CERNY & IVEY ENGINEERS, INC.

CONSULTING ENGINEERS - TESTING LABORATORY

5650 PEACHTREE PARKWAY, NORCROSS (ATLANTA), GA. 30092
770-449-6936 • FAX 770-368-1148
EMAIL: CERNY.AND.IVEY@MINDSPRING.COM

June 28, 2001

Engineering Report 21117

Uniform Load Testing
E. Dillon & Company
Nova Brik

SUMMARY

On April 3 through 5, 2001, uniform load testing was performed on six assemblies of Nova Brik veneer siding manufactured by E. Dillon & Company. The mortarless concrete bricks were assembled onto standard wooden frames in a Cerny & Ivey Engineers, Inc. test chamber. The specimens were constructed with #2, 2-inch by 4-inch nominal wood studs spaced at 16-inches on centers, nominal 1/2-inch thick plywood, felt paper, and furring strips per the manufacturer's published instructions. The wall assemblies were tested to determine their performance characteristics when subjected to negative uniform loads. The testing was modeled after ASTM E330, "Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference."

Three of the panels were constructed using #8 by 3-inch bugle head 305 stainless steel wood screws for the framing and the brick attachment. The average ultimate negative load recorded for these specimens was 266 PSF (51 inches H_2O). In all three cases, failure occurred as cracking and crushing of the studs throughout the frame of the panel.

Three of the panels were constructed using #8 by 2-1/2-inch galvanized deck screws for the framing and the brick attachment. The average ultimate negative load recorded for these specimens was 260 PSF (50 inches H_2O). In all three cases, failure occurred as cracking and crushing of the studs throughout the frame of the panel. In one specimen, brick screws pulled out of the furring strips and a section of the bricks separated from the wall panel at the ultimate failure load.

Standard Building Code (SBCCI 1999) minimum negative wind velocity design pressures for a worst case 110 mph, wall end zone, on an enclosed building with a 60-foot mean roof height would be -55.1 PSF (based on SBCCI 1999 Figure 1606 - Basic Wind Speeds for 50-Year Mean Recurrence Interval, Table 1606.2A - Velocity Pressure (q) (PSF), and Figure 1606.2C - Wall Coefficients, GC_p, Components and Cladding).

International Building Code (IBC 2000) minimum negative wind design loads for a continental U.S. worst case 30-foot mean roof height at 150 mph basic wind speed in urban / suburban areas (Exposure B) would be –54.2 PSF (based on IBC 2000 - Figure 1609, Basic Wind Speed, Figure 1609.6 (2) - Component and Cladding Loading Diagrams, and Table 1609.6.2.1(2) - Component and Cladding Loads for a Building with a Mean Roof Height of 30 feet Located in Exposure B (PSF)).

Results for all Nova Brik panels tested using both the #8 by 3-inch bugle head 305 stainless steel wood screws and the #8 by 2 1/2-inch galvanized deck screws, exceeded the above SBCCI and IBC minimum negative pressure design loads by more than a factor of four.

This testing was to establish suitability of the product for meeting required negative wind pressure design load requirements of the above mentioned building codes. No statement, implied or otherwise, is intended concerning the suitability of this product regarding other requirements of these building codes.

If you have any questions or need additional information, please contact us.

Respectfully submitted,

Phillip B. Plyler
Staff Engineer

Christopher B. Shiver, P.E.
Vice President – Principal Engineer

GEORGIA REGISTERED No 16312 PROFESSIONAL ENGINEER CHRISTOPHER B. SHIVER

INTRODUCTION

On April 3 through 5, 2001, uniform load testing was performed on six assemblies of Nova Brik veneer siding manufactured by E. Dillon & Company. The mortarless concrete bricks were assembled onto standard wooden frames in a Cerny & Ivey Engineers, Inc. test chamber, and tested to determine their performance characteristics when subjected to negative uniform loads. The testing was modeled after ASTM E330, "Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference." Photographs of the assembly and testing are included in this report.

SPECIMEN

Each of the specimens tested was an assembly of a 4-foot wide by 8-foot high wall section. The specimen consisted of a standard wooden support frame with mechanically attached plywood sheathing. Felt paper and wood furring strips were applied to the exterior surface of the sheathing. The Nova Brik veneer siding systems used for the test were installed by E. Dillon & Company personnel in accordance with the manufacturer's instructions using predetermined support spacing and fasteners.

The brick veneer siding system was comprised of non-structural, mortarless, interlocking concrete brick castings that measured a nominal 8-inches long by 6-inches high, and had a 2-inch average thickness cross-section (Photographs 1 and 2, Figure 1). Two different types of screws were used to determine their effectiveness when compared to the #10 by 3-inch long square drive case hardened and corrosion resistant coated steel "Nova Screw" tested previously (refer to Cerny & Ivey Engineers, Inc. Report 98470 dated November 18, 1998).

Support Frame – Specimens #1 through 3

The standard wooden support frame used for the test was constructed of #2, nominal 2-inch by 4-inch lumber placed at 16-inches on centers (Photographs 3 and 4) using a series of #8 by 3-inch long bugle head 305 stainless steel self-drilling wood screws (Photographs 5 and 6). The support frame measured a nominal 48-inches wide by 96-inches high (Photograph 9). A nominal 1/2-inch thick sheet of BC grade plywood sheathing was attached to the support frame with a series of the same type #8 by 3-inch long screws (Photographs 9 and 10).

A layer of #15 asphalt felt paper was rolled over the plywood and stapled to the surface of the support frame (Photograph 11). Five nominal 1-inch by 4-inch wood vertical furring strips were attached along each long edge of the support frame and at 16-inches on centers with the same type #8 by 3-inch long screws. A nominal 1-inch by 6-inch wood horizontal baseboard was attached along one of the short edges of the support frame, using the same type #8 by 3-inch long screws (Photograph 12).

A 6-mil sheet of polyethylene was placed over the furring strips prior to the application of the Nova Brik to seal the specimen into the test chamber. This sheet is not part of the normal wall construction and was placed with pleats so no load was carried by spanning joints or causing filets (Photograph 13). The frame was then lifted into place and secured in the text fixture, ensuring the 1 x 6 baseboard was along the bottom edge of the support frame (Photograph 14). The first course of Nova Brik was attached with two screws in each brick into the baseboard using the same type #8 by 3-inch long screws (Photograph 15). The Nova Brik were then stacked in courses using a running bond pattern starting at the base course and working up (Photographs 16 through 18). During assembly, every fourth course was drilled and fastened to the vertical furring strips with one #8 by 3-inch long screw per each brick that landed in front of a furring strip. Construction of the wall panel continued in this pattern until the specimen was complete.

Support Frame – Specimens #4 through 6

The standard wooden support frame used for the test was constructed of #2, nominal 2-inch by 4-inch lumber placed at 16-inches on centers (Photographs 3 and 4) using a series of #8 by 2-1/2-inch long galvanized self-drilling deck screws (Photographs 7 and 8). The support frame measured a nominal 48-inches wide by 96-inches high (Photograph 9). A nominal 1/2-inch thick sheet of BC grade plywood sheathing was attached to the support frame with a series of the same type #8 by 2-1/2-inch long deck screws (Photographs 9 and 10).

A layer of #15 asphalt felt paper was rolled over the plywood and stapled to the surface of the support frame (Photograph 11). Five nominal 1-inch by 4-inch wood vertical furring strips were attached along each long edge of the support frame and at 16-inches on centers with the same type #8 by 2-1/2-inch long deck screws. A nominal 1-inch by 6-inch wood horizontal baseboard was attached along one of the short edges of the support frame, using the same type #8 by 2-1/2-inch long deck screws (Photograph 12).

A 6-mil sheet of polyethylene was placed over the furring strips prior to the application of the Nova Brik to seal the specimen into the test chamber. This sheet is not part of the normal wall construction and was placed with pleats so no load was carried by spanning joints or causing filets (Photograph 13). The frame was then lifted into place and secured in the text fixture, ensuring the 1 x 6 baseboard was along the bottom edge of the support frame (Photograph 14). The first course of Nova Brik was attached with two screws in each brick into the baseboard using the same type #8 by 2-1/2-inch long deck screws (Photograph 15). The Nova Brik were then stacked in courses using a running bond pattern starting at the base course and working up (Photographs 16 through 18). During assembly, every fourth course was drilled and fastened to the vertical furring strips with one #8 by 2-1/2-inch long deck screw per each brick that landed in front of a furring strip. Construction of the wall panel continued in this pattern until the specimen was complete. The general assembly of each of the six panels is depicted in Figure 1.

PROCEDURE

Deflection measurements were made at four points along each test specimen (Photograph 18). One deflection gage, readable to 0.0005 inch, was installed at the mid-span of the panel along the top row of bricks (gage 1). A second gage was installed at the mid-span and mid-height of the panel (gage 2). The third gage was installed at the mid-span of the panel along the bottom row of bricks (gage 3). A fourth gage was installed at mid-height of the panel, at the closest furring strip to the left of gage 2 (gage 4).

Each panel was placed into the test chamber and gradually loaded with an equivalent negative static air pressure difference of 26 PSF (5 inches H_2O) for 60 seconds. After 60 seconds of load, the deflection gages were read, and the specimen was unloaded to 0 PSF (0 inches H_2O) for approximately one minute. After one minute with no load, the deflection gages were read, and the panel was loaded to 52 PSF (10 inches H_2O). This procedure was repeated in increasing 26 PSF (5 inches H_2O) static load increments up to failure. This procedure is in accordance with ASTM E 330 "Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference." The chamber pressure was measured using a water manometer accurate to 0.1 inches of water. The gages were removed and deflection readings were halted after 208 PSF (40 inches H_2O) to prevent potential damage to the gages.

RESULTS

The average ultimate negative load obtained by specimens 1 through 3 was 266 PSF (51 inches H_2O). At this load, the 2 x 4 studs of the wooden support frame failed along the assembly's mid-span, causing loud popping and cracking noises and noticeable deflection of the brick veneer. All three specimens exhibited similar modes of failure (Photographs 19 through 25). Post-failure examination indicated that the wooden studs had cracked in some areas and crushed in others. Average load and deflection data at the wall mid-span are represented in the table, below, and the graph at the end of this report:

Table 1: Nova Brik Veneer Siding Ultimate Loads

Specimen No.	**Ultimate Failure Load** (PSF)
1	273.5
2	270.4
3	254.8
Average	**266**

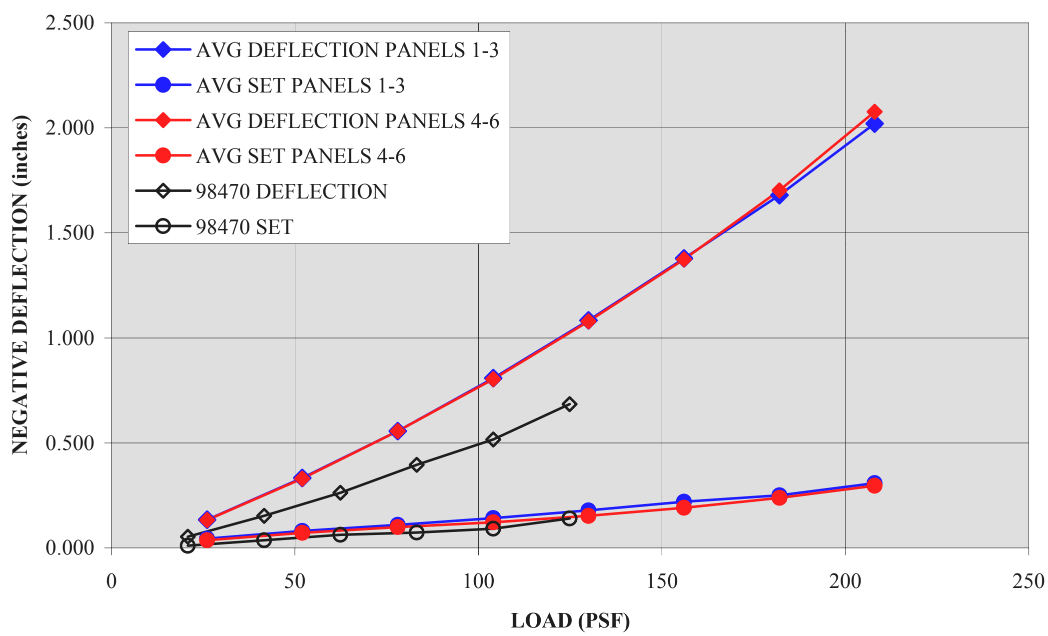
The average ultimate negative load obtained by specimens 4 through 6 was 260 PSF (50 inches H_2O). At this load, the 2 x 4 studs of the wooden support frame failed along the assembly's mid-span, causing loud popping and cracking noises and noticeable deflection of the brick veneer. All three specimens exhibited similar modes of failure (Photographs 26 through 32). Post-failure examination indicated that the wooden studs had cracked in some areas and crushed in others. Specimen 5 also had several partial courses of brick separate and fall away from the upper portion of the assembly. Post-failure examination indicated that several screws had pulled out of the 2 x 4 studs and released the attached brick. These bricks caused other unattached bricks to fall as well.

Average pressure and deflection data at the wall mid-span are represented in the table and graph below. Cerny & Ivey Engineers, Inc. Report 98470 describes the same tests run previously using ceramic coated bugle head screws for panel construction and brick attachment (Photograph 33). The results from that report are also included on the graph for comparison:

Table 2: Nova Brik Veneer Siding Ultimate Loads

Specimen No.	**Ultimate Failure Load** (PSF)
4	234.0
5	260.0
6	286.0
Average	**260**

AVERAGE MID-PANEL DEFLECTION AND SET



PHOTOGRAPH 1
NOVA BRIK AS RECEIVED

PHOTOGRAPH 2
INDIVIDUAL NOVA BRIK CASTING

PHOTOGRAPH 3
2 x 4's USED IN FRAME CONSTRUCTION

PHOTOGRAPH 4
2 x 4's USED IN FRAME CONSTRUCTION

<u>PHOTOGRAPH 5</u>
#8 BY 3" STAINLESS STEEL BUGLE HEAD
SCREWS FOR PANELS 1, 2 AND 3

<u>PHOTOGRAPH 6</u>
#8 BY 3" STAINLESS STEEL BUGLE HEAD
SCREWS FOR PANELS 1, 2 AND 3

<u>PHOTOGRAPH 7</u>
2-1/2" GALVANIZED DECK SCREWS USED FOR PANELS 4, 5 AND 6

<u>PHOTOGRAPH 8</u>
2-1/2" GALVANIZED DECK SCREWS USED FOR PANELS 4, 5 AND 6

<u>PHOTOGRAPH 9</u>
NOVA BRIK SUPPORT FRAME 48" x 96"

<u>PHOTOGRAPH 10</u>
BC GRADE PLYWOOD USED ON SUPPORT FRAMES

PHOTOGRAPH 11
ATTACHMENT OF FELT PAPER TO FRAME

PHOTOGRAPH 12
FURRING STRIPS AND BASEBOARD
ATTACHED TO FRAME

PHOTOGRAPH 13
POLYETHYLENE SHEET ATTACHED TO FRAME

PHOTOGRAPH 14
FRAME IN PLACE IN TEST CHAMBER; READY FOR NOVA BRIK

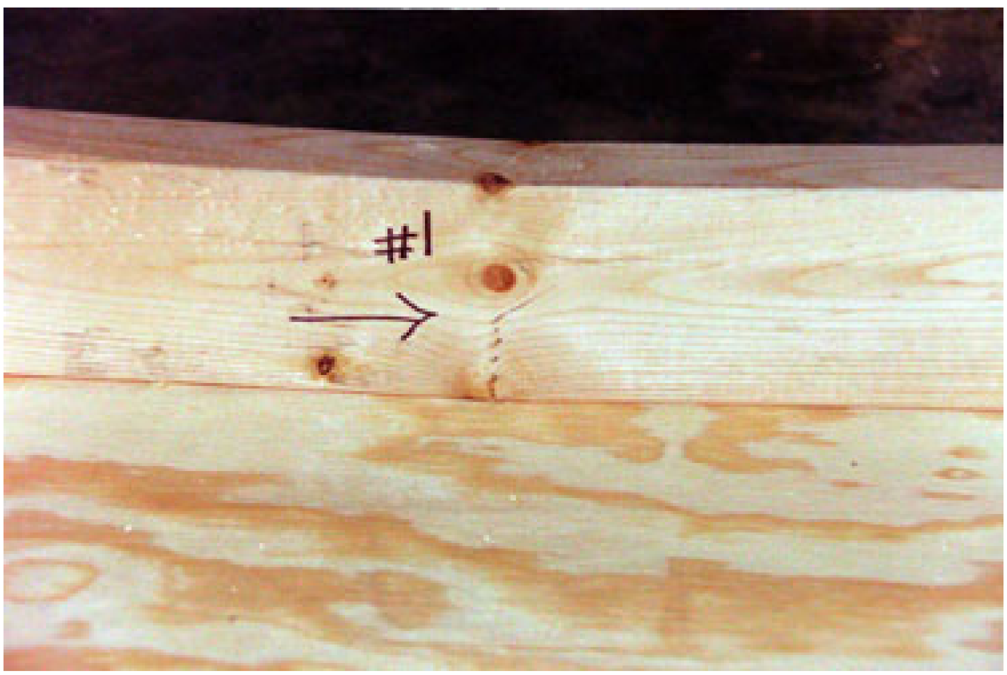
PHOTOGRAPH 15
ATTACHING THE FIRST COURSE TO THE BASEBOARD

PHOTOGRAPH 16
RUNNING BOND PATTERN ASSEMBLY OF NOVA BRIK PANEL

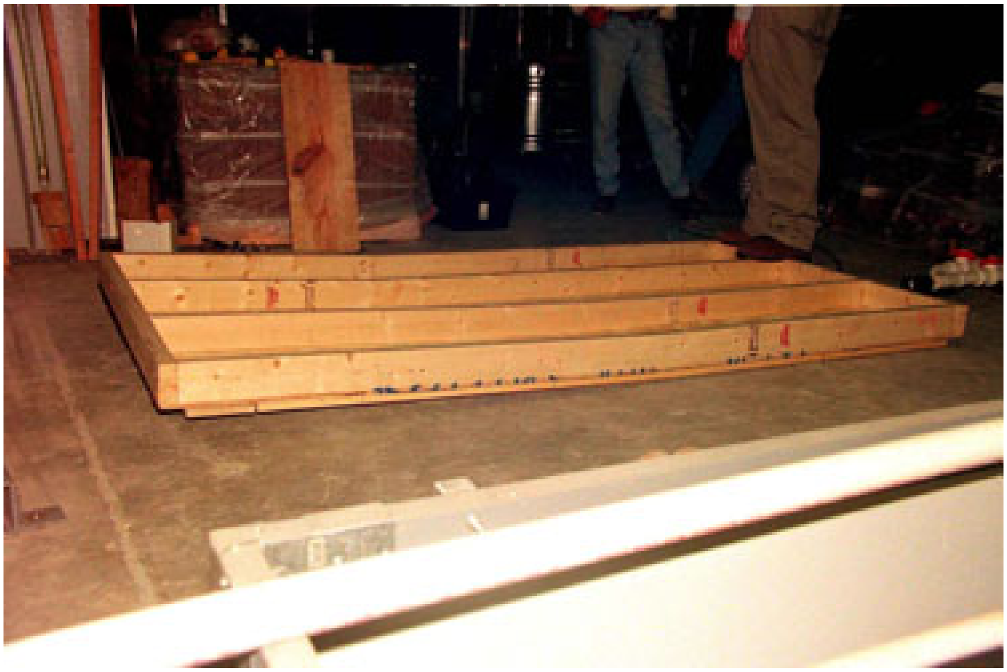
PHOTOGRAPH 17
CONSTRUCTION OF NOVA BRIK WALL PANEL

PHOTOGRAPH 18
COMPLETED NOVA BRIK WALL PANEL READY FOR TESTING

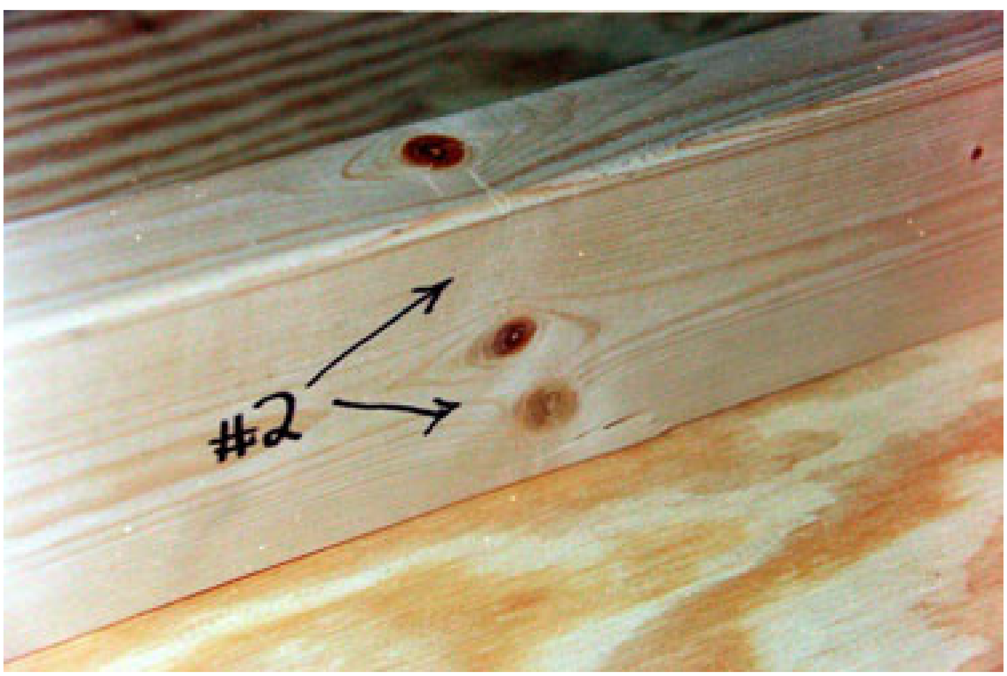
PHOTOGRAPH 19
SPECIMEN 1 FAILURE OF 2 x 4 STUD



PHOTOGRAPH 20
SPECIMEN 1 FAILURE OF 2 x 4 STUD



PHOTOGRAPH 21
PANEL 1 BOWING AFTER FAILURE OF STUDS



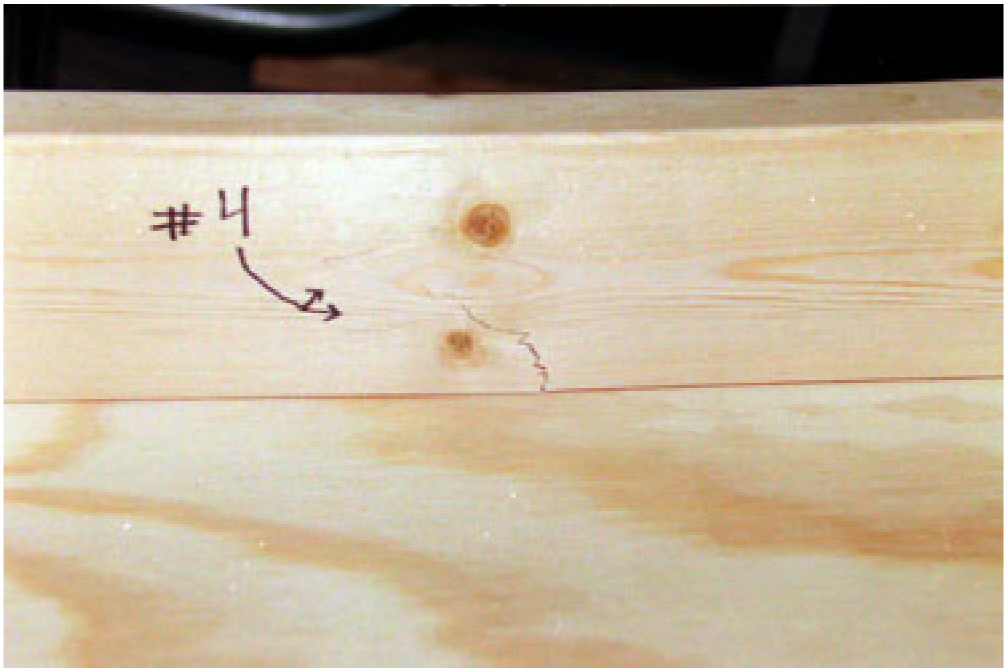
PHOTOGRAPH 22
SPECIMEN 2 FAILURE OF 2 x 4 STUD

PHOTOGRAPH 23
SPECIMEN 3 FAILURE OF 2 x 4 STUD

PHOTOGRAPH 24
SPECIMEN 3 FAILURE OF 2 x 4 STUD

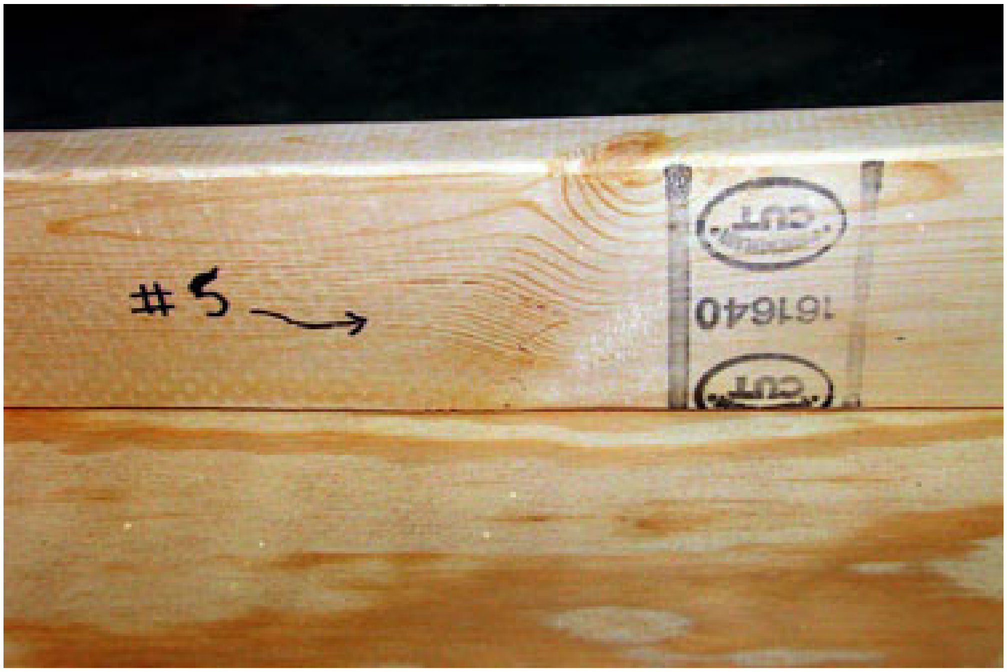
<u>PHOTOGRAPH 25</u>
SPECIMEN 3 FAILURE OF 2 x 4 STUD

<u>PHOTOGRAPH 26</u>
SPECIMEN 4 FAILURE OF 2 x 4 STUD



PHOTOGRAPH 27
SPECIMEN 4 FAILURE OF 2 x 4 STUD

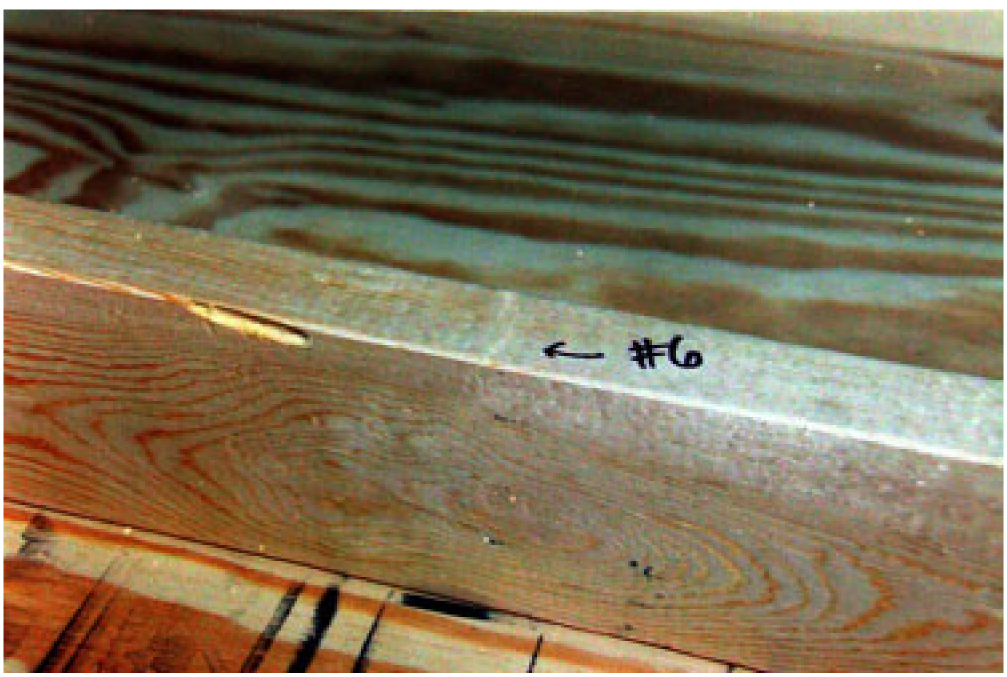
PHOTOGRAPH 28
BRICKS SEPARATED FROM PANEL AT
FAILURE OF SPECIMEN 5



<u>PHOTOGRAPH 29</u>
SPECIMEN 5 FAILURE OF 2 x 4 STUD

<u>PHOTOGRAPH 30</u>
SPECIMEN 5 FAILURE OF 2 x 4 STUD

PHOTOGRAPH 31
SPECIMEN 6 FAILURE AT 2 x 4 STUD



PHOTOGRAPH 32
SPECIMEN 6 FAILURE AT 2 x 4 STUD

PHOTOGRAPH 33
CERAMIC COATED BUGLE HEAD SCREW
USED IN C&I REPORT 98470