PLASTER INVESTIGATION AT
HASTINGS COLLEGE
OF LAW THEATER
100 McALLISTER STREET
SAN FRANCISCO CALIFORNIA

Simpson Gumpertz & Heger Inc.
BY MESSENGER

10 October 2003

Mr. David Seward, Chief Financial Officer
U.C. Hastings College of the Law
198 Mc Allister Street, Room 214
San Francisco, CA 94102

Project 37218.00 – Plaster Survey and Material Analysis, U.C. Hastings College of the Law,
100 McAllister Street, San Francisco, CA

Dear David:

Attached is our report of our investigation of the plaster ceiling in the Hasting College of Law Theater. Simpson Gumpertz & Heger Inc. approached the investigation with the understanding that there were perhaps two options for the ceiling repair during the rehabilitation of the space. One was to completely remove the plaster ceiling and walls and the other was to resolve the issue of asbestos contained within the plaster while repairing the damaged ceiling and walls in place.

According to good preservation practices, complete removal of historic materials or implementing a major aesthetic change to a significant space is only considered as the last resort when all other repair and restoration solutions are considered and reasoned to be unfeasible. Although the Theater is not registered as a Landmark, we approached the investigation taking into account the fact the vaulted ceilings and decorative plaster work gave the space its unique definition. Accordingly, we tried to design a method to save the plaster in-place. In addition, we had hoped that retaining the existing plaster would provide a more economical solution than replacement. However, after careful testing, analysis and deliberation, we come to the conclusion that there is no feasible solution other than removing the acoustical plaster.

We suggest that before demolishing the existing plaster, you may want to have a professional photographer document the plaster walls and ceilings for your archives. Please call CeCe Louie or me should you have any questions.

Sincerely,

Carolyn L. Searls, Principal

cc: Ms. Suzanne Brown, Swinerton Builders
Mr. Dean Randle, Patri Merker Architects, Inc.
Abstract

Simpson Gumpertz & Heger Inc. investigated the condition of the acoustical plaster ceiling at the Hastings College of Law Theater. We surveyed up close a representative area and performed a general survey. We took several samples of the different types of plaster and performed on-site cleaning tests. The samples were tested in the laboratory for materials characterization. Based on the characterization studies, we determined the plaster contained asbestos but could not be encapsulated. We further tested the acoustical plaster for compatibility with a surface conditioner and determined the surface conditioner was ineffective in strengthening the material. The only feasible repair is to remove the acoustical plaster and the adjoining decorative cast plaster and vaulted ribs.
# Table of Contents

Letter of Transmittal

**Abstract**

## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Introduction</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>Information from Others</td>
<td>3</td>
</tr>
<tr>
<td>2.1</td>
<td>PATRI, MERKER ARCHITECTS DRAWINGS, DATED 1 APRIL 2003</td>
<td>3</td>
</tr>
<tr>
<td>2.2</td>
<td>BULK ASBESTOS ANALYSIS REPORT BY CAROLYN HENRY OF NORTH TOWER ENVIRONMENTAL, DATED 18 OCTOBER 2002</td>
<td>3</td>
</tr>
<tr>
<td>2.3</td>
<td>INTERVIEW WITH HASTING SCHOOL BUILDING ENGINEER</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>Field Observations</td>
<td>4</td>
</tr>
<tr>
<td>3.1</td>
<td>Close-up Survey</td>
<td>4</td>
</tr>
<tr>
<td>3.1.1</td>
<td>Choir Loft</td>
<td>4</td>
</tr>
<tr>
<td>3.2</td>
<td>General Plaster Survey</td>
<td>5</td>
</tr>
<tr>
<td>3.2.1</td>
<td>Ceiling</td>
<td>5</td>
</tr>
<tr>
<td>3.2.2</td>
<td>Walls</td>
<td>6</td>
</tr>
<tr>
<td>3.3</td>
<td>Plaster Cleaning Tests</td>
<td>6</td>
</tr>
<tr>
<td>4.</td>
<td>Laboratory Tests</td>
<td>7</td>
</tr>
<tr>
<td>4.1</td>
<td>Samples</td>
<td>7</td>
</tr>
<tr>
<td>4.2</td>
<td>Characterization Study</td>
<td>7</td>
</tr>
<tr>
<td>4.2.1</td>
<td>Sample Preparation</td>
<td>7</td>
</tr>
<tr>
<td>4.2.2</td>
<td>Results</td>
<td>8</td>
</tr>
<tr>
<td>4.3</td>
<td>Coating Compatibility</td>
<td>10</td>
</tr>
<tr>
<td>4.3.1</td>
<td>Samples</td>
<td>10</td>
</tr>
<tr>
<td>4.3.2</td>
<td>Preparation</td>
<td>10</td>
</tr>
<tr>
<td>4.3.3</td>
<td>Procedure</td>
<td>11</td>
</tr>
<tr>
<td>4.3.4</td>
<td>Results</td>
<td>11</td>
</tr>
<tr>
<td>4.4</td>
<td>Discussion</td>
<td>12</td>
</tr>
<tr>
<td>5.</td>
<td>Discussion</td>
<td>13</td>
</tr>
<tr>
<td>6.</td>
<td>Conclusions</td>
<td>14</td>
</tr>
</tbody>
</table>

**Illustrations**
1. INTRODUCTION

The Hastings College of Law Theater is a space contained within a larger residential high-rise building owned by Hastings College. The 24-story terra cotta and brick building, designed by Miller and Pflueger/ Lewis P. Hobart, was completed in 1928 and originally named the William Taylor Hotel and Methodist Church. The original building program was multi-use and included a church, hotel and gymnasium. Although the church space originally functioned as designed, its use has changed over the years to include office and theater space. Currently it will be restored and function as a performing arts space. Simpson Gumpertz & Heger Inc. (SGH) investigated the interior plaster conditions at the Theater. Our scope of work included a general survey of the interior plaster finish, a close-up survey of two representative areas, sampling of the plasters for material characterization and conservation treatment purposes, and in-situ cleaning tests of the plaster. This report summarizes our assessment and recommendations for repair of the Theater's interior plaster.
2. INFORMATION FROM OTHERS

2.1 Patri, Merker Architects drawings, dated 1 April 2003

The drawings are a draft set of construction documents that include plans and elevations.

2.2 Bulk asbestos analysis report by Carolyn Henry of North Tower Environmental, dated 18 October 2002.

The report indicated nine plaster samples were taken at various areas. Five out of the nine samples tested positive for asbestos.

2.3 Interview with Hasting School Building Engineer

We spoke to the Ben Nerone the Building Engineer about the history of leaks.
3. FIELD OBSERVATIONS

On 28 and 29 August 2003, SGH performed an investigation of the interior plaster at the Hastings College of Law Theater. The investigation included a close-up survey of two areas from pipe frames erected in the choir loft (Photo 1), and a general survey of the plaster from the main floor level. The interior four-story space is a traditional cross in plan with a stage area at the north end, side aisles at the west and east sides, a two story choir loft at the south end and a groin vaulted ceiling.

The walls, ceiling and decorative trim consist of three different types of plaster including acoustical finish plaster, decorative cast plaster and vaulted rib plaster. The acoustical finish plaster has a rough textured finish and is primarily used at the ceilings and walls (Photo 2). The acoustical finish plaster is on average 3/8 in. thick over expanded diamond wire lath. At the ceiling, the wire lath is attached to steel furring channels, which in turn are suspended from the concrete roof slab by wire rods. A similar system of steel channel studs exists at the walls. We observed the use of deformed rebar to build out the small columns between the first floor tracery windows at the south end (Photo 3). The decorative cast plaster, used at moldings and ornate details, is reinforced with small quantities of wood and animal hair fiber and tied to the wood or steel framing with wire ties (Photo 4). The vaulted rib plaster is used to section off large vaulted ceilings areas (Photos 5 & 6).

3.1 Close-up Survey

3.1.1 Choir Loft

The pipe frames located in the choir loft allowed SGH close-up access to the walls, ceilings and vaulted ribs. The walls and ceiling are acoustical plaster finish. There are several deteriorated ceiling plaster locations indicating the presence of moisture. The plaster in these locations has efflorescence, water stains or missing sections of plaster (Photo 7). The surface is uniformly soiled. We found holes in the plaster system made for installation of sprinkler heads or access points for hanging fixtures, ceilings tiles, or pipes. Where the wire lath is exposed, we observed corrosion of the metal (Photo 8).

The wall plaster is typically soiled but mostly intact with the exception of holes made to provide access for piping or electrical wiring. We noted two areas with efflorescence. One was at the west wall, the other at the jamb of one of the south windows.
The vaulted ribs and horizontal cast plaster cornice moldings are in relatively good condition with little loss of material and a few cracks in portions of the moldings (Photo 9).

In addition to the close-up survey of the walls and ceiling, SGH made a note of the choir loft’s front railing conditions. It is composed of decorative cast plaster. Most of the top portion is missing. With the inside portion of the balcony rail exposed, we noted the cast plaster is tied back to the wood framing with animal fiber (Photo 4).

3.2 General Plaster Survey

We noted the conditions of the wall, ceiling and vaulted rib plaster from the 1st floor level and where there was stair access (stage area). See drawing sheets A2.04 and A5.01-A5.03.

3.2.1 Ceiling

In general, the plaster at the ceiling is in worse condition than at the walls or vaulted ribs. The acoustical ceiling plaster has several areas with efflorescence, staining, soiling, and missing sections of plaster (Photos 5 & 10). The survey of the ceiling was done from the theater floor level which made distinguishing water stains from efflorescence difficult. Based on our limited survey of the ceiling, we estimate there are 900 locations and approximately 200 square feet of ceiling missing plaster, and there is approximately 1300 square feet of efflorescence/water staining. The majority of the missing plaster appears as small holes made for installing anchors for fixtures, dropped ceiling tiles and sprinkler heads. Other holes appear to be a result of water damage. Several hanging wires remain protruding through the ceiling (Photo 11). There is one large stain located at the stage area, which does not appear to be a result of water damage (Photo 12).

We reviewed a limited portion of the ceiling from above by accessing through a crawl space and roof hatch. At the choir loft, a plumbing pipe above the ceiling appeared to be located at one area where efflorescence and water staining was noted from the under side. Above the main floor area toward the stage, we noted a roof drain with evidence of leakage located directly above ceiling plaster that was missing and/or had efflorescence and water staining (Photos 13 & 14).
3.2.2 Walls

The walls are finished with acoustical plaster. There are large sections of wall plaster missing (or removed) along the first floor east and west arched aisle walls, specifically at the column faces (Photo 15). The aisle walls at the second and third stories have efflorescence/water staining; much of which is localized at window openings.

The decorative cast tracery plaster at the first floor windows at the south end is partially intact with much of the adjacent wall and column plaster missing. The shape of the plaster columns are formed with steel reinforcement and wire mesh (Photo 3). Portions of the steel reinforcement are bent out of shape and portions of the wire mesh are missing. Directly above this area is the choir loft balcony railing. The front face of the railing is decorative cast plaster and appears mostly intact with small areas of material loss.

The vaulted ribs at the walls and ceiling appear to be in good condition with localized areas of water damage (Photo 10).

3.3 Plaster Cleaning Tests

The ceiling and walls are equally soiled and the level of soiling is similar to that seen close-up at the choir loft pipe framed areas (Photo 16). The exception is the heavy soiling located at the stage area ceiling.

SGH performed a cleaning test of the acoustical plaster. Two areas were marked out; one area had heavier soiling than the other. The Sample One area, with the heavier soiling, was first cleaned using the HEPA Vac with its standard brush attachment. The abatement contractor (CST) applied even pressure while rubbing the brush across the plaster surface. Removal of the soiling was imperceptible.

The Sample Two area was cleaned using a stiff nylon brush. Loose material was captured with the HEPA Vac. The abatement contractor applied even pressure while rubbing the brush across the plaster surface. The removal of the soiling was noticeable.

SGH applied the same cleaning method used at the Sample area Two on the heavily soiled areas of Sample One area. The use of the stiff nylon brush was successful in removing the heavy soiling. (Photo 17)
4. LABORATORY TESTS

A total of seven plaster samples were taken from the choir loft region. They were prepared and tested in SGH’s laboratory for material characterization and compatibility with a silicone surface conditioner called Sto Plex W Surface Condition, manufactured by Sto.

4.1 Samples

The samples included acoustical plaster, decorative cast plaster and vaulted rib plaster and are described in Table One.

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Description</th>
<th>Nominal Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Acoustical Ceiling Plaster - efflorescence</td>
<td>2 ¾ in. diameter, 5/8 in. thick</td>
</tr>
<tr>
<td>#2</td>
<td>Vaulted Rib Plaster</td>
<td>2 ¾ in. diameter, 1 ¼ in. thick</td>
</tr>
<tr>
<td>#3</td>
<td>Cast plaster molding - east wall of choir loft at vertical crack</td>
<td>2 ¾ in. diameter, 1 7/8 in. thick</td>
</tr>
<tr>
<td>#4</td>
<td>Acoustical ceiling plaster – no efflorescence</td>
<td>2 ¾ in. diameter, 3/8 in. thick</td>
</tr>
<tr>
<td>#5</td>
<td>Acoustical ceiling plaster - water stain</td>
<td>2 ¾ in. diameter, 3/8 in. thick</td>
</tr>
<tr>
<td>#6</td>
<td>Acoustical wall plaster – no efflorescence</td>
<td>2 ¾ in. diameter, 3/8 in. thick</td>
</tr>
<tr>
<td>#7</td>
<td>Cast plaster – top of choir loft front rail</td>
<td>2 ¾ in. diameter, 3/8 in. thick</td>
</tr>
</tbody>
</table>

4.2 Characterization Study

4.2.1 Sample Preparation

We cut nominal 3/4 to 1 in. wide sections from the centers or ends of plaster samples representing each of the three types of plaster and/or observed surface conditions (cracking, water staining, efflorescence, etc.). We prepared ultra-thin (20 to 25 μ) sections from Samples #1, #2, #3, #4, #5, and #7. We examined the prepared sections with the aid of a transmitted, polarized light microscope at magnifications of 25X to 400X.

We also digested a portion of plaster from samples #2, #3, #4, #6, and #7 using hydrochloric acid. We conducted the acid digestion tests, in order to determine the insoluble residue content of each plaster. We assume that the entire weight of non-binder materials (lime and gypsum) represents the total aggregate fraction in each plaster. The results of the insoluble residue analyses are summarized below in Table 2:
### Table 2 – Insoluble Residue Content

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Test 1 (%)</th>
<th>Test 2 (%)</th>
<th>Average (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#2</td>
<td>60.8</td>
<td>67.0</td>
<td>63.9</td>
</tr>
<tr>
<td>#3</td>
<td>0.84</td>
<td>1.0</td>
<td>0.92</td>
</tr>
<tr>
<td>#4</td>
<td>64.0</td>
<td>65.5</td>
<td>64.7</td>
</tr>
<tr>
<td>#6</td>
<td>63.9</td>
<td>70.7</td>
<td>67.3</td>
</tr>
<tr>
<td>#7</td>
<td>0.39</td>
<td>0.46</td>
<td>0.43</td>
</tr>
</tbody>
</table>

### 4.2.2 Results

The results of our microscopic examination and chemical analysis of the submitted plaster samples indicate the following:

**Acoustical Plaster – Samples #1, #4, #5, and #6**

- The acoustical plaster samples consist of fully reacted gypsum and lime plasters.

- The plaster incorporates natural lightweight aggregate particles of volcanic pumice as sound proofing media.

- The acoustical plaster samples contain asbestos fibers. The estimated asbestos fiber content of the acoustical plaster is less than 3% by volume for each sample.

- In addition to gypsum, the plaster contains 3% to 5% lime by volume of binder. As a result, efflorescence, which occurs on the surface of Sample #1 and within the area of water staining on Sample #5 includes deposits of calcium carbonate (calcite crystals) that appear as a white or off white crystalline deposits on the surfaces of the plaster samples.

- The paste structure on exposed surfaces of the plaster samples are discolored (beige to brown) due to the effects of surface carbonation.

- According to the results of our chemical analysis, the insoluble residue content of plaster samples #4 and #6 are 64.7% and 67.3%, respectively by weight of sample. Using the loose bulk density for lime (40 lb/ft³), gypsum (55 lb/ft³), and natural quartz sand (80 lb/ft³), the calculated proportions of the acoustical plaster samples is 1:1 binder to aggregate, with 95% to 97% of the binder being composed of gypsum and 3% to 5% being composed of lime.

- In addition to pumice, the aggregate constituents of the acoustical plaster samples include granite, basalt, feldspar, quartz, ferromagnesian minerals such as biotite, hornblende, calcite, and minor amounts of non-reacted gypsum/anhydrite.

- The particles of pumice are sub-rounded to rounded in shape. The particles are uniformly graded and range in size from 0.6 to 1.5 mm. Occasionally, there are elongated particles of pumice that are 1 to 1 1/2 mm x 3 mm in size. However, the
overwhelming majority of particles are less than 2 mm in size, with a sub-rounded to rounded shape.

- The samples appear to be applied in one layer. There is no evidence of multiple layer application.
- The samples appear porous. We observed voids and capillaries with the naked eye.

Cast Plaster – Samples #3 and #7

- The samples of cast plaster are composed entirely of fully reacted gypsum plaster.
- The gypsum plaster incorporates minor (<1%) natural aggregate particles that are present as contaminants that occur in natural gypsum deposits.
- The cast plaster samples do not contain asbestos fibers.
- The insoluble residue content of plaster samples #3 and #7 are 0.92% and 0.43%, respectively. Using the loose bulk density for lime (40 lb/ft³), gypsum (55 lb/ft³), and natural quartz sand (80 lb/ft³), the calculated proportions of the cast plaster is 1:0 binder to aggregate, with nearly 100% of the binder being composed of natural hydrated gypsum.
- The aggregate constituents of the cast plaster samples include feldspar and quartz, calcite, and minor amounts of non-reacted gypsum/anhydrite.
- The cast plaster samples are reinforced with wood and animal fibers.
- The exposed surfaces of Samples #3 and #7 contain up to four separate layers of thinly applied plaster. Each layer is distinctive, with occasional separation fractures between layers. The outer layer on Sample #3 includes the intentional addition of finely graded natural stone aggregate particles. A portion of the natural stone sand includes particles of volcanic pumice.

Vaulted Rib Plaster – Sample #2

- The sample of plaster molding consists of fully reacted gypsum plaster. Unlike the gypsum plaster in Samples #3 and #7, the paste structure of the reacted gypsum in the plaster molding contains more well developed crystals of hydrated gypsum.
- The plaster was applied in four separate lifts or layers.
- The plaster molding sample does not contain asbestos.
- The insoluble residue content of plaster molding is 63.9%. Using the loose bulk density for gypsum (55 lb/ft³), and natural quartz sand (80 lb/ft³), the calculated proportions of the plaster molding are 1:1 binder to aggregate, with nearly 100% of the binder being composed of hydrated gypsum. The coarsely crystalline structure of the gypsum plaster and absence of natural aggregate contaminants suggest that the gypsum is a processed rather than naturally occurring product.
• The aggregate constituents of the vaulted rib plaster include granite, basalt, feldspar, and quartz, ferromagnesian minerals such as biotite, hornblende, calcite, and minor amounts of non-reacted gypsum/anhydrite.

4.3 Coating Compatibility

Based on our material characterization study, we determined a traditional silicate-based encapsulating treatment will be ineffective due to the acoustical plaster's thin section and porosity. Other treatment options include application of an elastomeric coating, a cement based coating or a water-soluble low resin silicone surface conditioner. We decided against an elastomeric coating since its thicker consistency can induce stresses in application and curing that may cause damage to the existing plaster. We also decided against a cement based coating since application may further disturb the existing plaster and not fully bond to the plaster.

The advantage to the silicone surface conditioner is that it can be spray applied (which will less likely disturb the plaster), it requires minimal surface preparation, and it penetrates and strengthens the plaster. We decided to test the compatibility of the silicone surface conditioner with the acoustical plaster. Based on our experience with this type of material, we tested Sto Plex W manufactured by Sto.

4.3.1 Samples

Sample numbers 1, 5 and 6 were prepared and tested for compatibility with a silicone surface conditioner. Sample No. 5 with the water stain was dried with a hot air gun before performing any tests.

4.3.2 Preparation

We performed an Elcometer adhesion test based on ASTM D4541 on the acoustical ceiling plaster samples 'as received' and after coating with Sto Plex W. We photographed the samples at each step of the testing. The following summarizes our procedures:

• For the 'as received' tests, we cleaned the surface of the plaster of any loose particles or efflorescence with a soft bristle brush and used either 5-minute epoxy or methylmethacrylate glue to adhere the Elcometer discs. We allowed the adhesive to cure overnight, then tested with the Elcometer and recorded the load.

• After the initial pull-off tests, we coated the samples with a surface conditioner, Sto Plex W. The following summarizes our coating procedure:
4.3.3 Procedure

- We brushed the samples with a soft bristle brush to remove any loose particles, weighed the samples and recorded the starting weight.

- We mixed the Sto Plex W in the container manually with a stick.

- We sprayed applied Sto Plex W to samples #5 and #6 using a Graco 190ES painter fitted with a 0.015 in. tip. We coated the samples with two passes of the painter.
  - We calculated a wet film coverage rate of 12 to 36 grams per square foot based on Sto’s recommended rate of 500 to 1500 square feet per 5 gallon bucket of Sto Plex W.
  - We performed a test using a square foot panel and determined that two passes of the spray result in 25 grams per square foot coverage.

- We brush applied Sto Plex W to sample #1 using a paint brush.
  - We weighed the samples, recorded the weight and allowed the samples to dry overnight.

- We used 5-minute epoxy glue to adhere the Elcometer discs to the samples, allowed the adhesive to cure, tested with the Elcometer and recorded the load.

- We measured the depth of the adhered coating remaining on all the pull-off discs with vernier calipers after the tests to determine the approximate depth of the failure plane and recorded the results.

4.3.4 Results

Table 1. Estimated Coverage

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Approximate Surface Area (sq ft)</th>
<th>Weight before Application (g)</th>
<th>Weight after Application (g)</th>
<th>Approximate Coverage (g/sq ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>0.024</td>
<td>34.24</td>
<td>36.02</td>
<td>74.17</td>
</tr>
<tr>
<td>#5</td>
<td>0.034</td>
<td>30.70</td>
<td>34.02</td>
<td>97.65</td>
</tr>
<tr>
<td>#6</td>
<td>0.017</td>
<td>15.85</td>
<td>16.76</td>
<td>53.53</td>
</tr>
</tbody>
</table>

Table 2. Elcometer Test Results

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Elcometer Load w/o Sto Plex W (psi)</th>
<th>Elcometer Load w/ Sto Plex W (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>100</td>
<td>50 or less</td>
</tr>
<tr>
<td>#5</td>
<td>100</td>
<td>50 or less</td>
</tr>
<tr>
<td>#6</td>
<td>100</td>
<td>50 or less</td>
</tr>
</tbody>
</table>
Table 3. Depth of Failure Plane¹

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Maximum Depth (in.)</th>
<th>Minimum Depth (in.)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 w/o Sto Plex W</td>
<td>0.128</td>
<td>0.054²</td>
<td>50% of area is at maximum depth.</td>
</tr>
<tr>
<td>#1 w/ Sto Plex W</td>
<td>0.169</td>
<td>0.089</td>
<td>50% of area is at maximum depth.</td>
</tr>
<tr>
<td>#5 w/o Sto Plex W</td>
<td>0.197</td>
<td>0.058</td>
<td>75% of area is at maximum depth.</td>
</tr>
<tr>
<td>#5 w/ Sto Plex W</td>
<td>0.163</td>
<td>0.070</td>
<td>90% of area is at maximum depth.</td>
</tr>
<tr>
<td>#6 w/o Sto Plex W</td>
<td>0.200</td>
<td>0.038</td>
<td>40% of area is at maximum depth.</td>
</tr>
<tr>
<td>#6 w/ Sto Plex W</td>
<td>0.212</td>
<td>0.071</td>
<td>90% of area is at maximum depth.</td>
</tr>
</tbody>
</table>

¹ These measurements are taken assuming the thickness of the glue is the same in each trial and therefore negligible in comparison.
² Some of the surface of the disc is visible; this measurement is taken in the area with the least amount of plaster.

4.4 Discussion

The application of Sto Plex W on the acoustical ceiling plaster caused a reduction in pull-off strength of the plaster when tested approximately 24 hours after application. It appears that our application techniques or sample conditions resulted in a coverage greater than recommended by the manufacturer. Although we allowed more than the recommended drying time, the introduction of moisture to the plaster from the Sto Plex W may have caused the reduction in strength. We may have seen higher pull-off values with additional curing time or less coverage.

Although the application of Sto Plex W to the plaster caused a decrease in pull-off strength, it appears to have increased the depth of the failure plane. This may indicate that the product is penetrating and binding the plaster and has the ability to coat the existing efflorescence. However, the surface of the plaster remains friable after the application of Sto Plex W. The addition of Sto Silco Shield may help to encapsulate the plaster, but we did not have a Silco Shield sample and were not able to determine this in the laboratory.
5. DISCUSSION

Typically, an acoustical plaster system in a similar condition could be repaired, consolidated and coated in order to retain as much of the original material as possible and contain the asbestos material. However, this acoustical plaster is thin in section and porous in nature, making the use of conventional silicate-based (i.e. sodium or potassium) consolidants and coatings an ineffective solution to encapsulating the material. There is too little lime to expect a consolidant will react as intended. In this case, the silicate that does not react with the plaster will leave a glossy, friable film that will interfere with the adhesion of a successive coating.

Laboratory testing of an alternate water-soluble, low resin silicone coating to penetrate and strengthen the acoustical plaster was unsuccessful in providing additional strength, and in fact reduced it. If abatement or encapsulation of the asbestos is desired, we do not recommend the application of Sto coatings. We do not believe that a coating that will maintain the current appearance of the plaster and encapsulate the asbestos exists. Removal of the plaster will be necessary.

Although the cast plaster and vaulted rib plaster do not contain asbestos, the removal of the acoustical plaster will impact and possibly irreversibly damage these features. Salvaging these features for use with a future plaster ceiling will be difficult. The cast plaster at the rosary window, the tracery windows along the east and west walls and at the south end can be salvaged if enough protection is provided during the removal of the other plaster.
6. CONCLUSIONS

The Hastings College Theater acoustical plaster ceiling cannot be repaired and strengthened in place. The friable nature of the material makes encapsulation ineffective. An alternate method of treating the material with a surface conditioner coating appears to reduce the strength of the material rather than strengthen it and is not advised. Removal of the ceiling and the decorative components is the only solution. Positive identification of asbestos in the acoustical plaster will require removal to adhere to an industrial hygienist's guidelines for the treatment of a hazardous material.
Photo 1:
We performed the close-up survey of the interior plaster from a pipe frame erected in the choir loft.

Photo 2:
The acoustical plaster at the walls and ceiling has a rough textured finish.
The decorative cast plaster at the tracery windows at the Theater's south end is formed with deformed rebar and wire lath.

The decorative plaster at the choir loft's front railing is mostly missing. Remnants of the plaster have constituents of wood and animal fiber and are tied to the wood and steel framing with wire ties.
Photo 5:
The theater ceiling is distinguished by its vaulted construction composed of arched ribs.

Photo 6:
This is a close-up of a typical vaulted rib.
Photo 7:
The choir loft acoustical plaster has efflorescence, water stains or missing section of plaster.

Photo 8:
The wire lath support for the acoustical plaster was corroded where exposed.
Photo 9:
The decorative cast plaster at the horizontal moulding is in good condition with small quantities of material loss and cracks.

Photo 10:
The majority of the Theater's ceiling has several areas with efflorescence, staining, soiling, and missing sections of plaster.
Photo 11:
Several hanging wires remain protruding through the ceiling.

Photo 12:
There is one large stain located at the stage area, which does not appear to be a result of water damage.
Photo 13:
The plaster at the stage area was missing and/or had efflorescence and water staining. We located a roof drain above the ceiling which had evidence of previous leakage.

Photo 14:
This is the roof drain located near the damaged ceiling plaster above the stage area. The pipe that connects to the drain and runs north/south above the ceiling has evidence of previous leakage.
Photo 15
The plaster is missing at and above the columns located along the east aisle.

Photo 16:
We taped off an area of the soiled choir loft acoustical plaster for cleaning tests. This is Sample One area.
Photo 17:

These are the two cleaning samples at the choir loft. The top area is Sample One; the bottom area is Sample Two. Both samples were ultimately cleaned using the stiff nylon brush, even pressure application and the HEPA Vac.