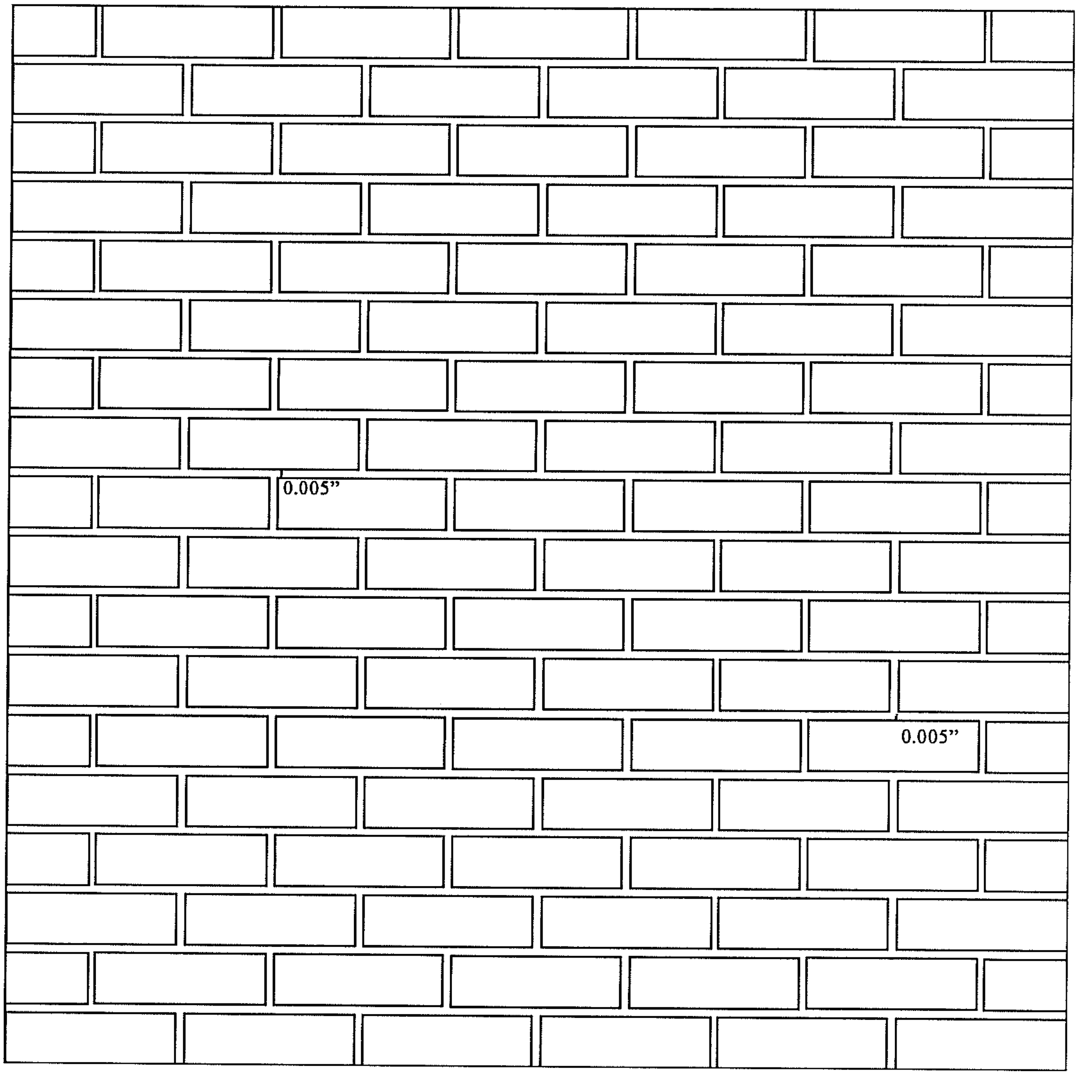
WALL: PCLM DATE: 1/23/95

SIDE: south



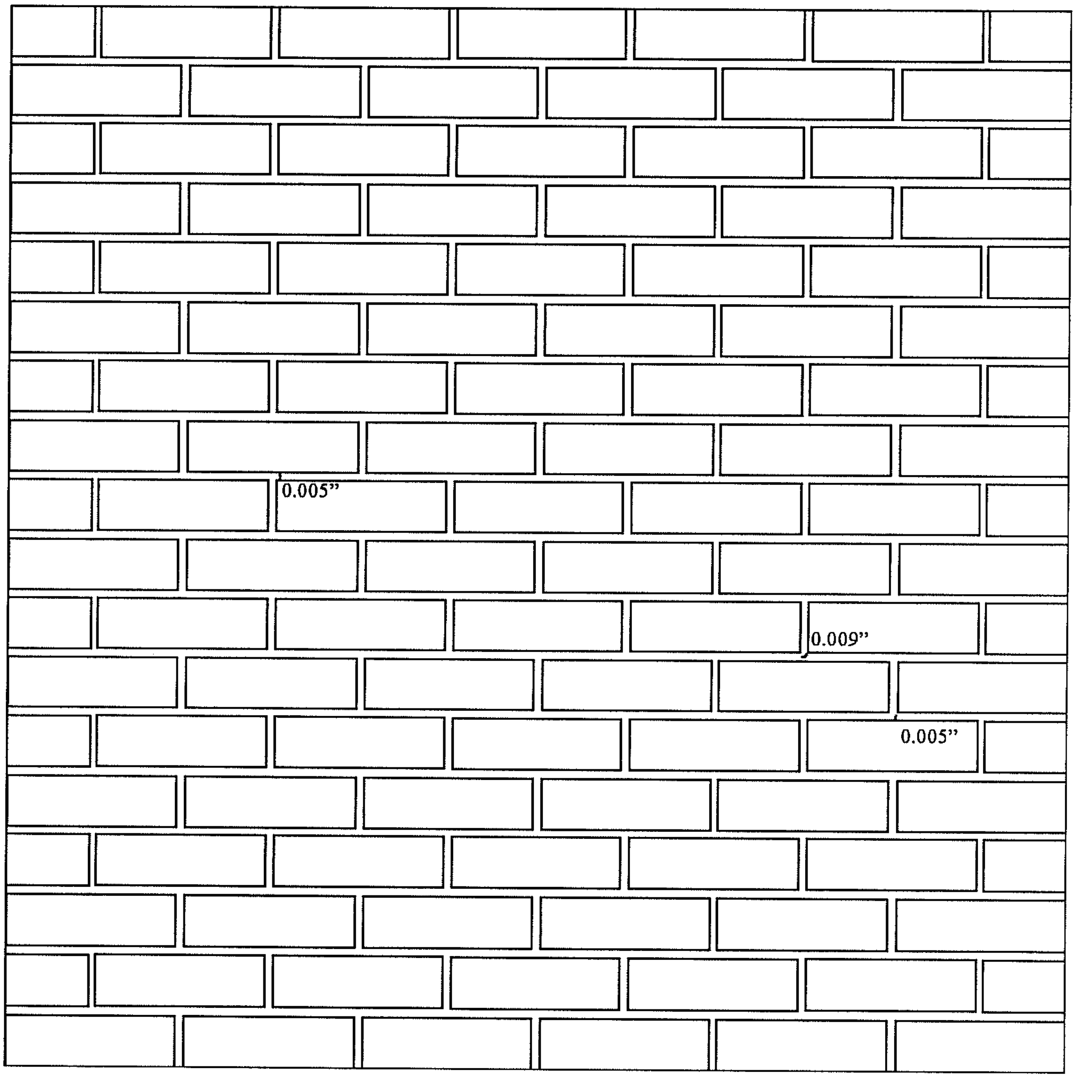
WALL: PCLM DATE: 1/26/95

SIDE: south



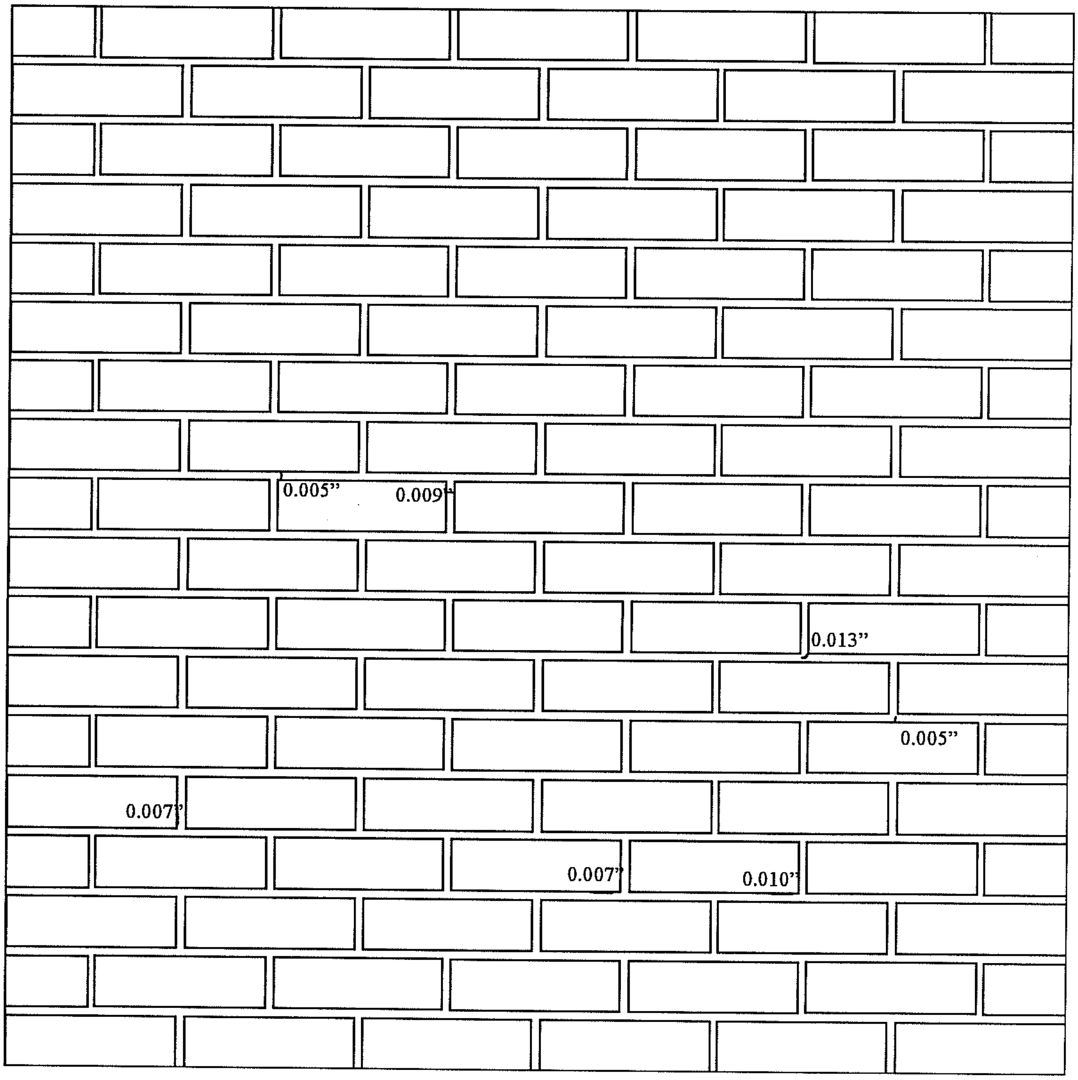
WALL: PCLM DATE: 1/31/95

SIDE: south



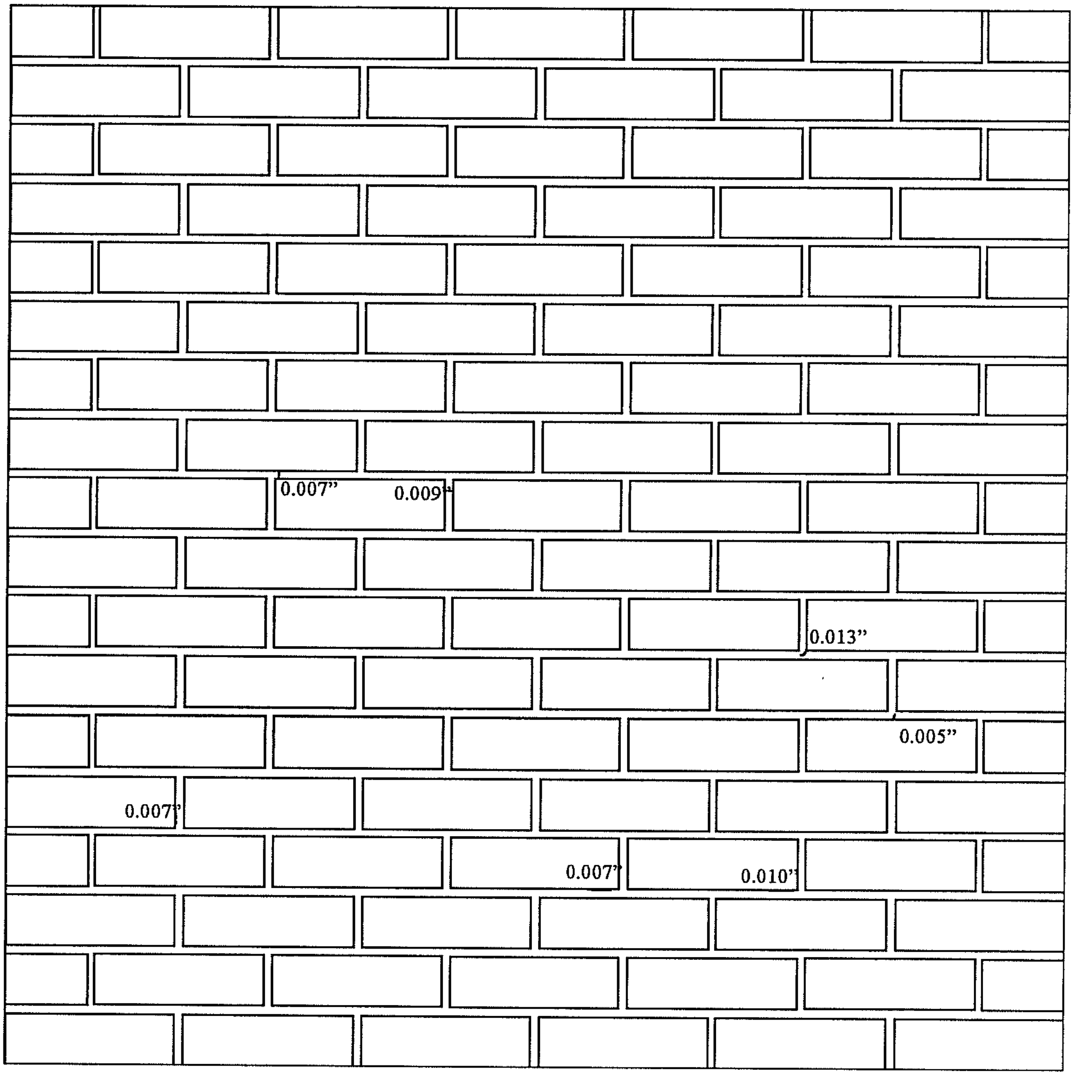
WALL: PCLM DATE: 2/5/95

SIDE: south



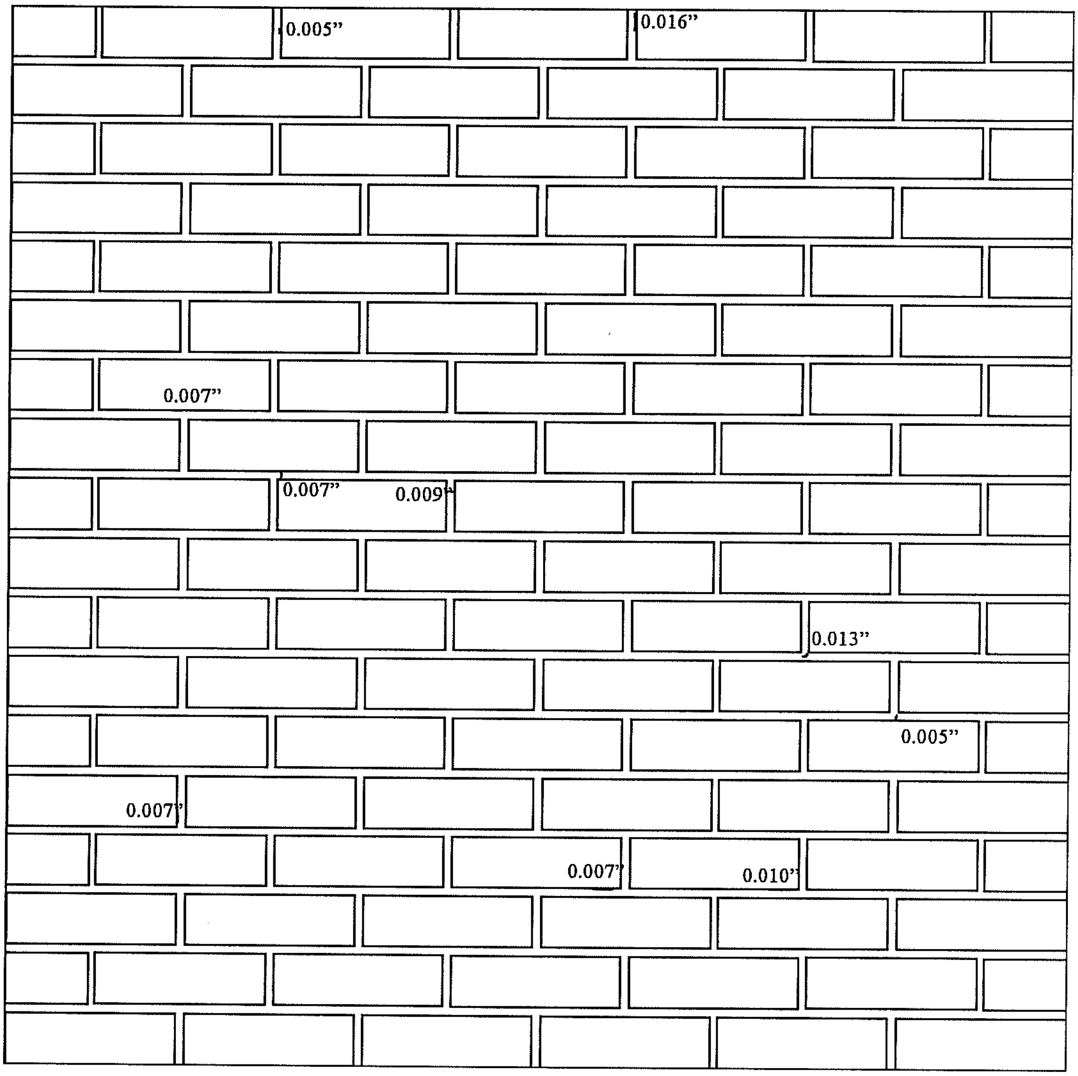
WALL: PCLM　　　　　　　　DATE: 2/10/95

SIDE: south



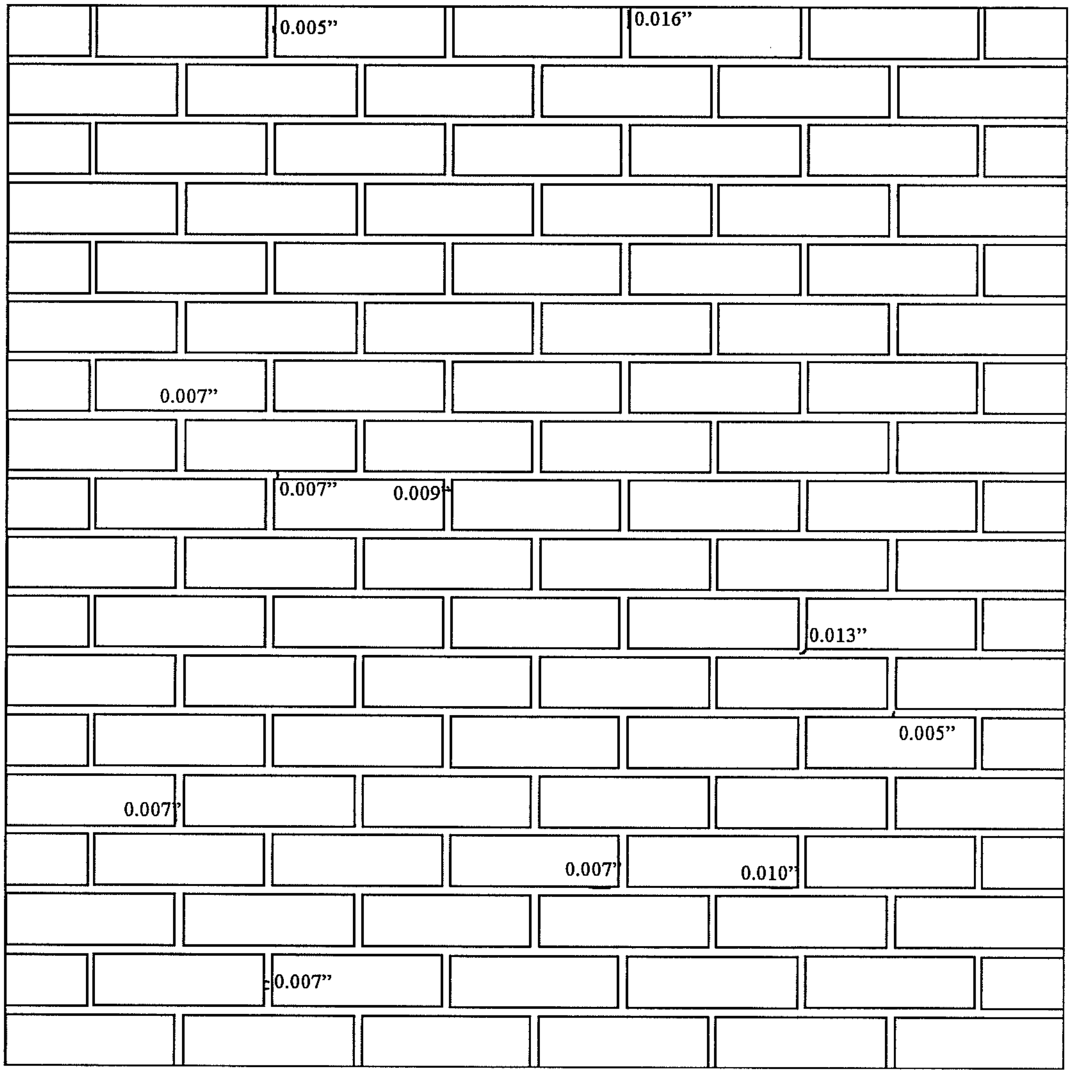
WALL: PCLM DATE: 2/15/95

SIDE: south



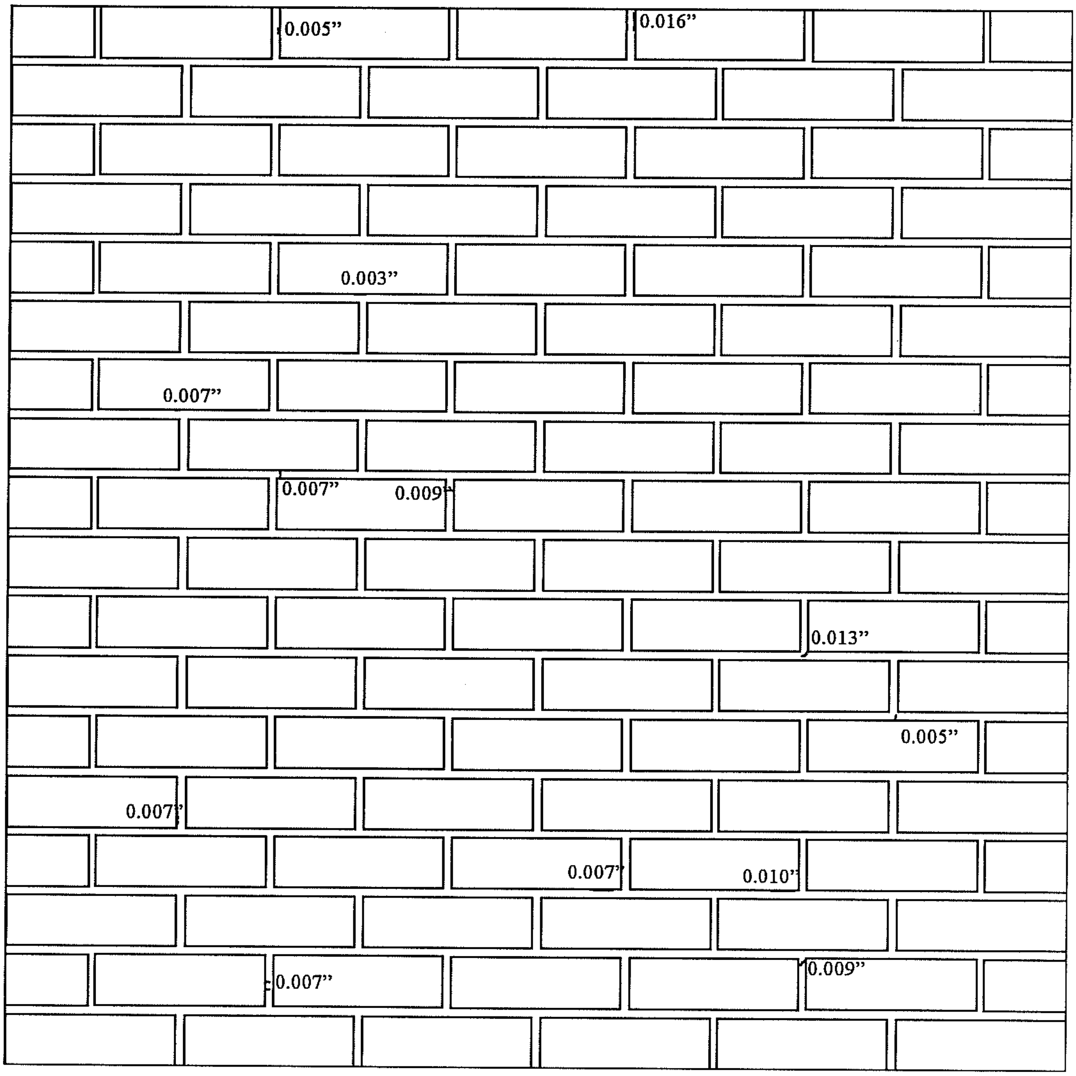
WALL: PCLM DATE: 2/21/95

SIDE: south



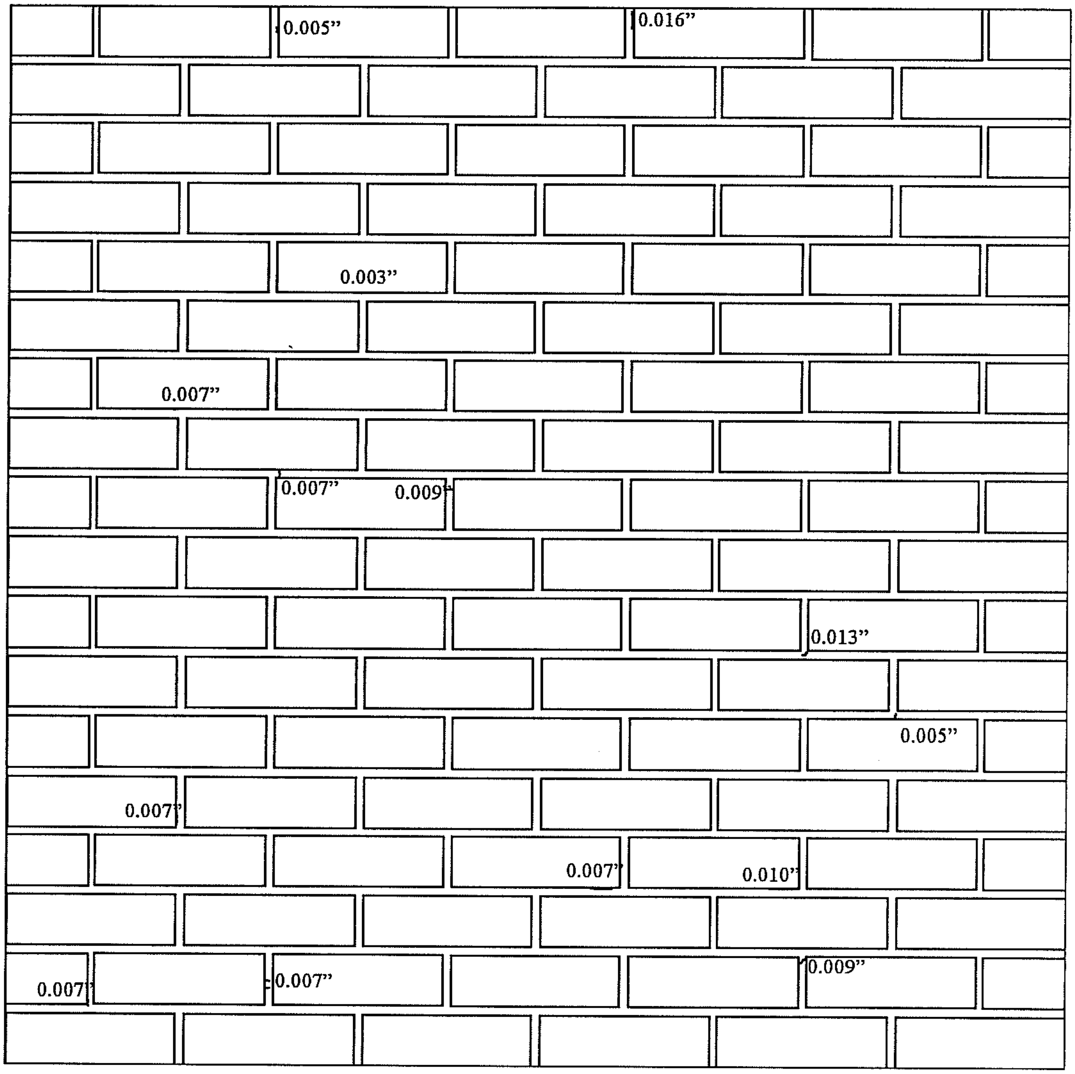
WALL: PCLM DATE: 3/7/95

SIDE: south



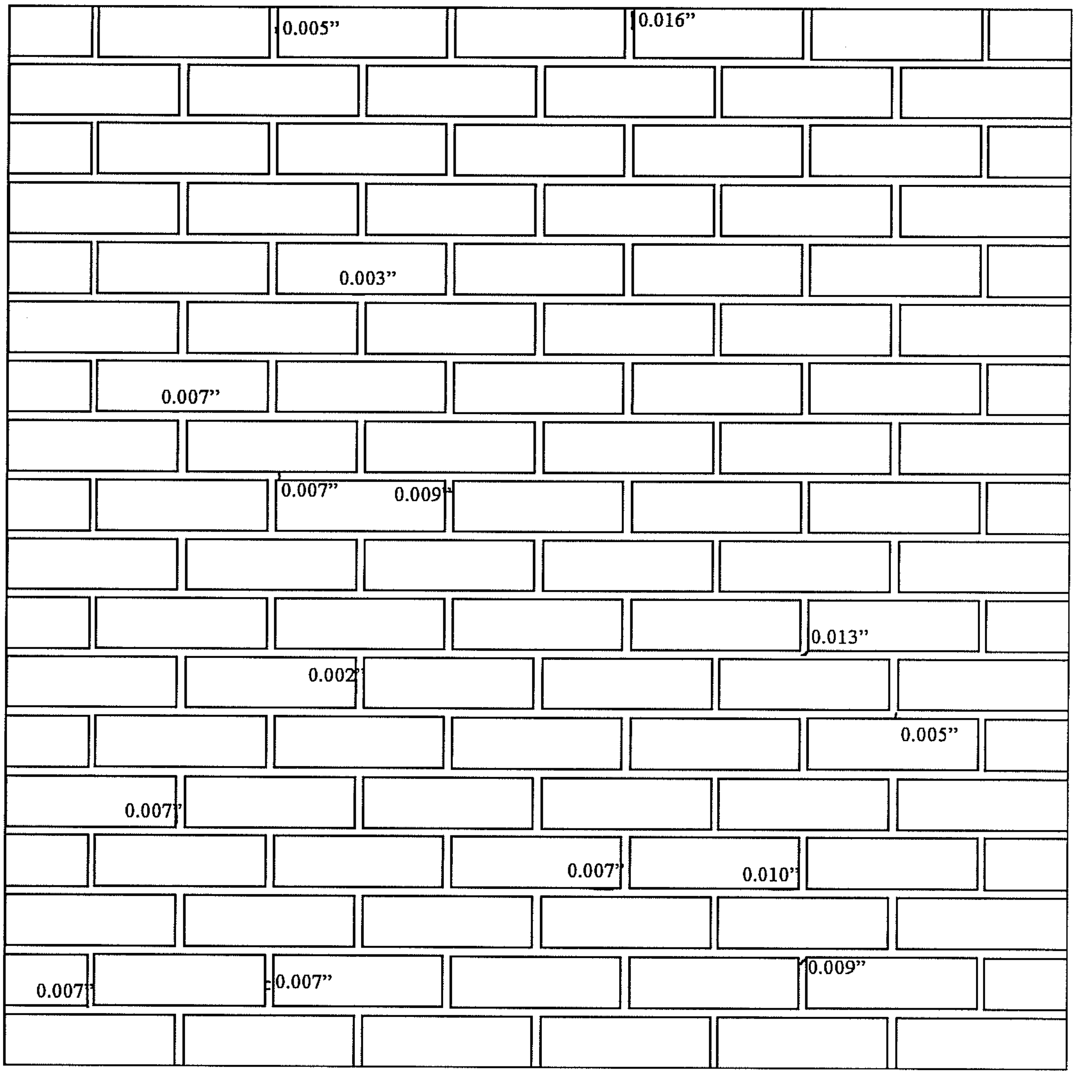
WALL: PCLM DATE: 3/14/95

SIDE: south

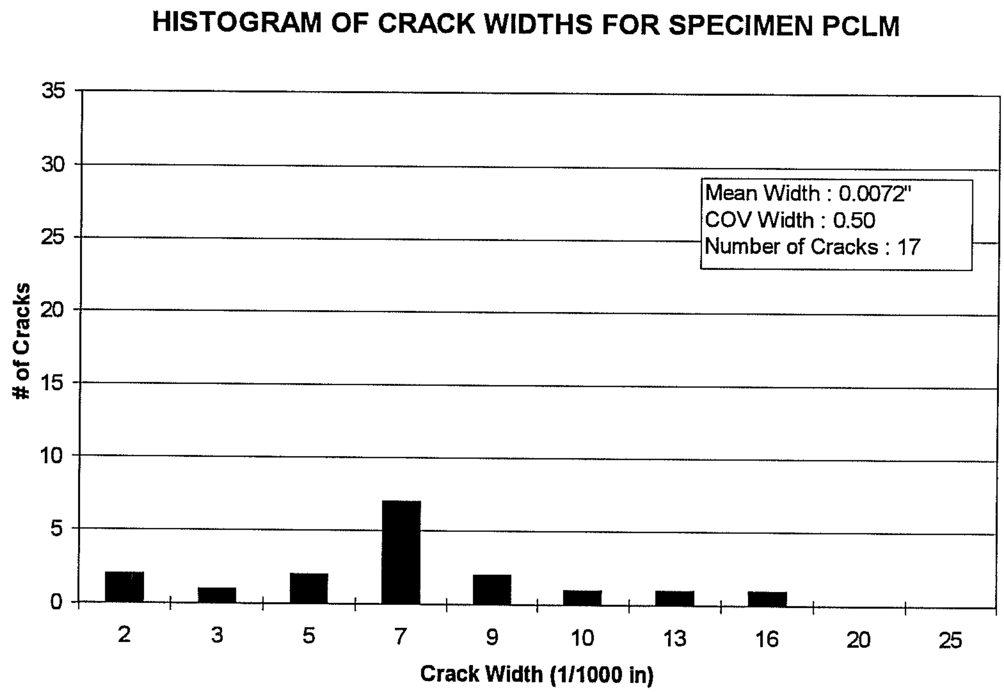


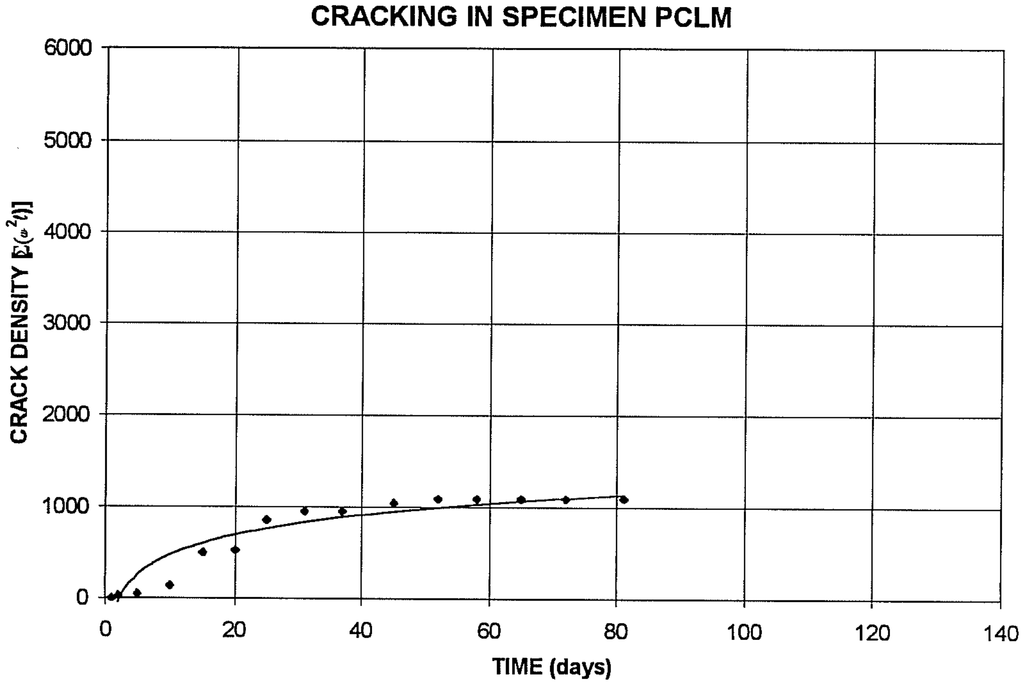
WALL: PCLM DATE: 4/12/95

SIDE: south



10.6.3 Histogram of Crack Widths and Cracking vs. Time for PCLM





10.7 Cracking in Specimen PCLS

Dates on which no changes were observed:

1/22, 1/23, 2/15

10.7.1 Quantitative Data for PCLS

1/26/95				
#	CRACK WIDTH	CRACK LENGTH	w^2l	
	(1/1000 in)	(joint widths)		
1	30	1	900	
SUM			900	

1/31/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	30	1	900
1	10	2	200
1	20	1	400
1	3	1	9
2	13	1	338
SUM			1847

2/5/95				
#	CRACK WIDTH	CRACK LENGTH	w^2l	
	(1/1000 in)	(joint widths)		
1	30	1	900	
1	10	2	200	
1	20	1	400	
1	3	1	9	
2	13	1	338	
1	16	1	256	
SUM			2103	

2/10/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	30	1	900
1	10	2	200
1	20	1	400
1	3	1	9
2	13	1	338
1	16	1	256
1	9	1	81
SUM			2184

2/21/95				
#	CRACK WIDTH	CRACK LENGTH	w^2l	
	(1/1000 in)	(joint widths)		
1	10	2	200	
1	20	1	400	
1	3	1	9	
2	13	1	338	
1	16	1	256	
1	9	1	81	
1	2	1	4	
1	9	1	81	
SUM			1369	

2/27/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	10	2	200
1	20	1	400
1	3	1	9
2	13	1	338
1	16	1	256
1	9	1	81
1	2	1	4
1	9	1	81
1	7	1	49
1	7	1	49
1	5	1	25
SUM			1492

3/7/95				
#	CRACK WIDTH	CRACK LENGTH	w^2l	
	(1/1000 in)	(joint widths)		
1	10	2	200	
1	20	1	400	
1	3	1	9	
2	13	1	338	
1	16	1	256	
1	9	1	81	
1	2	1	4	
1	9	1	81	
1	7	1	49	
1	7	1	49	
1	5	1	25	
2	25	1	1250	
SUM			2742	

3/14/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	10	2	200
1	20	1	400
1	3	1	9
2	13	1	338
1	16	1	256
1	9	1	81
1	2	1	4
1	9	1	81
1	7	1	49
1	7	1	49
1	5	1	25
2	25	1	1250
1	5	1	25
SUM			2767

3/20/95				
#	CRACK WIDTH	CRACK LENGTH	w^2l	
	(1/1000 in)	(joint widths)		
1	10	2	200	
1	20	1	400	
1	3	1	9	
2	13	1	338	
1	16	1	256	
1	9	1	81	
1	2	1	4	
1	9	1	81	
1	7	1	49	
1	7	1	49	
1	5	1	25	
2	25	1	1250	
1	5	1	25	
1	3	1	9	
SUM			2776	

3/27/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	10	2	200
1	20	1	400
1	3	1	9
2	13	1	338
1	16	1	256
1	9	1	81
1	2	1	4
1	9	1	81
1	7	1	49
1	7	1	49
1	5	1	25
2	25	1	1250
1	5	1	25
1	3	1	9
1	3	1	9
SUM			2785

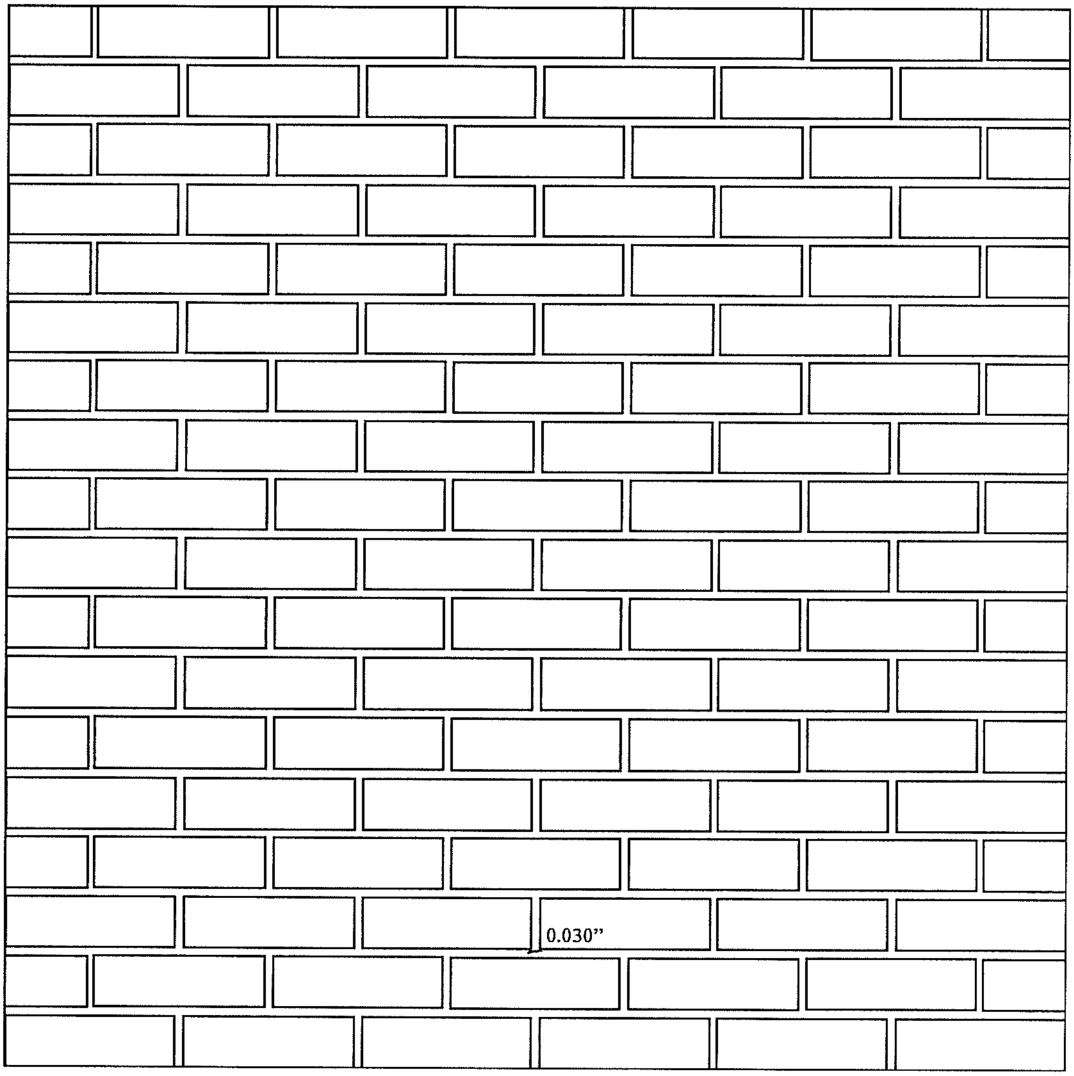
4/3/95				
#	CRACK WIDTH	CRACK LENGTH	w^2l	
	(1/1000 in)	(joint widths)		
1	10	2	200	
1	20	1	400	
1	3	1	9	
2	13	1	338	
1	16	1	256	
1	9	1	81	
1	2	1	4	
1	9	1	81	
1	7	1	49	
1	7	1	49	
1	5	1	25	
2	25	1	1250	
1	5	1	25	
1	3	1	9	
1	3	1	9	
1	3	1	9	
1	5	1	25	
1	5	1	25	
SUM			2844	

4/12/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	10	2	200
1	20	1	400
1	3	1	9
2	13	1	338
1	16	1	256
1	9	1	81
1	2	1	4
1	9	1	81
1	7	1	49
1	7	1	49
1	5	1	25
2	25	1	1250
1	5	1	25
1	3	1	9
1	3	1	9
1	3	1	9
1	5	1	25
1	5	1	25
1	3	1	9
SUM			2853

10.7.2 Panel Drawings for PCLS

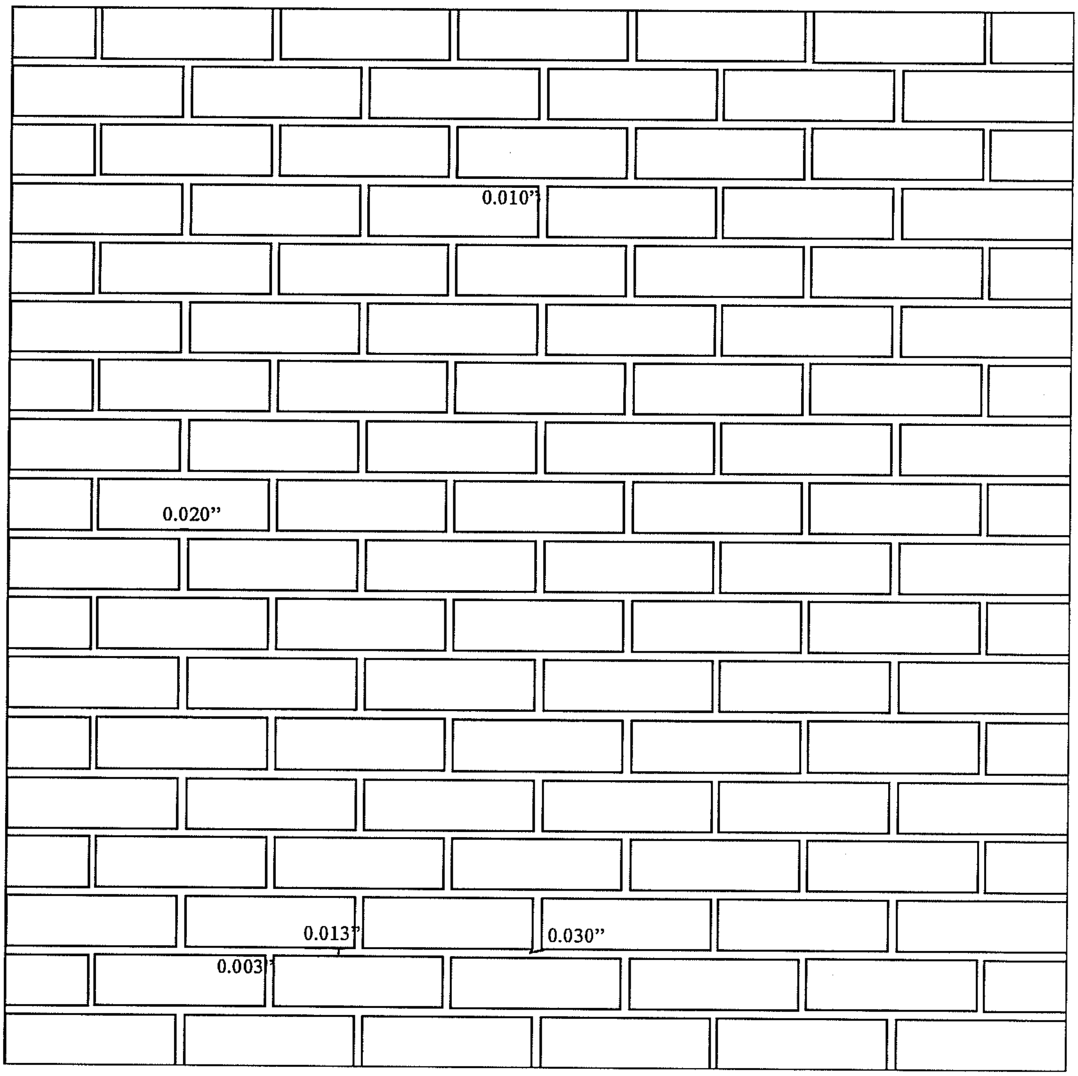
WALL: PCLS DATE: 1/26/95

SIDE: south



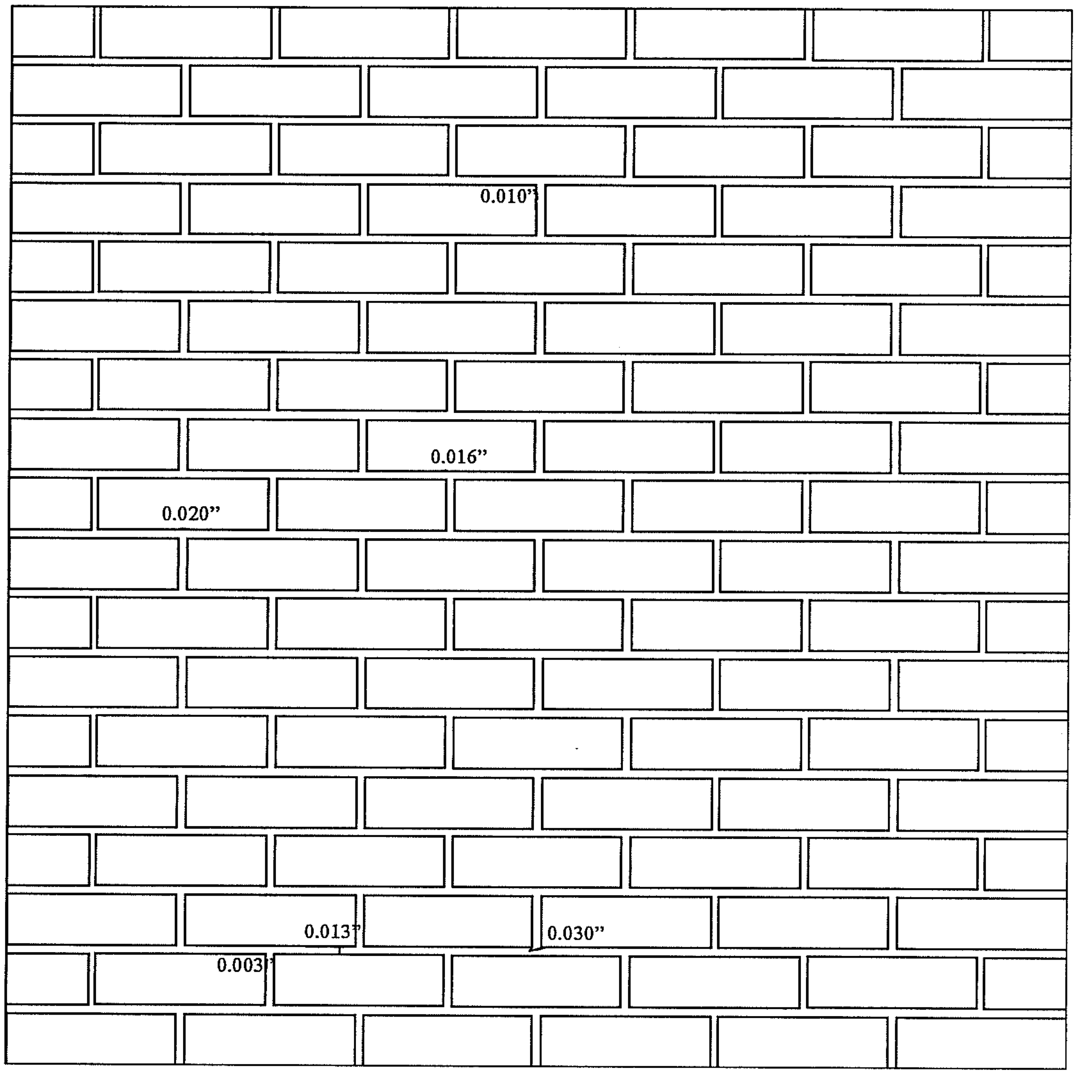
WALL: PCLS DATE: 1/31/95

SIDE: south



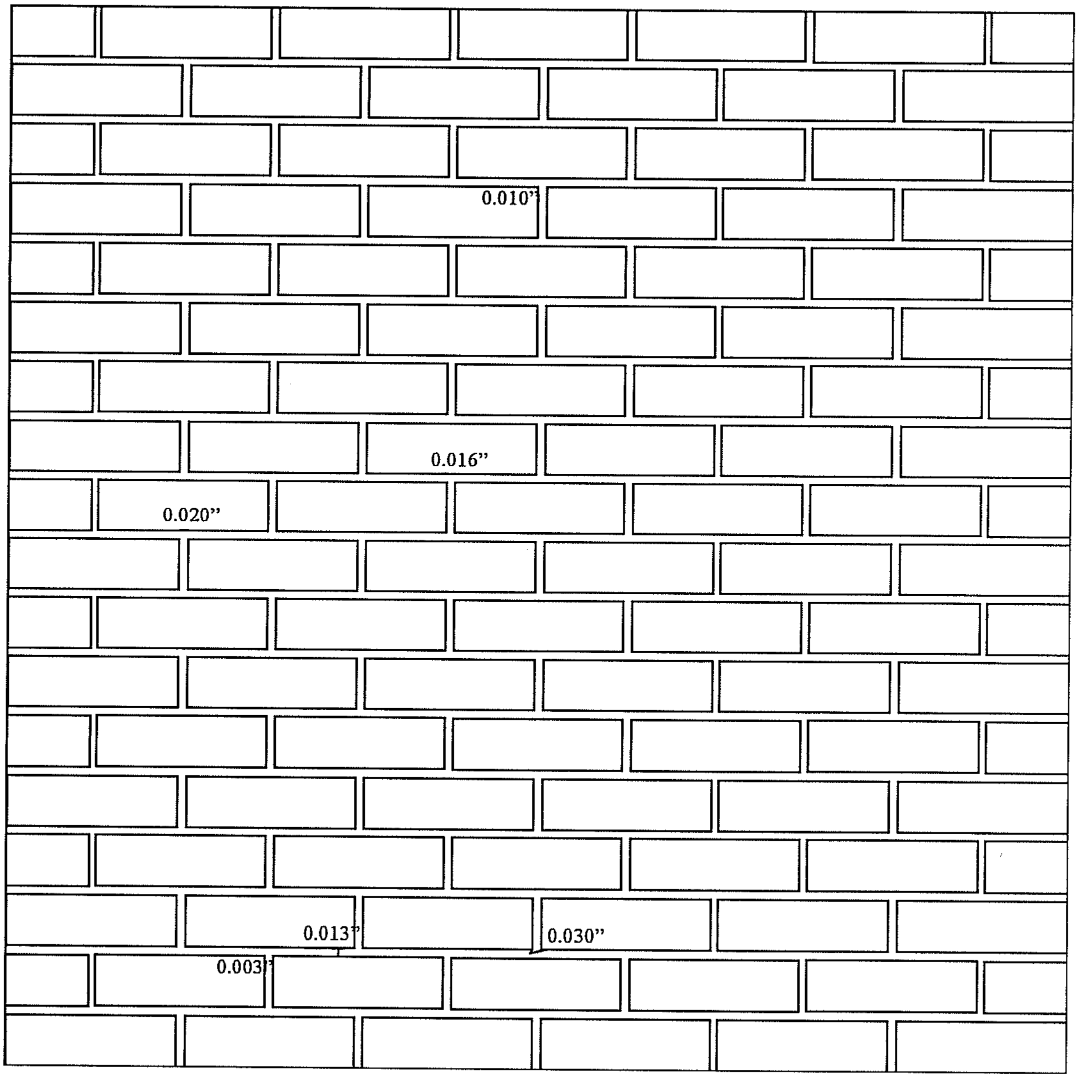
WALL: PCLS DATE: 2/5/95

SIDE: south



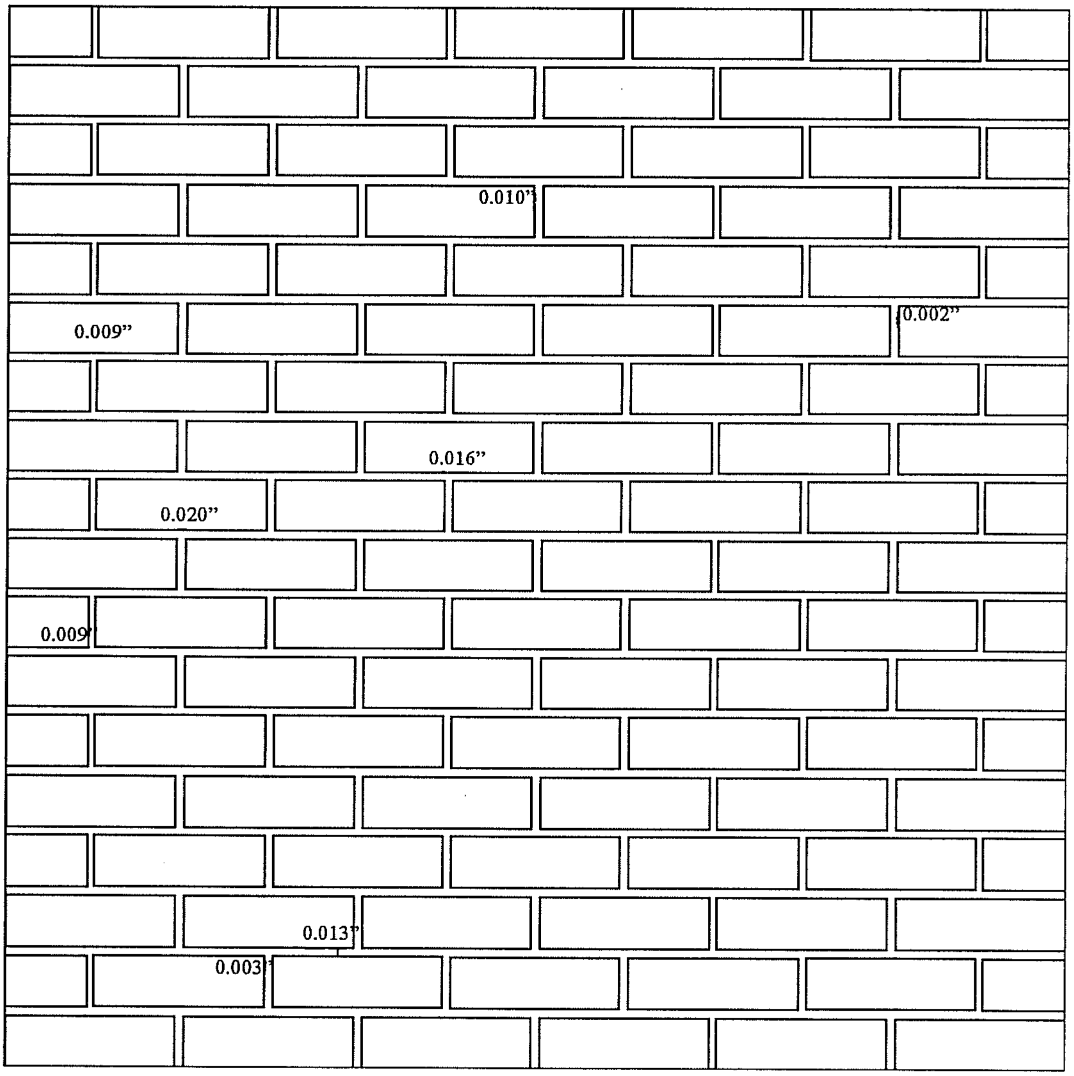
WALL: PCLS DATE: 2/10/95

SIDE: south



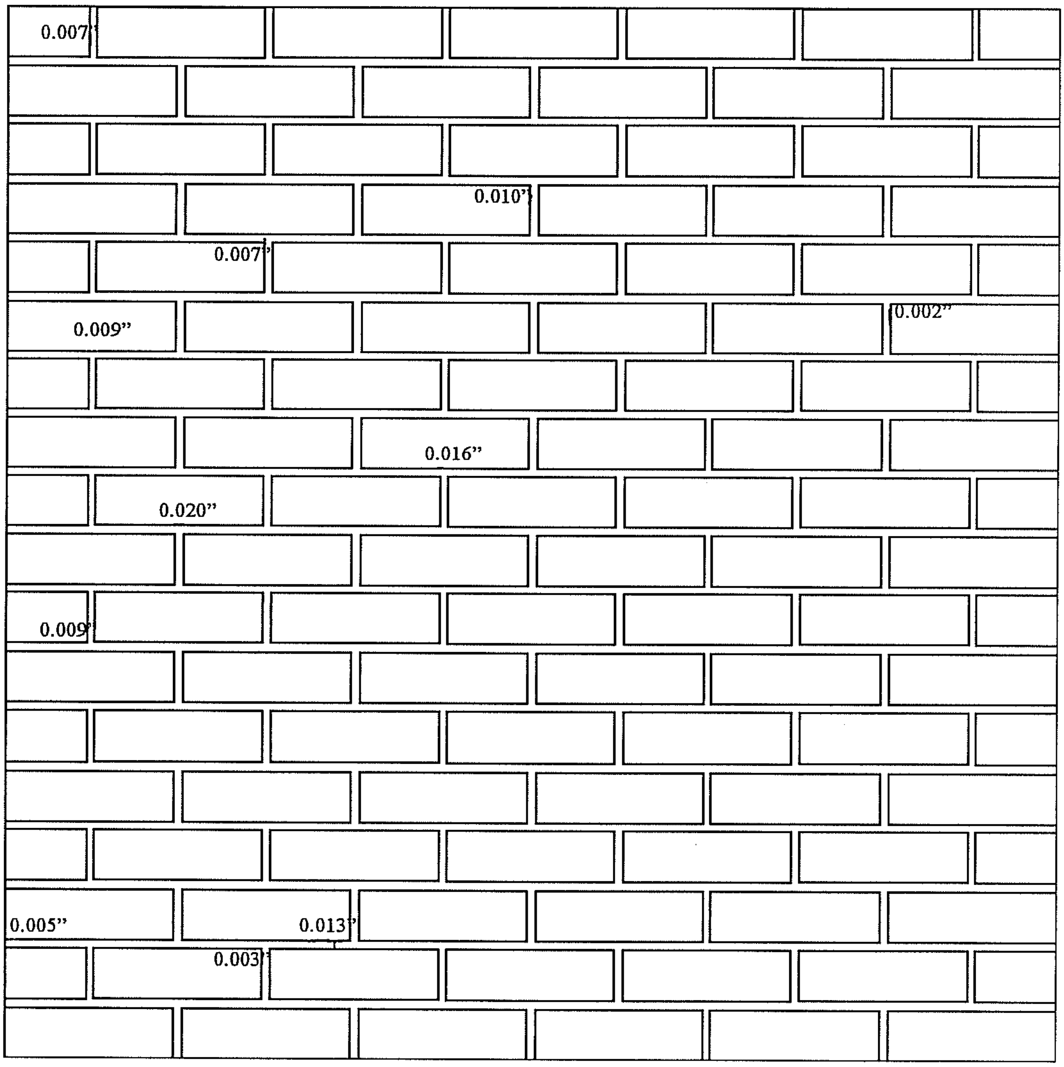
WALL: PCLS DATE: 2/21/95

SIDE: south



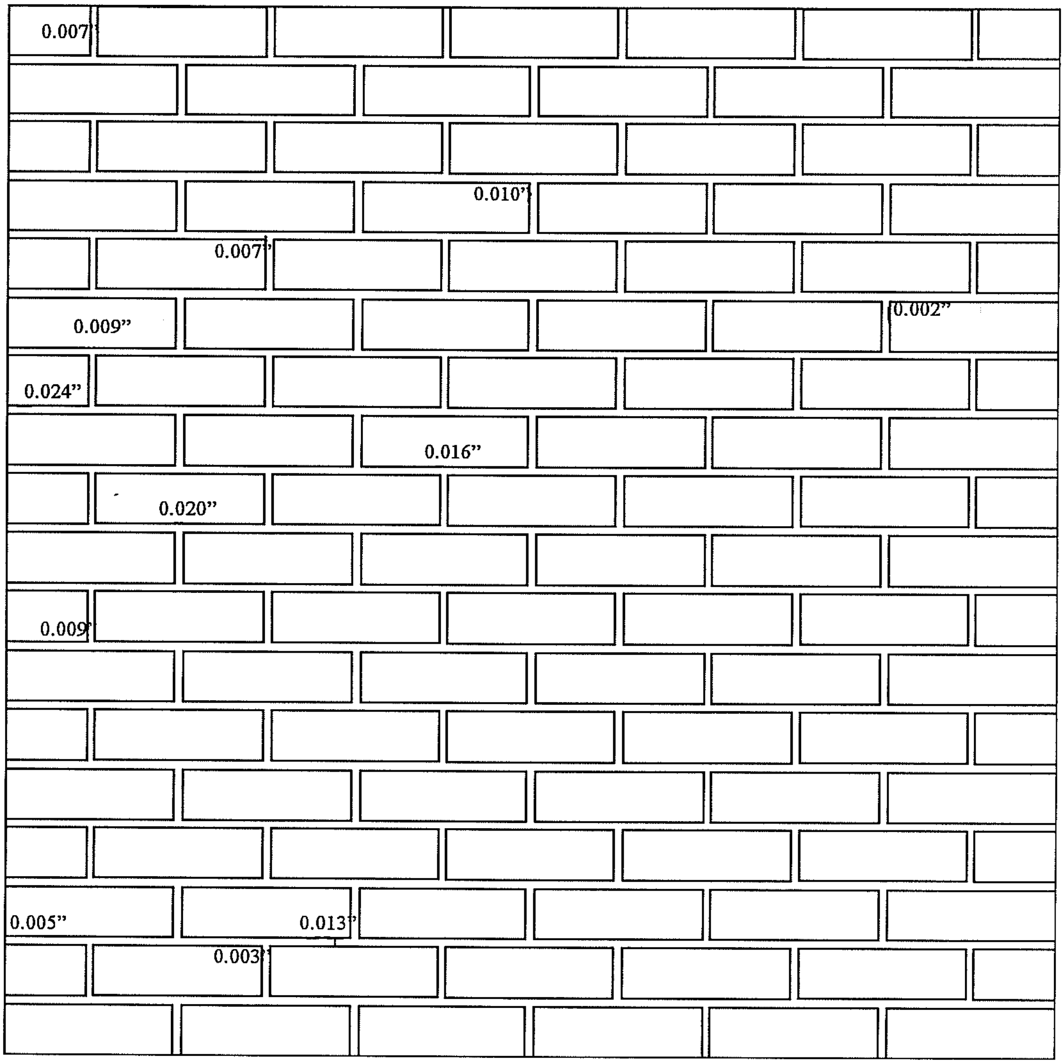
WALL: PCLS DATE: 2/27/95

SIDE: south



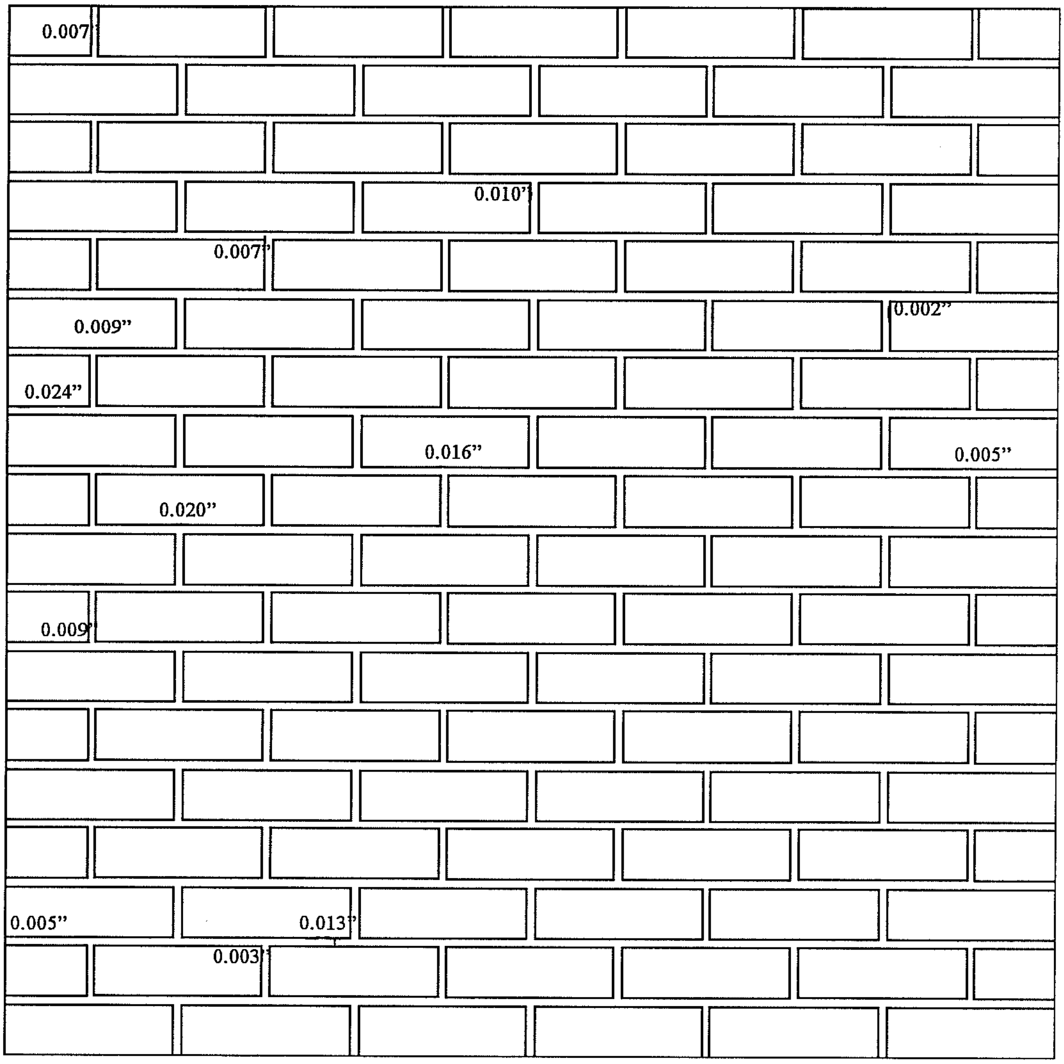
WALL: PCLS DATE: 3/7/95

SIDE: south



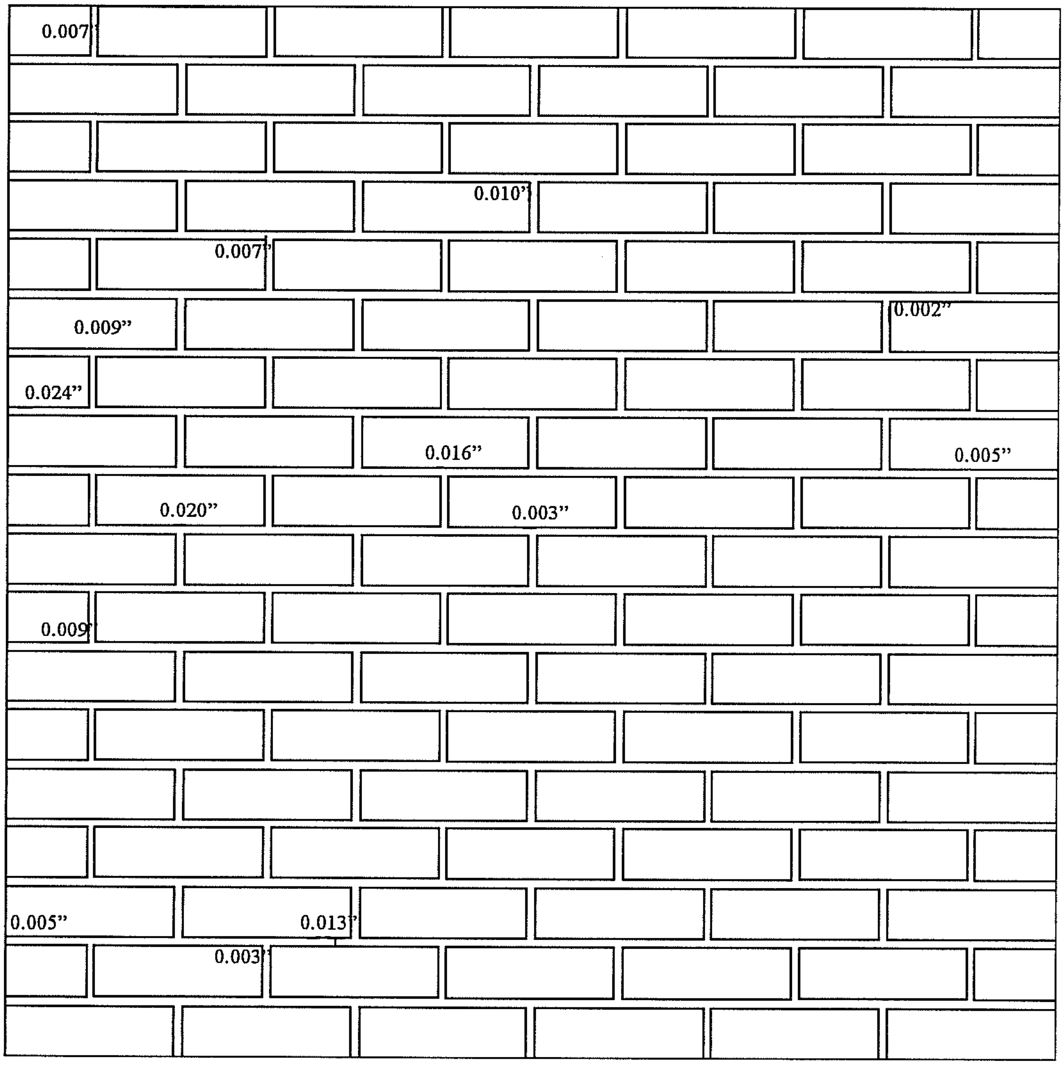
WALL: PCLS DATE: 3/14/95

SIDE: south



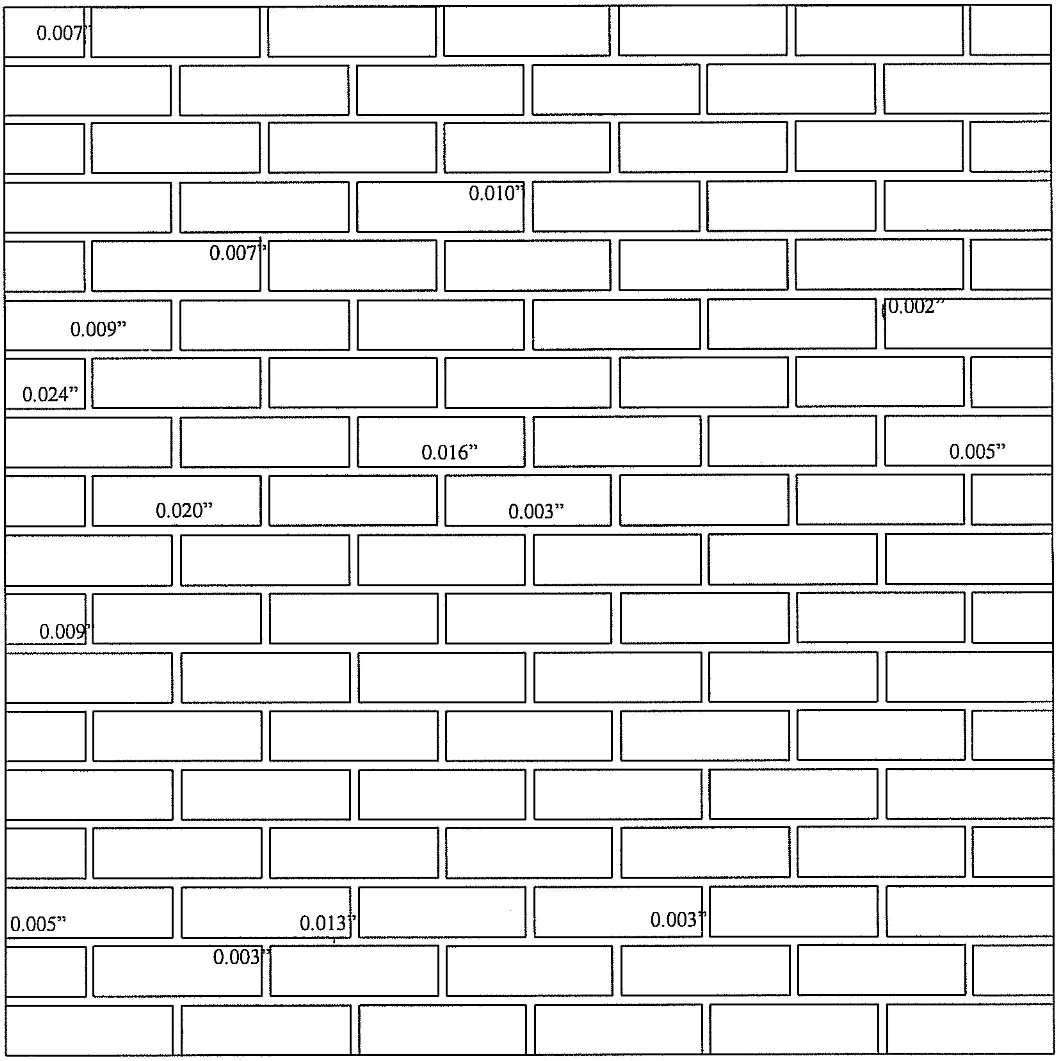
WALL: PCLS DATE: 3/20/95

SIDE: south



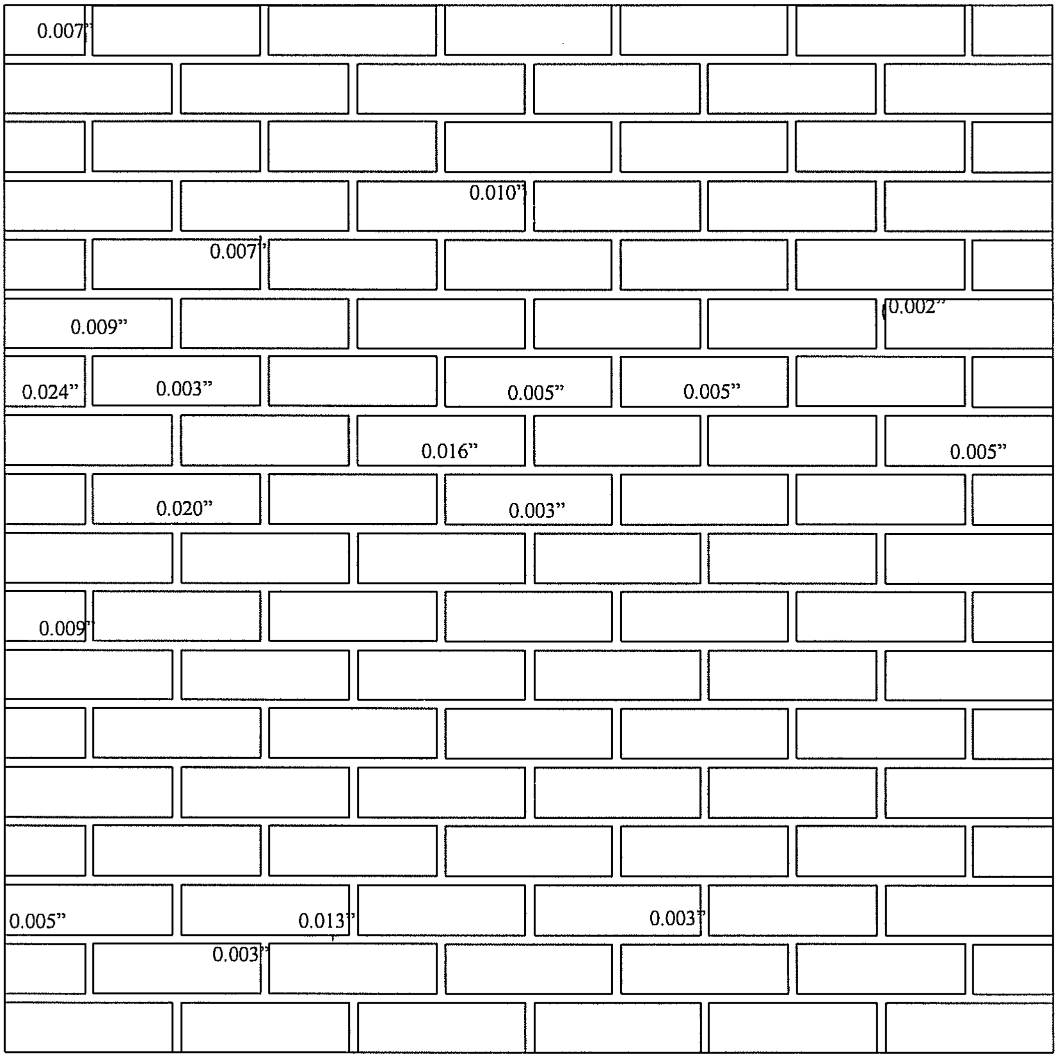
WALL: PCLS DATE: 3/27/95

SIDE: south



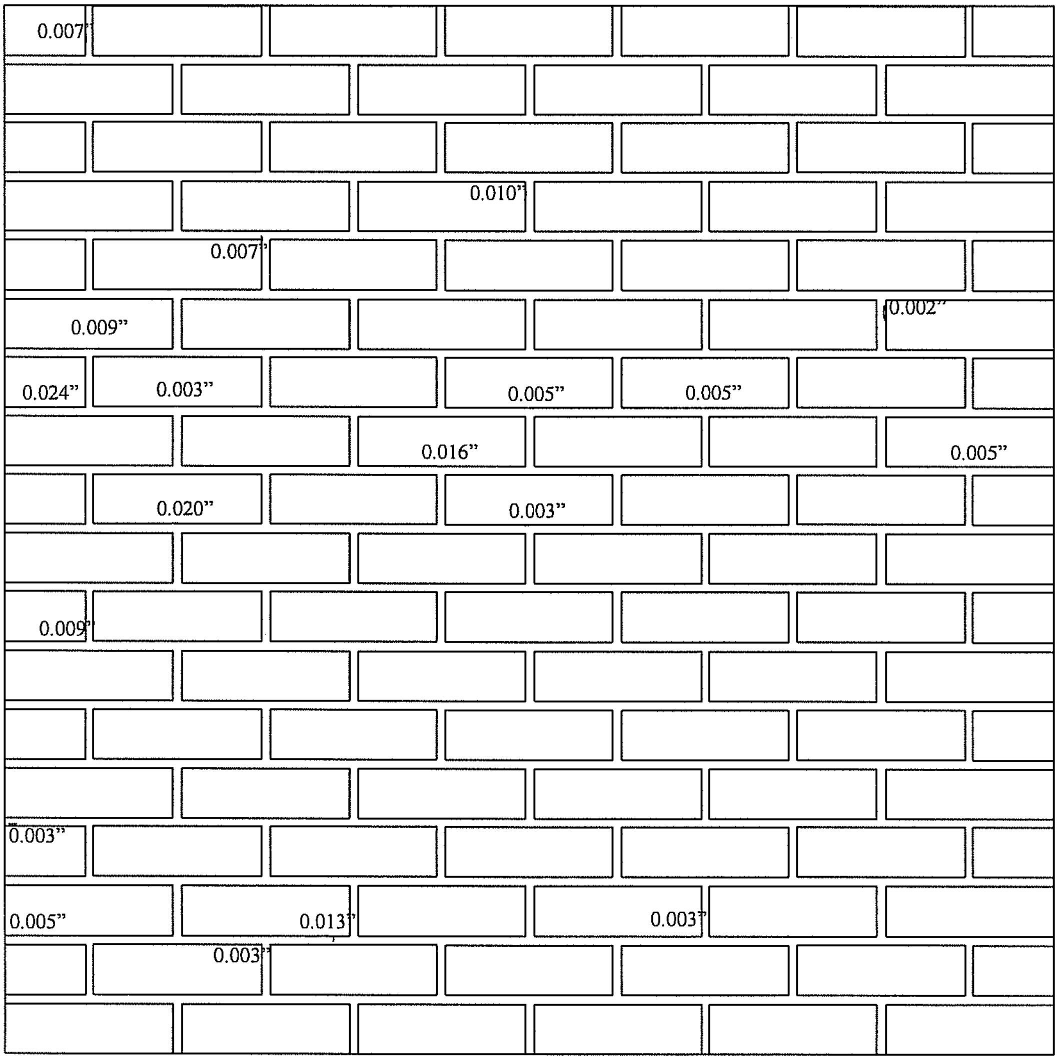
WALL: PCLS DATE: 4/3/95

SIDE: south

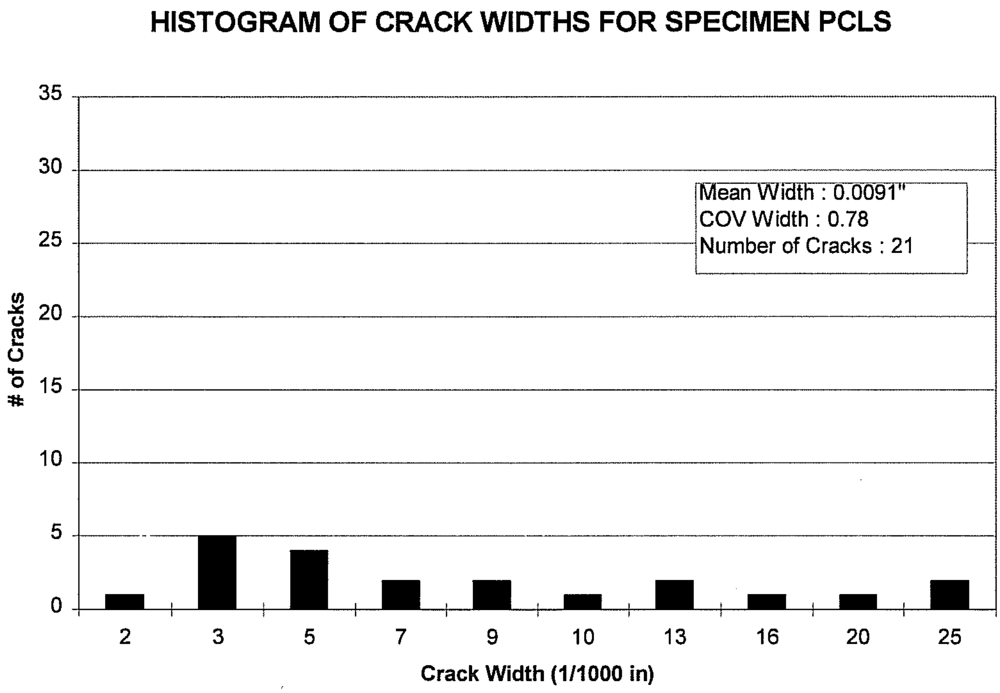


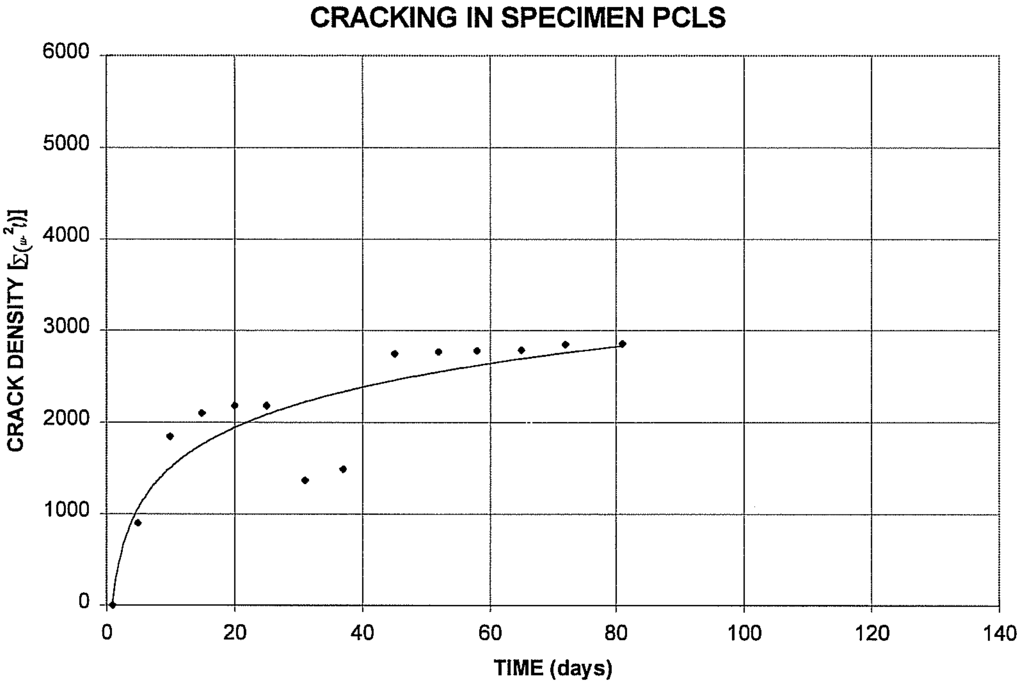
WALL: PCLS DATE: 4/12/95

SIDE: south



10.7.3 Histogram of Crack Widths and Cracking vs. Time for PCLS





10.8 Cracking in Specimen PCLN

Dates on which no changes were observed:

1/29, 1/31, 3/20, 3/27

10.8.1 Quantitative Data for PCLN

1/30/95					2/5/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l		#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)				(1/1000 in)	(joint widths)	
1	2	1	4		1	2	1	4
1	13	1	169		1	13	1	169
1	13	1	169		1	13	1	169
1	9	1	81		1	9	1	81
2	7	1	98		2	7	1	98
1	13	1	169		1	13	1	169
SUM			690		1	13	1	169
					SUM			859

2/10/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	2	1	4
1	13	1	169
1	13	1	169
1	9	1	81
2	7	1	98
1	13	1	169
1	13	1	169
1	9	1	81
SUM			940

2/15/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	2	1	4
1	13	1	169
1	13	1	169
1	9	1	81
2	7	1	98
1	13	1	169
1	13	1	169
1	9	1	81
1	13	1	169
SUM			1109

2/21/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	2	1	4
1	13	1	169
1	13	1	169
1	9	1	81
2	7	1	98
1	13	1	169
1	13	1	169
1	9	1	81
1	13	1	169
1	7	1	49
1	5	1	25
1	10	1	100
SUM			1283

2/27/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	2	1	4
1	13	1	169
1	13	1	169
1	9	1	81
2	7	1	98
1	13	1	169
1	13	1	169
1	9	1	81
1	13	1	169
1	7	1	49
1	5	1	25
1	10	1	100
1	3	1	9
1	7	1	49
SUM			1341

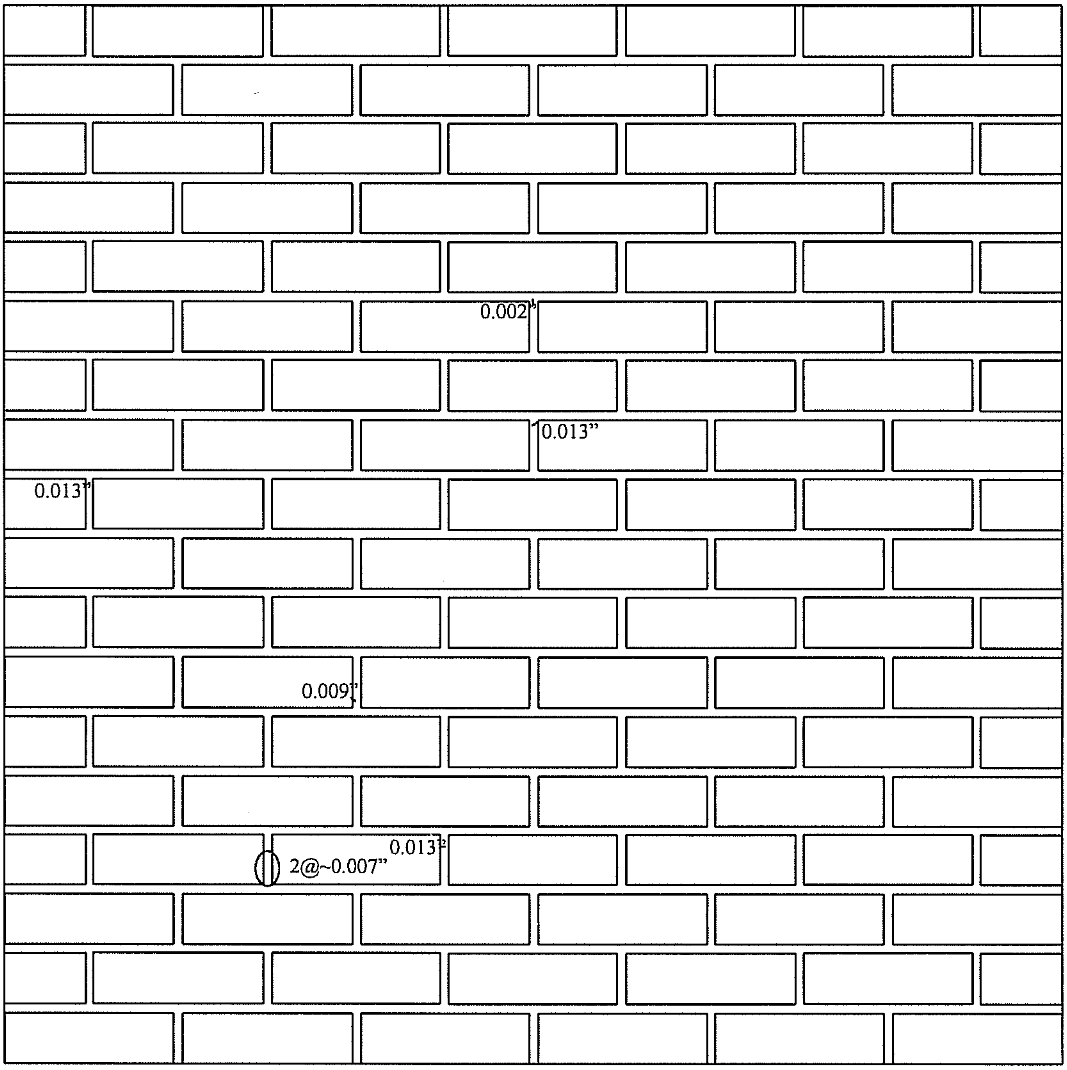
3/7/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	2	1	4
1	13	1	169
1	13	1	169
1	9	1	81
2	7	1	98
1	13	1	169
1	13	1	169
1	9	1	81
1	13	1	169
1	7	1	49
1	5	1	25
1	10	1	100
1	3	1	9
1	7	1	49
1	10	1	100
SUM			1441

3/14/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
1	2	1	4
1	13	1	169
1	13	1	169
1	9	1	81
2	7	1	98
1	13	1	169
1	13	1	169
1	9	1	81
1	13	1	169
1	7	1	49
1	5	1	25
1	10	1	100
1	3	1	9
1	7	1	49
1	10	1	100
1	5	1	25
1	7	1	49
1	9	1	81
2	3	1	18
SUM			1614

10.8.2 Panel Drawings for PCLN

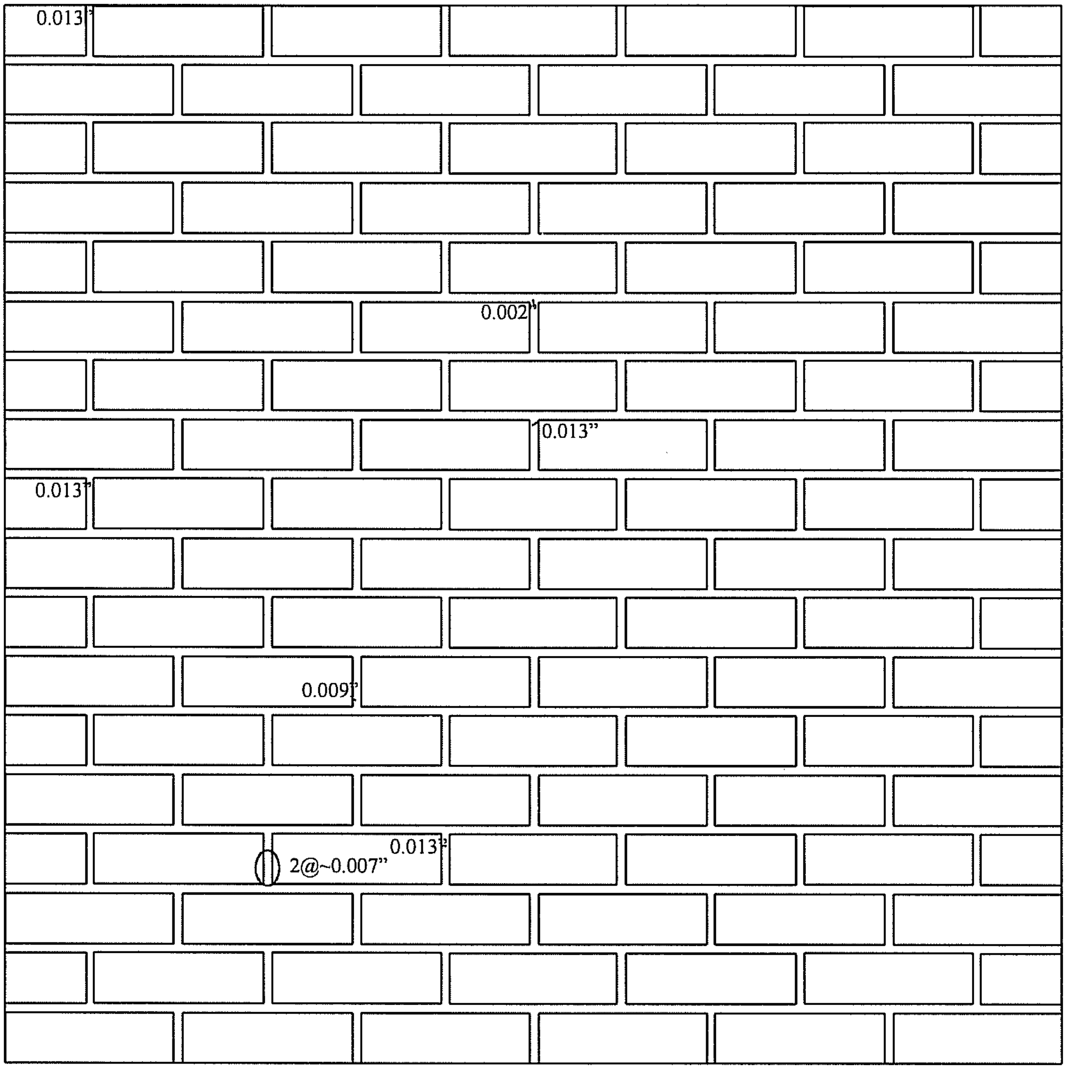
WALL: PCLN DATE: 1/30/95

SIDE: south



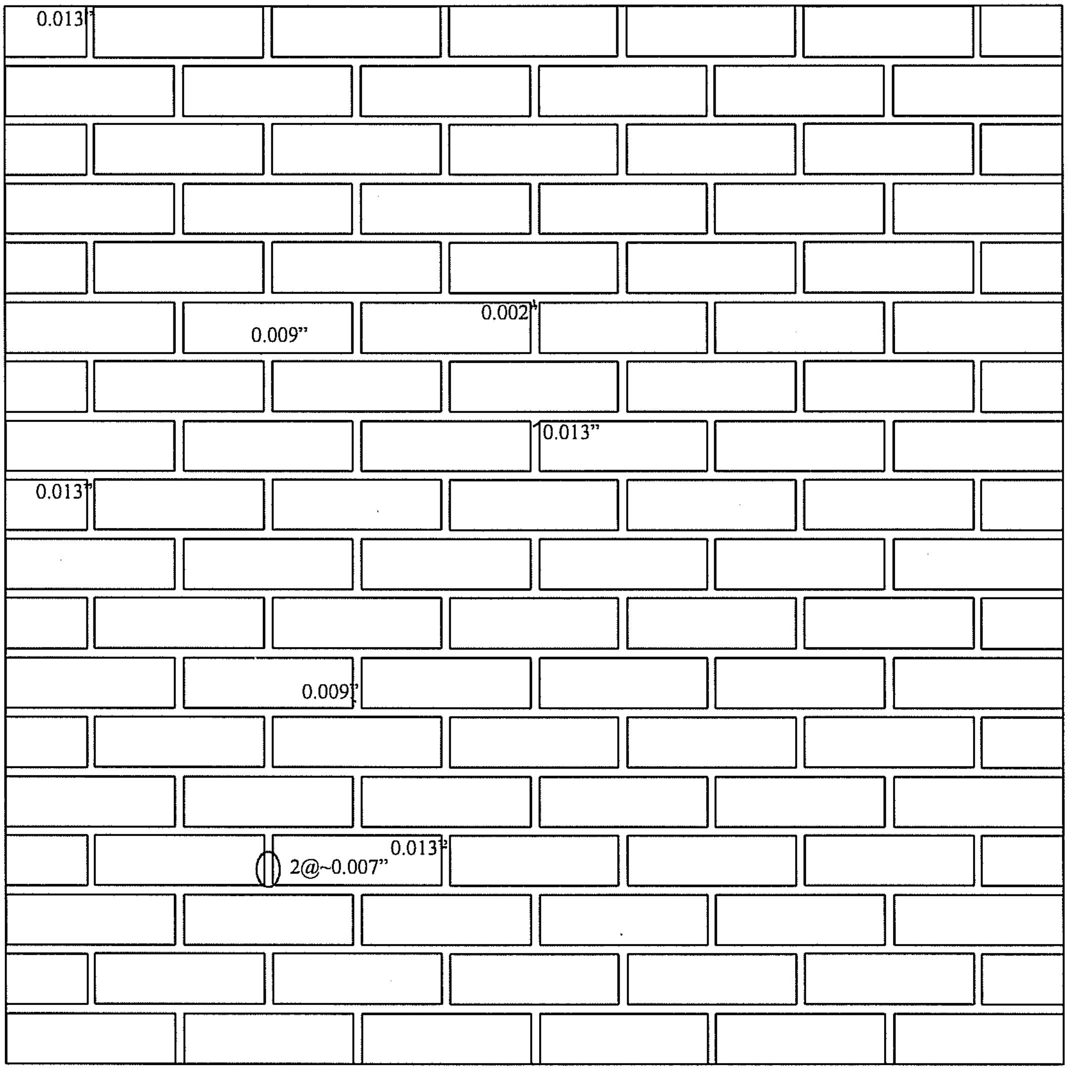
WALL: PCLN DATE: 2/5/95

SIDE: south



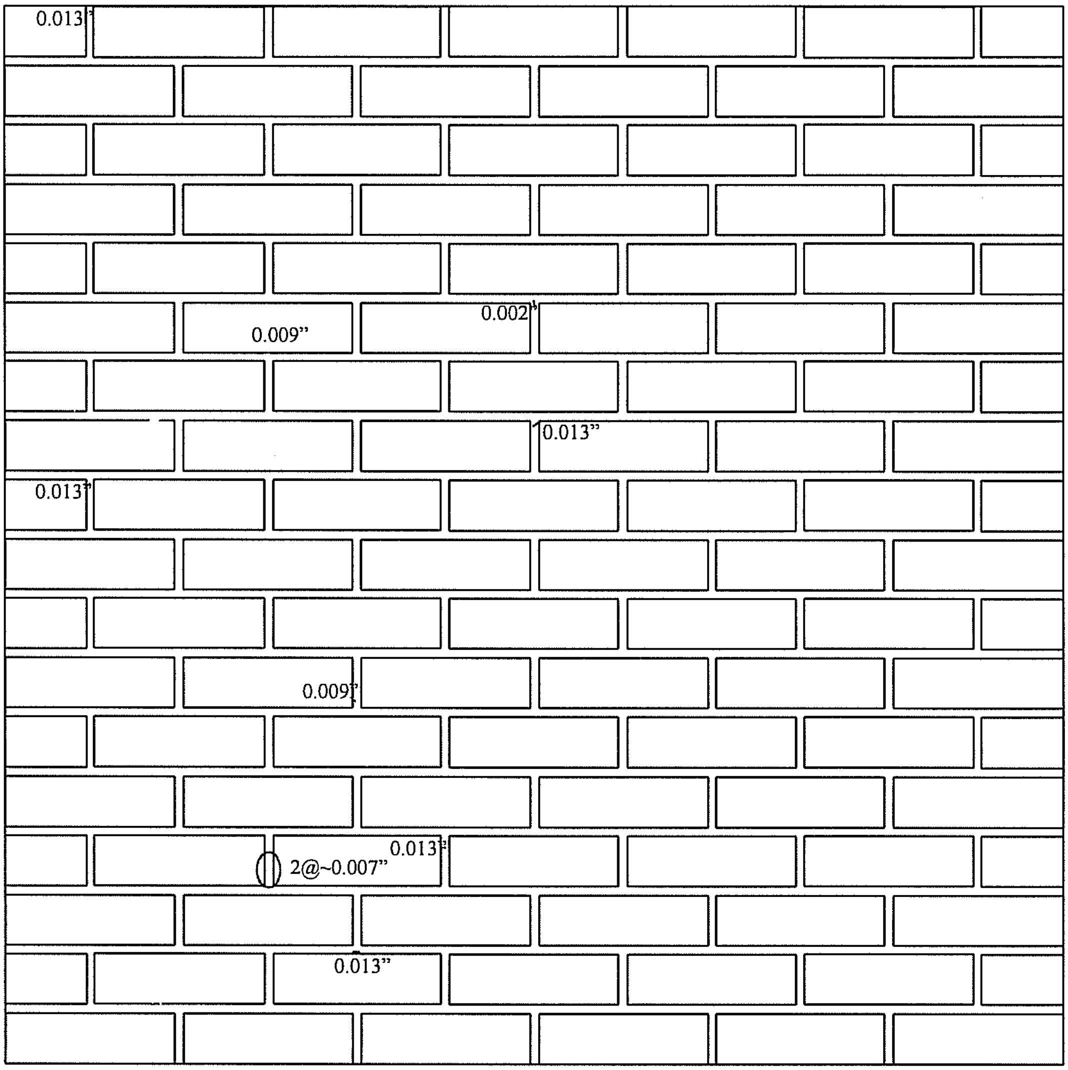
WALL: PCLN DATE: 2/10/95

SIDE: south



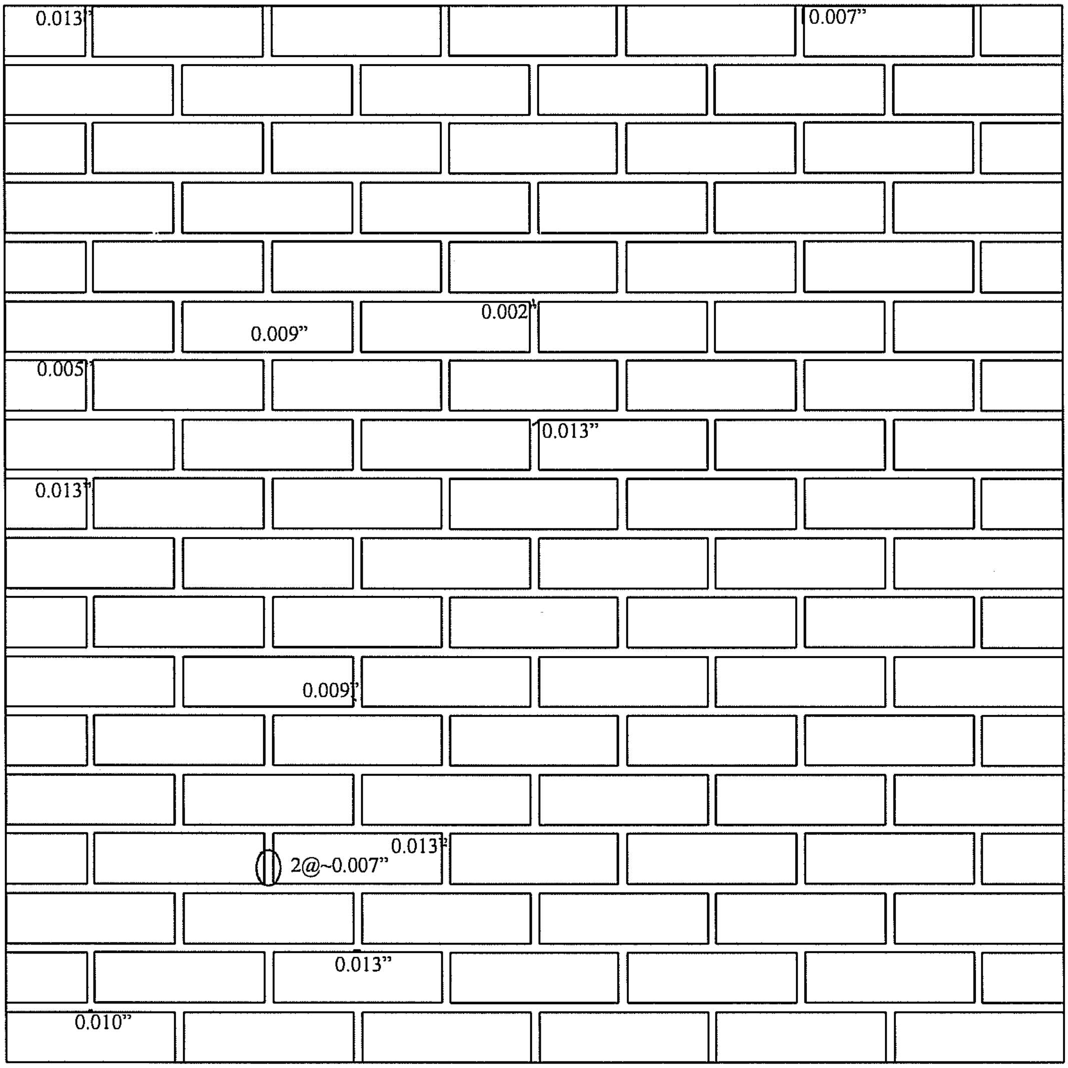
WALL: PCLN DATE: 2/15/95

SIDE: south



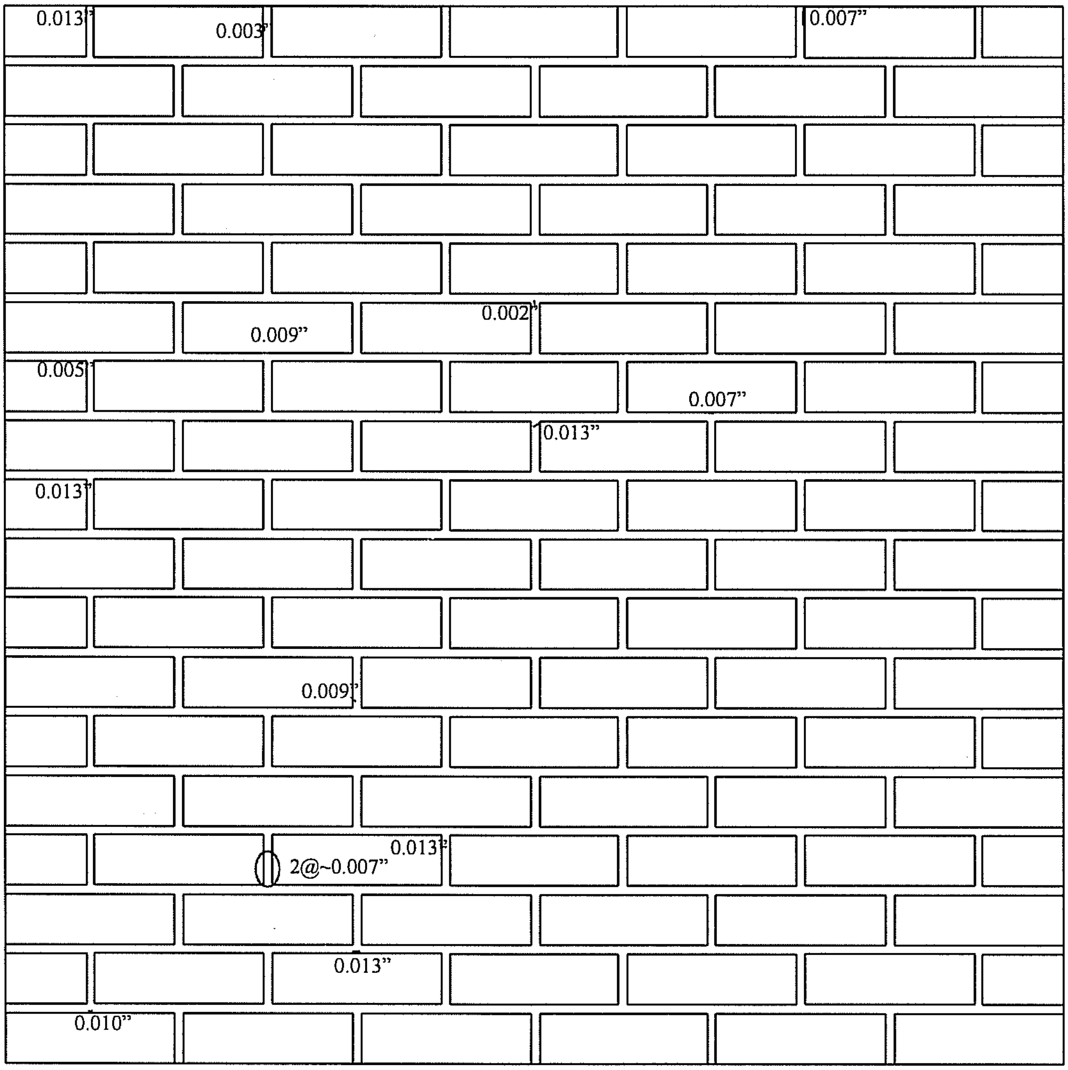
WALL: PCLN DATE: 2/21/95

SIDE: south



WALL: PCLN DATE: 2/27/95

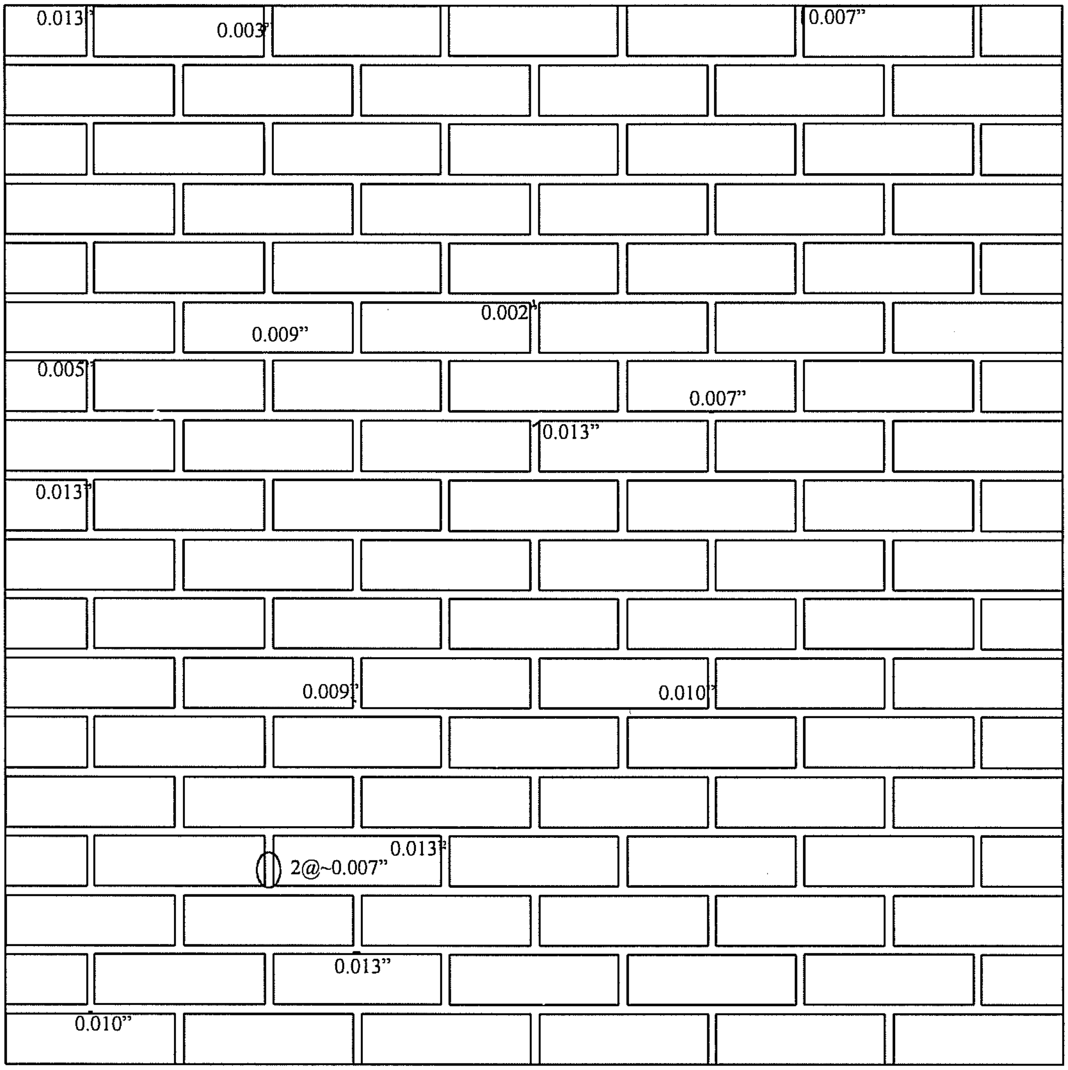
SIDE: south



WALL: PCLN

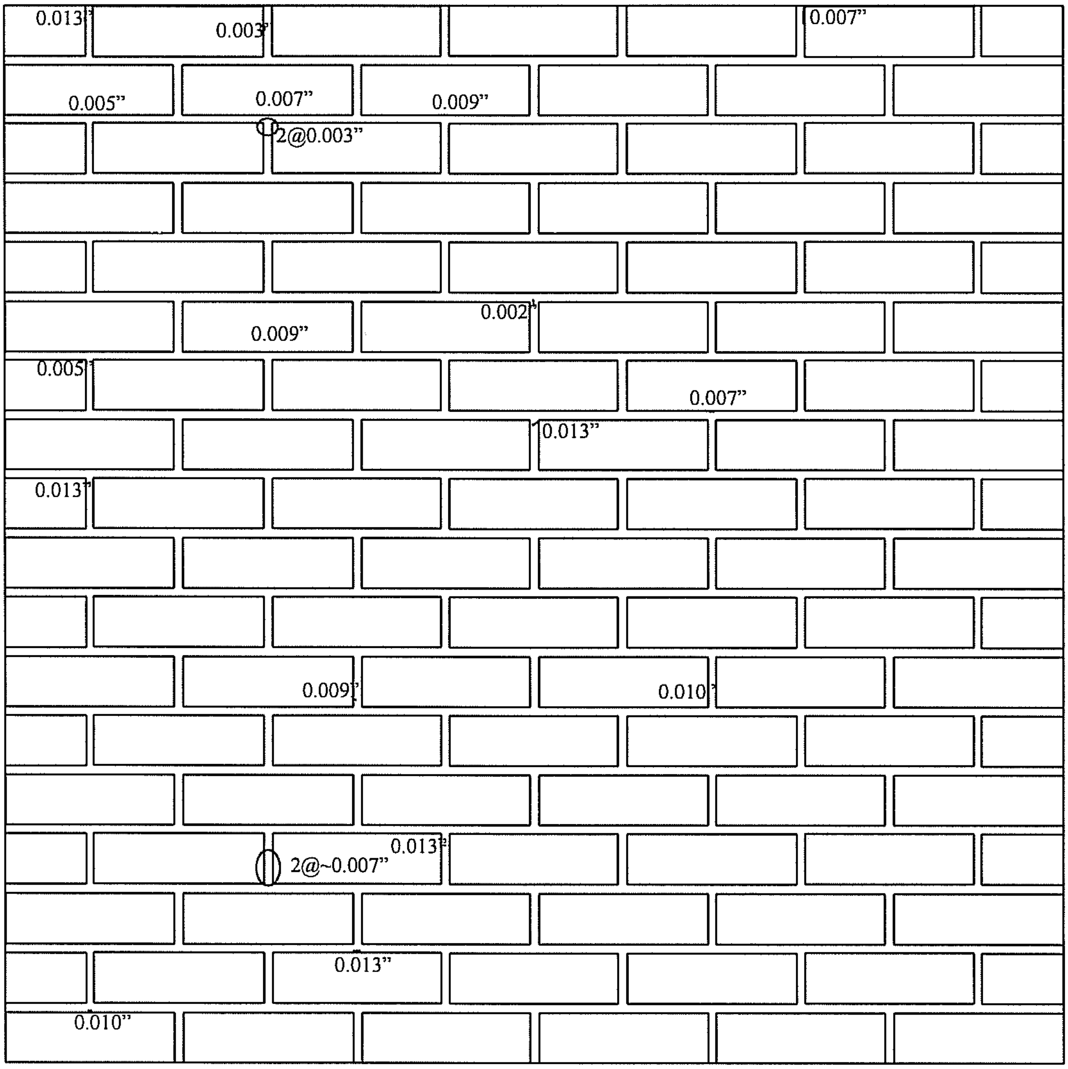
DATE: 3/7/95

SIDE: south

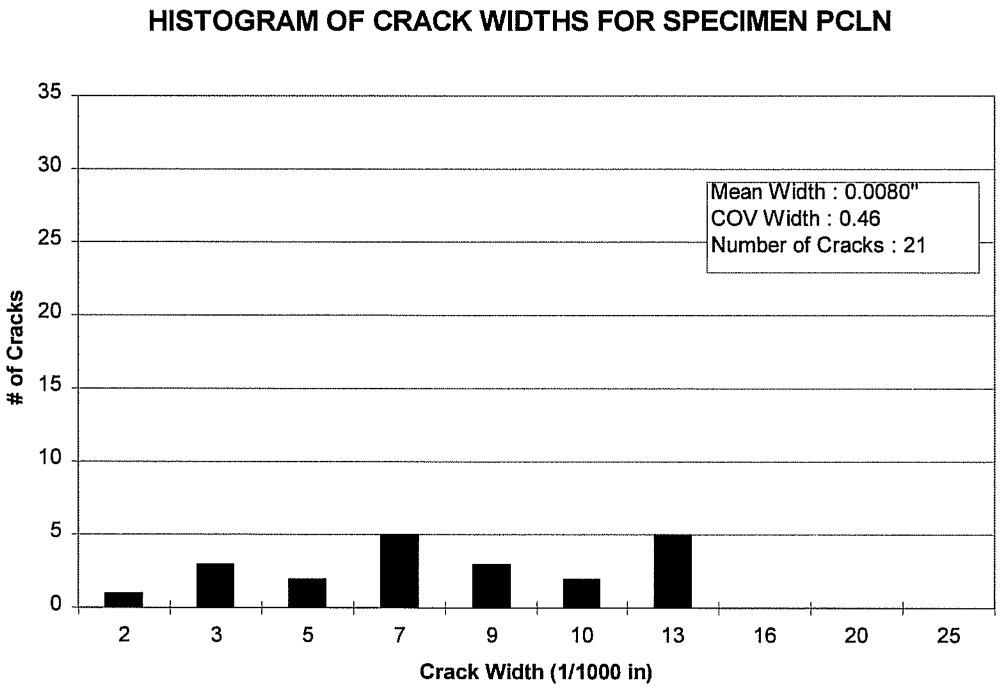


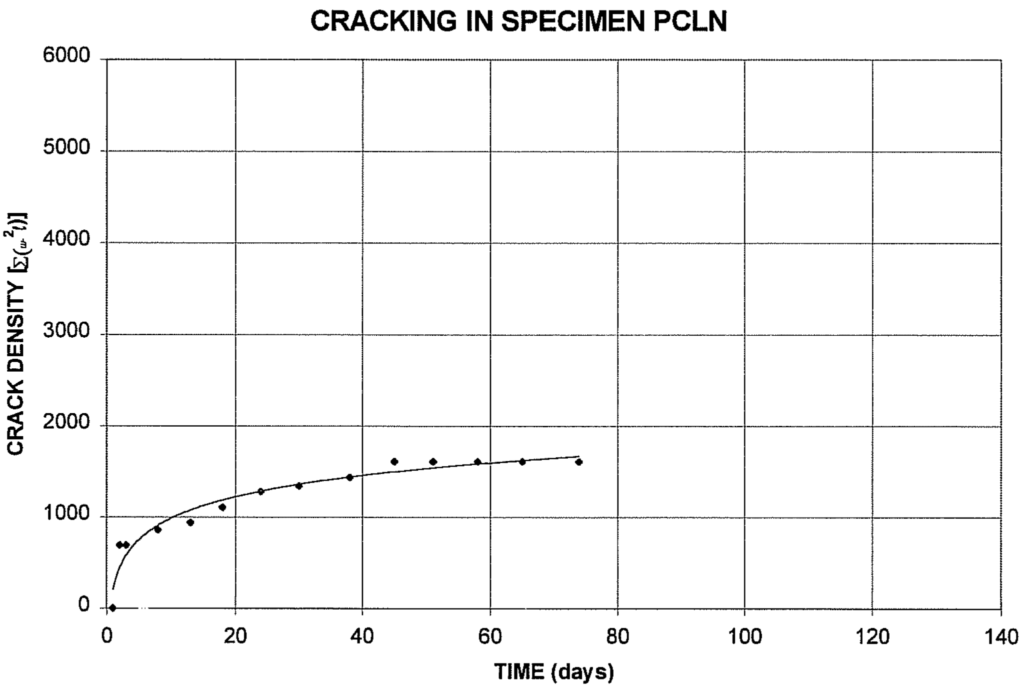
WALL: PCLN DATE: 3/14/95

SIDE: south



10.8.3 Histogram of Crack Widths and Cracking vs. Time for PCLN





10.9 Cracking in Specimen PCLO

Dates on which no changes were observed:

1/29, 1/31, 2/5, 2/27, 3/14, 3/20, 3/27

10.9.1 Quantitative Data for PCLO

1/30/95				
#	CRACK WIDTH	CRACK LENGTH	w^2l	
	(1/1000 in)	(joint widths)		
2	13	1	338	
SUM			338	

2/10/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
2	13	1	338
1	5	4	100
SUM			438

2/15/95				
#	CRACK WIDTH	CRACK LENGTH	w^2l	
	(1/1000 in)	(joint widths)		
2	13	1	338	
1	5	4	100	
1	9	1	81	
SUM			519	

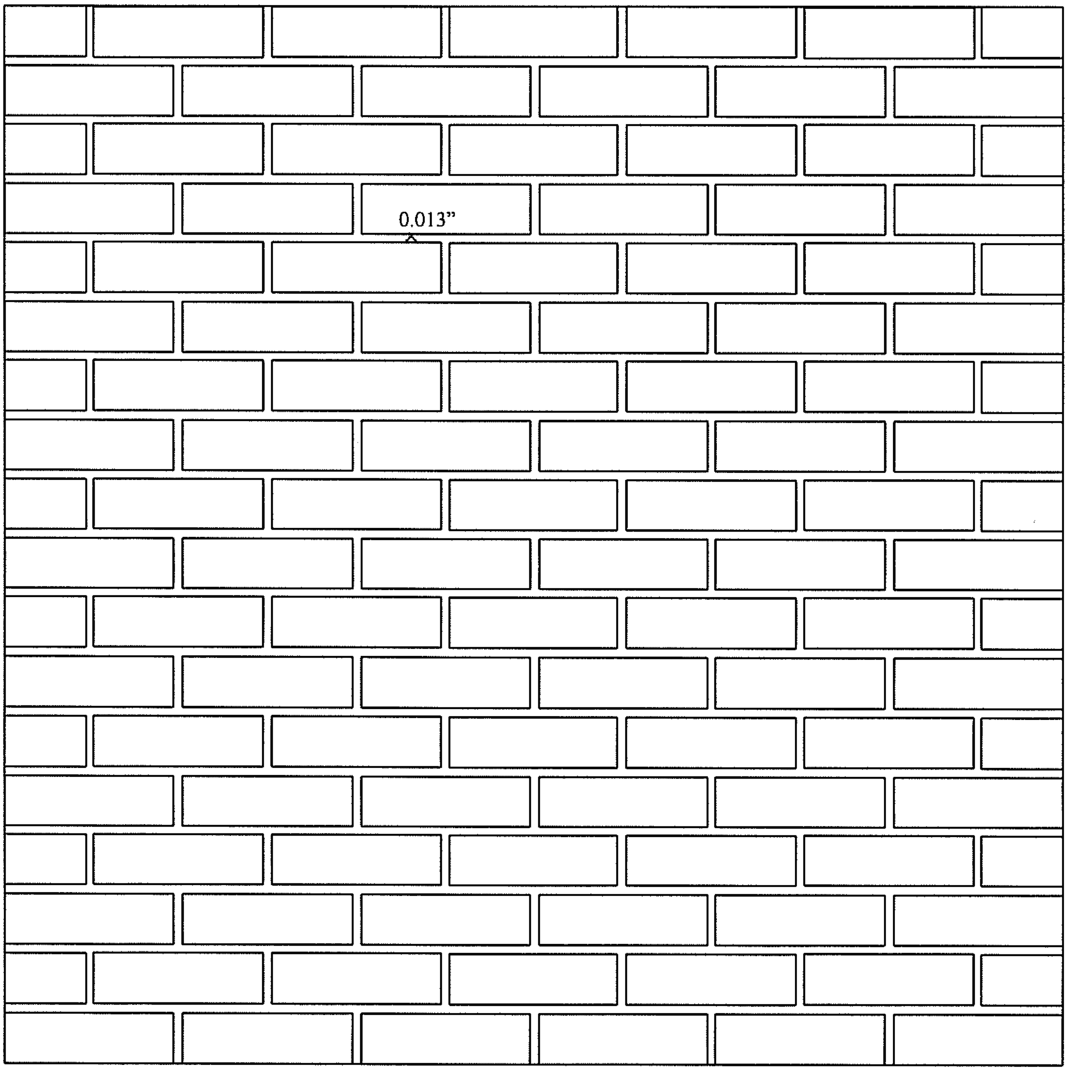
2/21/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)	
2	13	1	338
1	5	4	100
1	13	1	169
SUM			607

3/7/95					4/12/95			
#	CRACK WIDTH	CRACK LENGTH	w^2l		#	CRACK WIDTH	CRACK LENGTH	w^2l
	(1/1000 in)	(joint widths)				(1/1000 in)	(joint widths)	
2	13	1	338		2	13	1	338
1	5	4	100		1	5	4	100
1	13	1	169		1	13	1	169
1	16	1	256		1	16	1	256
SUM			863		1	3	1	9
					SUM			872

10.9.2 Panel Drawings for PCLO

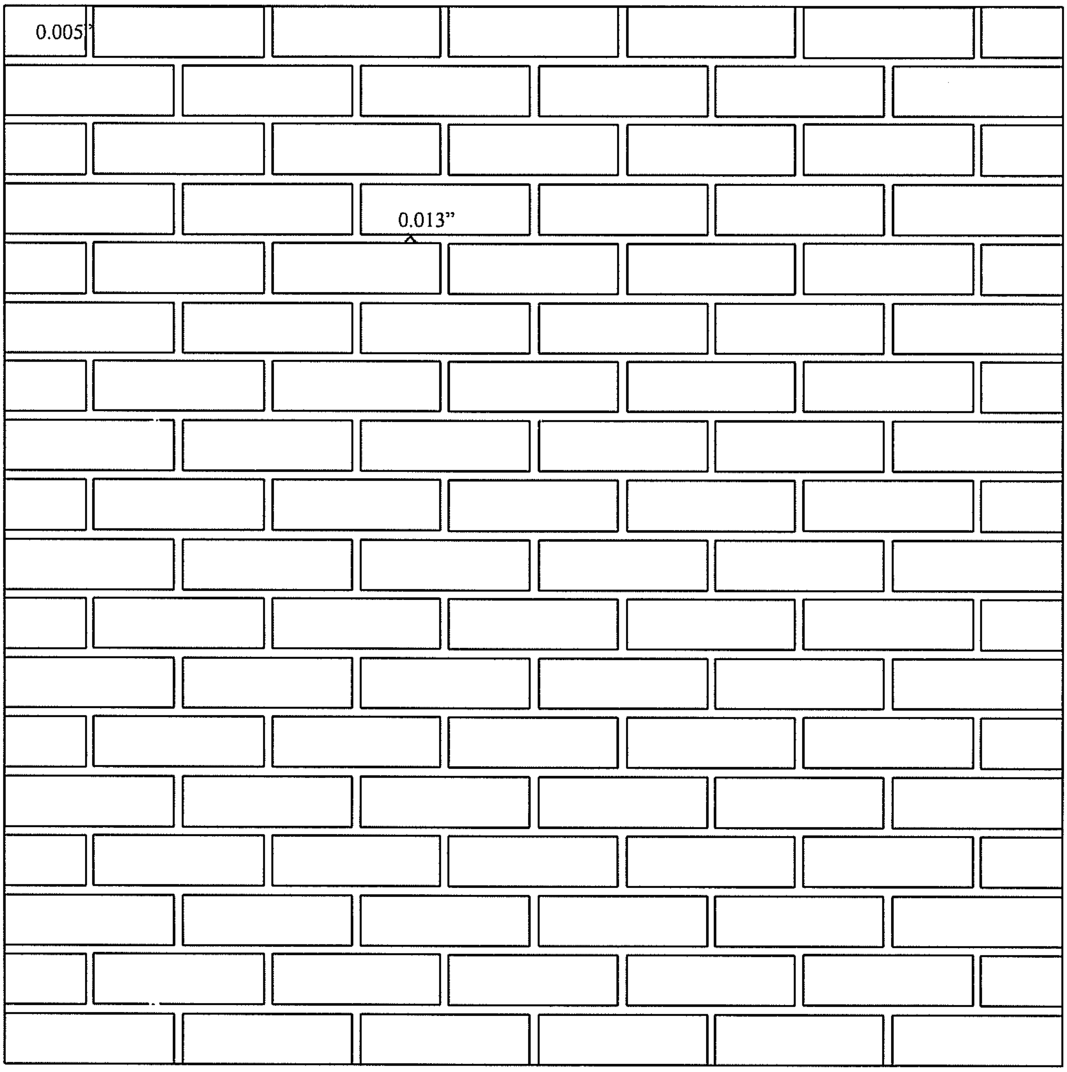
WALL: PCLO DATE: 1/30/95

SIDE: south



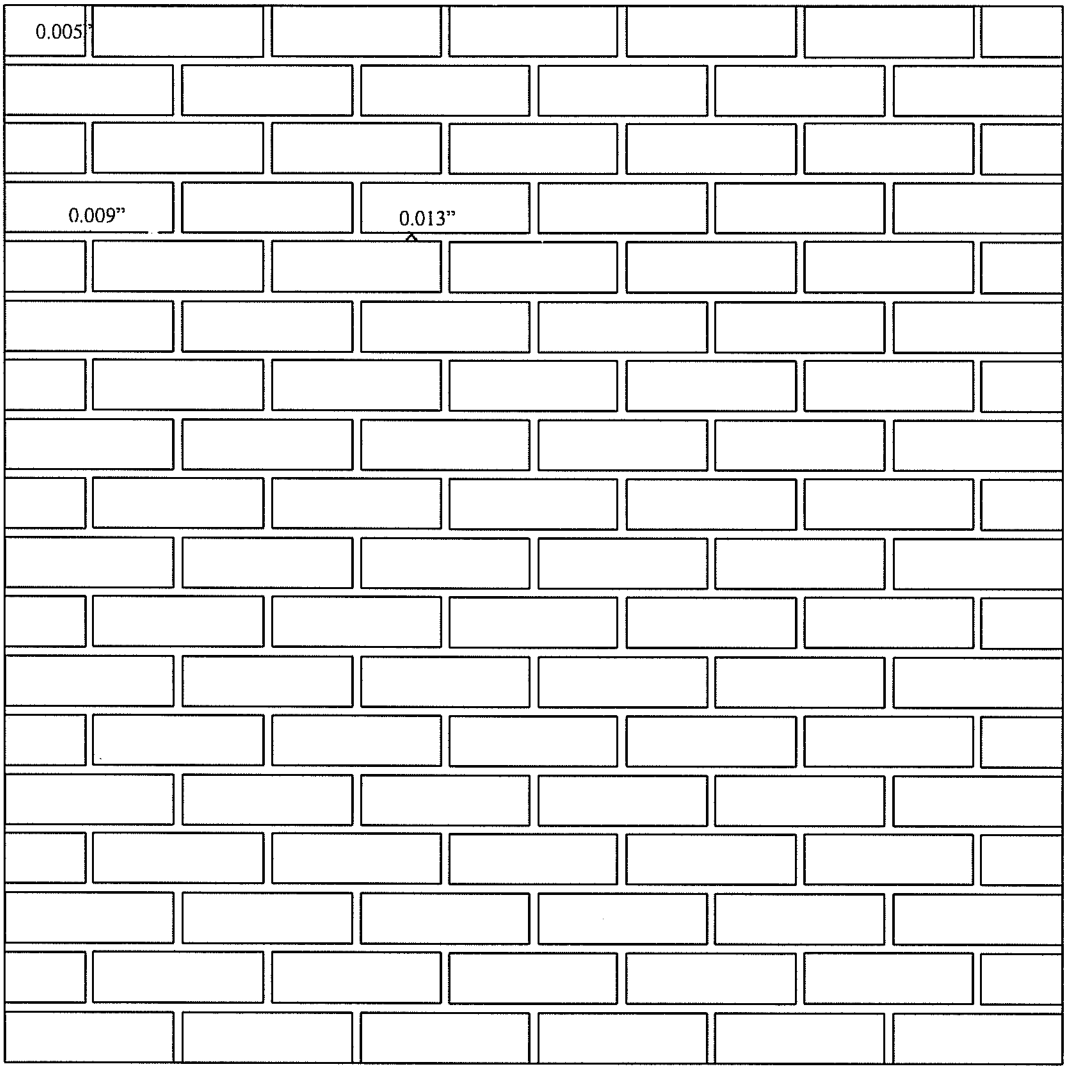
WALL: PCLO DATE: 2/10/95

SIDE: south



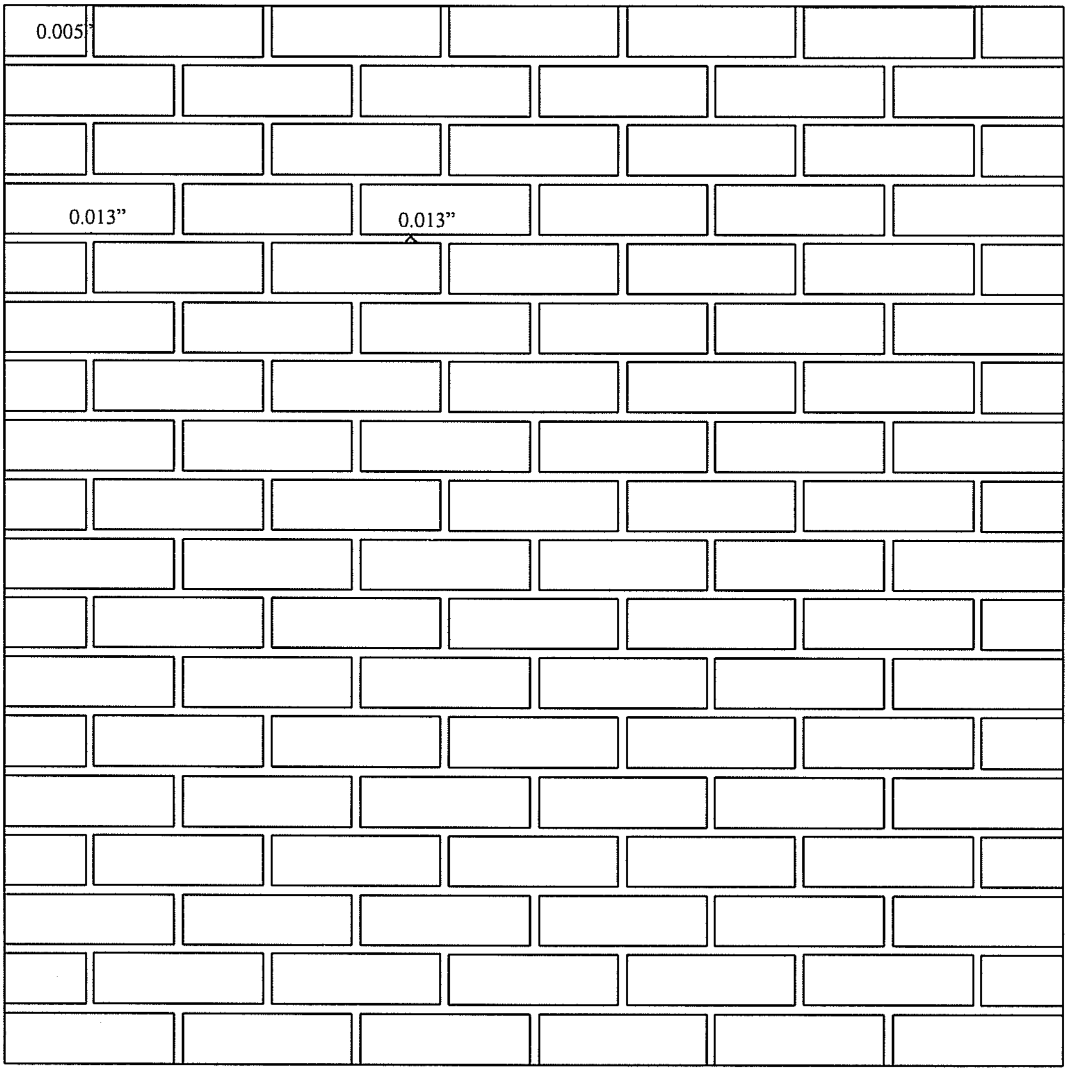
WALL: PCLO DATE: 2/15/95

SIDE: south TIME:



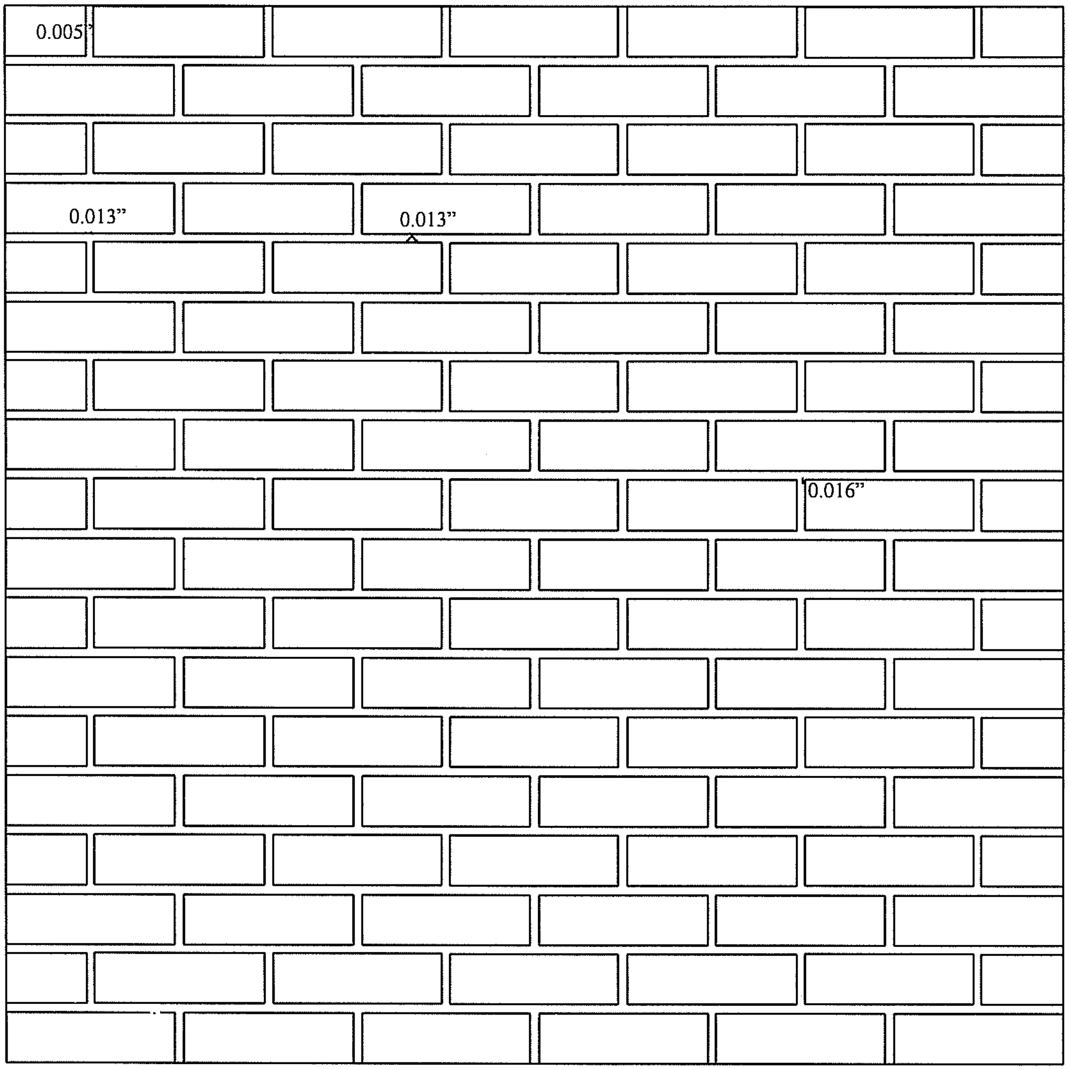
WALL: PCLO DATE: 2/21/95

SIDE: south



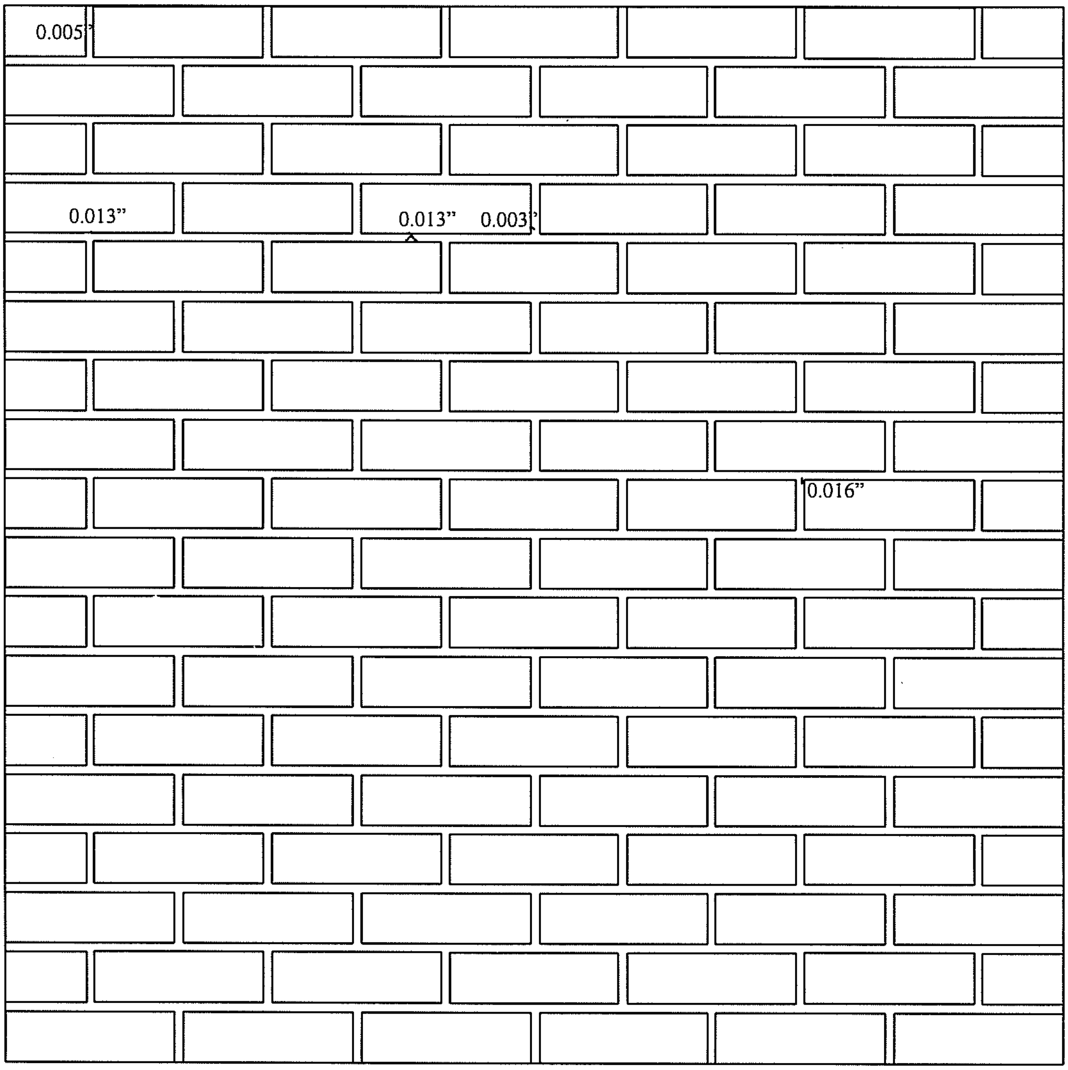
WALL: PCLO DATE: 3/7/95

SIDE: south

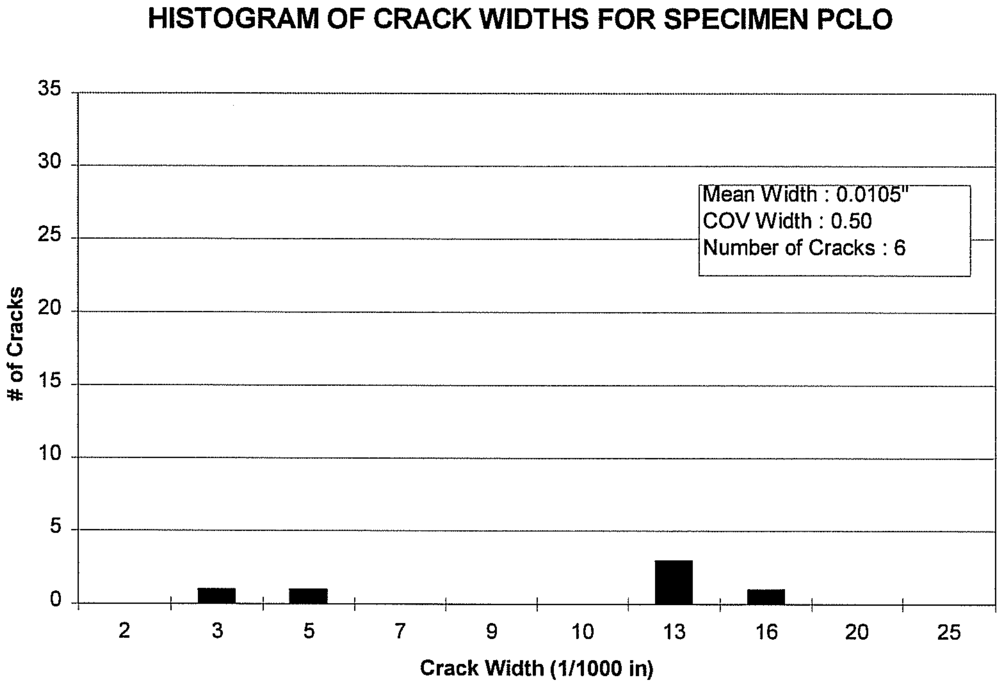


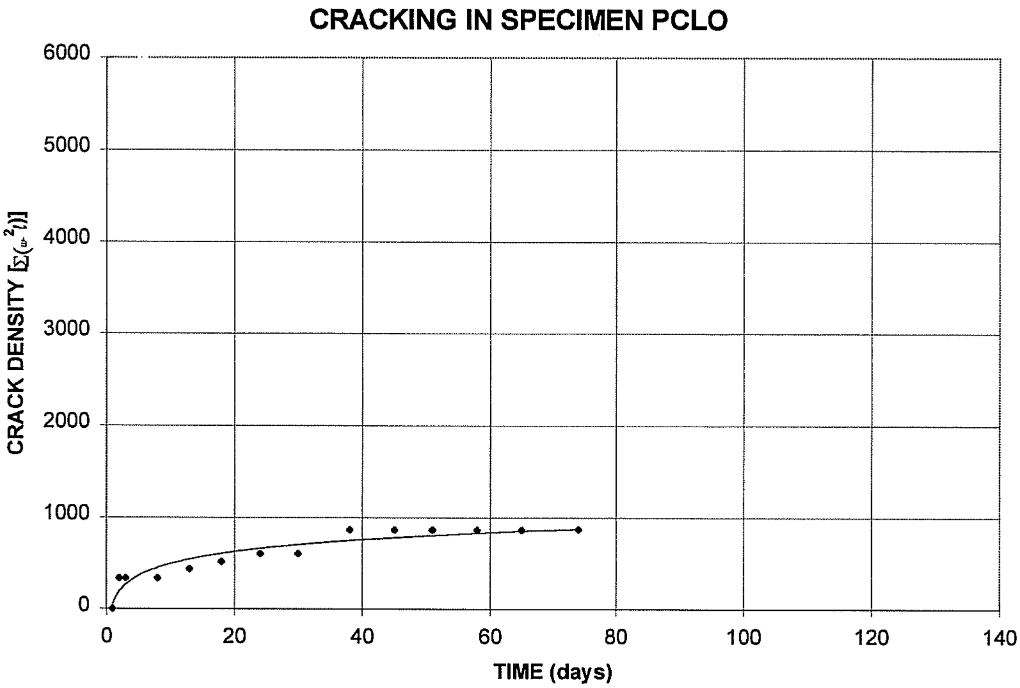
WALL: PCLO DATE: 4/12/95

SIDE: south



10.9.3 Histogram of Crack Widths and Cracking vs. Time for PCLO




CRACKING IN SPECIMEN PCLO
CRACK DENSITY
6000
5000
4000
3000
2000
1000
0
0
20
40
60
80
100
120
140
TIME (days)

11. Appendix E - Modulus of Rupture Data

Mortar	Flow	Bar		Force (lbs)	Span (in)	Moment (lb-in)	Tensile Str. (psi)	Mean (psi)	COV
MC1N	Mason	1	a	56.0	4	56.0	336.0	291.7	0.3342
		1	b	57.2	4	57.2	343.2		
		2	a	19.5	4	19.5	117.0		
		2	b	47.0	4	47.0	282.0		
		3	a	71.6	4	71.6	429.6		
		3	b	72.8	4	72.8	436.8		
		81	a	36.6	4	36.6	219.6		
		82	a	15.6	4	15.6	93.6		
		83	a	53.2	4	53.2	319.2		
		83	b	46.4	4	46.4	278.4		
		84	a	57.5	4	57.5	345.0		
		84	b	48.7	4	48.7	292.2		
		85	a	48.5	4	48.5	291.0		
		85	b	50.1	4	50.1	300.6		
	Lab	6	a	20.6	4	20.6	123.6	210.3	0.2906
		6	b	29.6	4	29.6	177.6		
		86	a	22.7	4	22.7	136.2		
		86	b	42.5	4	42.5	255.0		
		87	a	43.0	4	43.0	258.0		
		87	b	44.6	4	44.6	267.6		
		88	a	20.6	4	20.6	123.6		
		88	b	28.6	4	28.6	171.6		
		89	a	34.0	4	34.0	204.0		
		89	b	46.6	4	46.6	279.6		
		90	a	43.5	4	43.5	261.0		
		90	b	44.2	4	44.2	265.2		
MC1M	Mason	11	a	95.7	4	95.7	574.2	1076.4	0.2300
		11	b	116.8	4	116.8	700.8		
		12	a	208.0	4	208.0	1248.0		
		12	b	210.5	4	210.5	1263.0		
		13	a	195.0	4	195.0	1170.0		
		13	b	193.5	4	193.5	1161.0		
		14	a	203.0	4	203.0	1218.0		
		14	b	180.0	4	180.0	1080.0		
		15	a	219.0	4	219.0	1314.0		
		15	b	172.5	4	172.5	1035.0		
	Lab	16	a	180.5	4	180.5	1083.0	1096.2	0.1803
		16	b	200.0	4	200.0	1200.0		
		17	a	212.0	4	212.0	1272.0		
		17	b	188.5	4	188.5	1131.0		
		18	a	187.0	4	187.0	1122.0		
		18	b	189.5	4	189.5	1137.0		
		19	a	144.0	4	144.0	864.0		
		19	b	214.5	4	214.5	1287.0		
		20	a	108.0	4	108.0	648.0		
		20	b	203.0	4	203.0	1218.0		

12. Appendix F - Water and Air Content Data

Mortar	MC mass (g/cup)	MC used (cups)	MC used (g)	MC dens. (g/cm³)	PC mass (g/cup)	PC used (cups)	PC used (g)	PC dens. (g/cm³)	Lime mass (g/cup)	Lime used (cups)
MC1M	661.2	1	661.2	3.15	707.9	0	0	3.15	388.9	0
MC1N	661.2	1	661.2	3.15	707.9	0	0	3.15	388.9	0
MC2S	661.2	1	661.2	3.15	707.9	0	0	3.15	388.9	0
MC2N	661.2	1	661.2	3.15	707.9	0	0	3.15	388.9	0
PCLM	661.2	0	0	3.15	707.9	1	707.9	3.15	388.9	0
PCLS	661.2	0	0	3.15	707.9	0.666667	471.9333	3.15	388.9	0.333333
PCLN	661.2	0	0	3.15	707.9	0.5	353.95	3.15	388.9	0.5
PCLO	661.2	0	0	3.15	707.9	0.333333	235.9667	3.15	388.9	0.666667

Mortar	Lime used (g)	Lime dens. (g/cm³)	Sand mass (g/cup)	Sand used (cups)	Sand used (g)	Sand dens. (g/cm³)	Water (g)	400 ml mass (g)	Density (g/cm³)	Air (%)
MC1M	0	2.34	890	3	2670	2.65	400	768.2	2.306838	16.7
MC1N	0	2.34	890	3	2670	2.65	460	765.8	2.260095	15.3
MC2S	0	2.34	890	3	2670	2.65	400	818.3	2.306838	11.3
MC2N	0	2.34	890	3	2670	2.65	400	817.4	2.306838	11.4
PCLM	0	2.34	890	3	2670	2.65	520	877.6	2.224477	1.4
PCLS	129.6333	2.34	890	3	2670	2.65	520	866.5	2.188158	1.0
PCLN	194.45	2.34	890	3	2670	2.65	500	856.5	2.183427	1.9
PCLO	259.2667	2.34	890	3	2670	2.65	580	842	2.112067	0.3

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VITA

Brian James Harris was born in Fort Lee, Virginia on August 8, 1972, the son of Donald Lee Harris and Marilyn Lucille Harris. In 1990 he graduated from Thomas Jefferson High School for Science and Technology in Alexandria, Virginia. Beginning in the fall of 1990, he attended Duke University in Durham, North Carolina. He received the degree of Bachelor of Science in Engineering from Duke University in May, 1994. In August 1994, he entered The Graduate School at the University of Texas at Austin.

Permanent Address: 5976 Burnside Landing Drive
Burke, Virginia 22015

This thesis was typed by the author.