GEOLOGIC SITE ASSESSMENT

SQUARE TOWER UNIT, HOVENWEEP NATIONAL MONUMENT

United State Department of Interior
National Park Service
Mesa Verde National Park
Mesa Verde Colorado 81330

GF Project No: 36541.092

July 2001

Gannett Fleming

Gannett Fleming

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July 23, 2001

Larry Martin, Hydrogeologist
NPS-Water Resources Division
1201 Oakridge Dr., Suite 250
Ft. Collins, CO 80525

Re: Site Assessment, Hovenweep National Monument, Utah

Dear Mr. Martin:

Attached is a copy of the Site Assessment Report prepared for the Square Tower Unit at Hovenweep National Monument. Our conclusions and recommendations are based on the site visit conducted on June 18, 2001 with Kathy Fiero and Preston Fisher of Mesa Verde National Park and a review of the information supplied by the Park Service.

Gannett Fleming concludes that the surface water runoff, particularly from the western drainage area, is a major contributor of moisture to the Square Tower foundation block. Further, we feel that refining the hydrologic model will not significantly influence the remedial alternatives for the site. It is our opinion that further study of the source(s) of the groundwater affecting the foundation boulder is not warranted. We suggest that resources expended to stabilize the rock block would be more cost effective than further study and reach the goal of preserving the archeological resource more quickly.

The construction of a stormwater collection system for the western drainage area is recommended to intercept and conduct surface water flow away from the buried architecture and Tower Unit foundation. This can be accomplished using visual and physical unobtrusive methods and means. Gannett Fleming recommends enhancing the strength and durability of the foundation block by injecting a stone-stabilizing compound into the rock block. A schematic approach for the rock block stabilization is described in the report. It is important to note that Gannett Fleming has devised a remedial alternative that can be implemented by Park Service personnel; however, there are design elements of the remedial approach that are beyond the scope of this report that must be performed to ensure proper and successful application of the alternative.

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1.0 INTRODUCTION

1.1. Purpose and Scope

Gannett Fleming, Inc. (GF) was retained to by the National Park Service to perform a geologic assessment and site evaluation of the Square Tower Unit at Hovenweep National Monument located in southeastern Utah. GF's scope included a site reconnaissance and evaluation of the local seepage conditions, and delivery of a letter report with recommendations for additional hydrogeologic study and/or remedial measures to protect the Square Tower foundation area from continued deterioration.

1.2. Site Background

The Square Tower Unit at Hovenweep National Monument is founded on a large, detached boulder located on the floor of Little Ruin Canyon. Hypotheses have been developed that suggest subsurface (artesian) water is causing the boulder to weather. The National Park Service has installed several shallow piezometers and lysimeters to identify the groundwater conditions and the source of water affecting the Square Tower Unit boulder. Further, NPS is considering a detailed hydrologic investigation to refine the groundwater model and determine if there are remediation measures that will reduce the amount of water flowing through the boulder; thereby, prolonging the life of the Square Tower.

A brief synopsis of the preservation work at Square Tower is included as Appendix A. Preservation actions have included: selective vegetation removal, application of silicate stone stabilizer, construction of a masonry wall at the base, an attempt to install subsurface drain, repointing the tower masonry, and modifying the exterior ground surface on the southwest side of the tower.

1.3. References

Several references were provided to Gannett Fleming to aid in the evaluation of the conditions at Square Tower. These references included:

- General photographs of the site, and
- "Hydrogeologic Study Plan, Square Tower, Hovenweep National Monument" June 1999, provided by Larry Martin, NPS Ft. Collins, CO.
- Summary of Square Tower Unit Preservation work,
- Precipitation Data for Hovenweep,
- Square Tower Groundwater Monitoring Data,
- "Hydrologic Investigation at Square Tower, Hovenweep National Monument" June 1999, and
- Copies of Historic Photographs of the Square Tower foundation boulder, provided by Kathy Fiero, NPS Mesa Verde, CO.

- Figures showing plan locations of known architecture features at Square Tower, provided by Preston Fisher NPS Mesa Verde, CO.

Additional References include:

- Product Specification Guides from Hilti
- Product Specification Guides from ProSoCo for Conservare® H100 and OH100.

2.0 GANNETT FLEMING SITE OBSERVATIONS

2.1. General

Ms. Kathy Fiero and Preston Fisher of the Mesa Verde National Park and Mitch Weber and Deb Miller of Gannett Fleming were at the site for the assessment.

2.2. Surface Drainage

There are four major surface drainage paths into the canyon in the immediate vicinity of the Square Tower Unit. Two are bedrock joints that have become conduits for surface water flow due to erosion along the joint surfaces. The two others are surface water pour-offs. One joint is located north of the Hovenweep Castle on the east side of Little Ruin Canyon. The second joint is located at the northeast corner of the canyon headwall. Photographs 2-1 and 2-2 show these features.

The path of the discharge from both joints appear to lead into the canyon bottom channel and do not have a direct affect on the Square Tower Unit.

(continued on next page)

Photograph 2-1: View of joint on east side of Little Ruin Canyon.

Photograph 2-2: View of joint in northeast corner at the head of Little Ruin Canyon.

The pour-offs discharge water northwest and west of the Square Tower Unit. Photograph 2-3 shows these features.

Photograph 2-3: View of northwest and west pour-off.

2.3. Groundwater Observations

Ms. Kathy Fiero read the instrumentation during the site visit. All of the piezometers had water levels significantly below the ground surface. Several of the instruments were dry. The seep at the head of the canyon was moist; the flow rate was very low and was not measurable. Lysimeters were also read, indicating a variable degree of soil moisture in and around the tower. There was no flow in Little Ruin channel.

2.4. Geologic Observations

The foundation beneath the Square Tower Unit appears to be a 'free standing' rock block. The rock is a massive, well-sorted, poorly-cemented, quartz sandstone. The unit is cross-bedded (planar cross-beds) and relatively homogeneous. The surface of the rock shows several weathering characteristics including: iron and manganese staining, lichen growth and some mildew, and a friable surface.

There are no significant joints or other discontinuities within the exposed areas of the rock mass. There are no large spalls on the surface or detritus piles around the base of the rock block.

3.0 CONCLUSION AND RECOMMENDATIONS

3.1. Conclusions

Based on field observations and review of the provided material, Gannett Fleming concludes that the major contributor to the disintegration of the foundation rock mass at Hovenweep Square Tower is surface runoff. If, artesian groundwater conditions exist, they would certainly exacerbate the condition.

The source of the water affecting the rock mass is essentially academic. The solution to abate the groundwater affects is largely contingent on increasing the strength and durability of the rock mass; thereby, reducing the chemical and physical weathering potential.

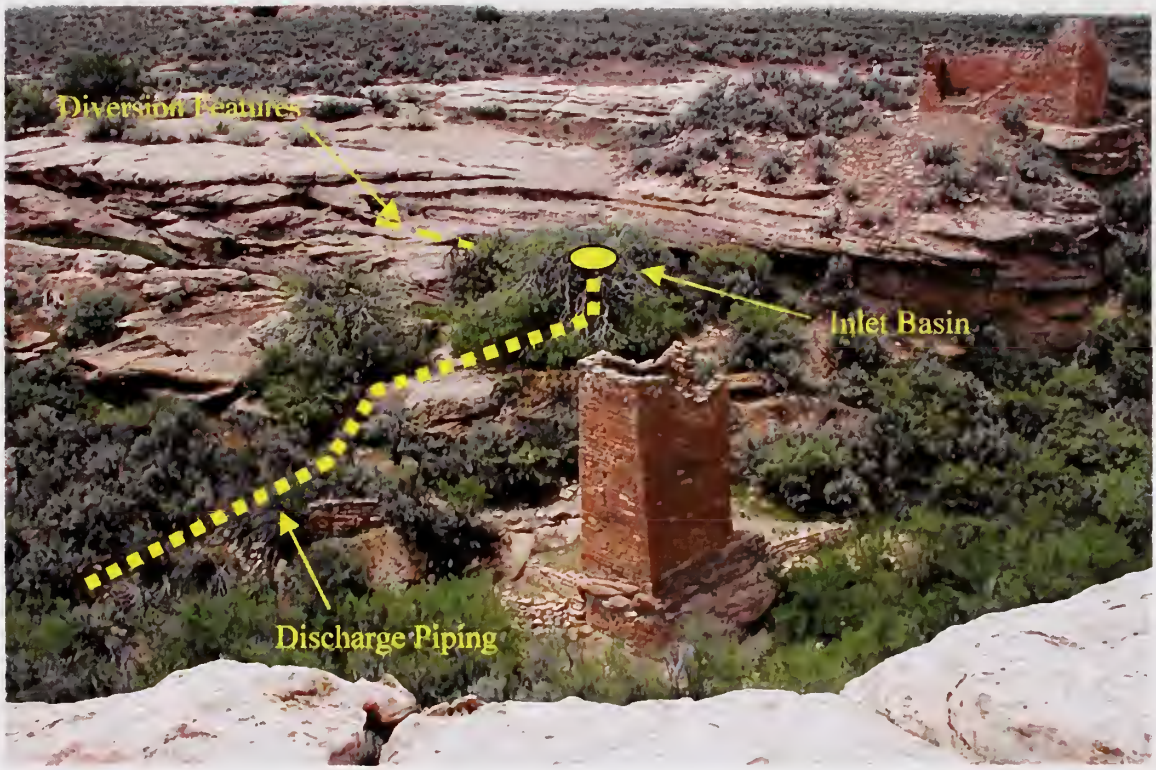
It appears that surface runoff from the western drainage discharges into the talus deposit northwest of the tower. This area shows evidence of erosion due to surface runoff near the canyon wall but the flow is rapidly transmitted into the highly permeable talus deposit. A kiva and other underground architecture are located between the Tower and the discharge. The buried features may be acting as sumps or drains; effectively concentrating groundwater in the soil north and west of the Tower foundation boulder. Installation of a drain in 1994 in the vicinity of the kiva proved impracticable.

3.2. Recommendations

Gannett Fleming recommends that two methods of remediation be undertaken. The first will be to intercept the drainage [redacted]west of the Tower and conduct the discharge, via piping, to a location downstream of the Tower. This can be accomplished using methods Gannett Fleming observed at Mesa Verde including:

- Minor channelization of the runoff on the west canyon rim by a combination of 'natural stone' diversion dikes and some minor rock excavation.
- Installing a collection inlet basin at the pour-off, incorporating natural stone and colored mortar to minimized visual impacts.
- Installation of outlet pipe to a discharge point downstream of the Tower.

Photographs 3-1 and 3-2 show the drainage area to be diverted and the pour-off. Figure 1 is a schematic plan of stormwater diversion and discharge recommendation.



Photograph 3-1: Features of Stormwater Diversion and Discharge Scheme.

Photograph 3-2: View of western pour-off above Square Tower.

The second recommendation is to stabilize the rock mass. This will be accomplished by drilling small diameter (6 to 12 mm) injection holes and gravity filling the holes with a stone-stabilizing compound such as Conservare® H100. The injection holes should be drilled by systematic means around the perimeter of the Tower, and along the exposed faces of the rock. The injection holes can be drilled vertical or at an angle to stabilize beneath the Tower walls. Holes can be drilled on both vertical and flat surfaces. The equipment used to drill the holes limits the depth of the hole. Rechargeable drilling equipment is typically to limited to depths of about 550 mm (20-inches). Electric or pneumatic equipment can drill to depths of over 800 mm (30-inches). An example of an injection pattern determination is presented in Appendix B. A typical injection hole layout is shown on Figure 2.

Gannett Fleming recommends that the site be surveyed to facilitate the design of the stormwater diversion portion of the project. Further, Gannett Fleming recommends that the testing protocol recommended by the stone-stabilization manufacturers be followed to ensure the results are consistent with the expectations.

Appendix C is a collection of selected manufacturer data sheets for the drilling and stone-stabilization products.

Discussion at the site included consideration of removing the masonry wall at the south face of the tower and re-constructing it as a dry masonry wall. This may facilitate air circulation and moisture evaporation behind the stone wall. Injection holes should be drilled along this face whether or not the concrete wall behind the masonry is removed to stabilize the rock mass at that location.

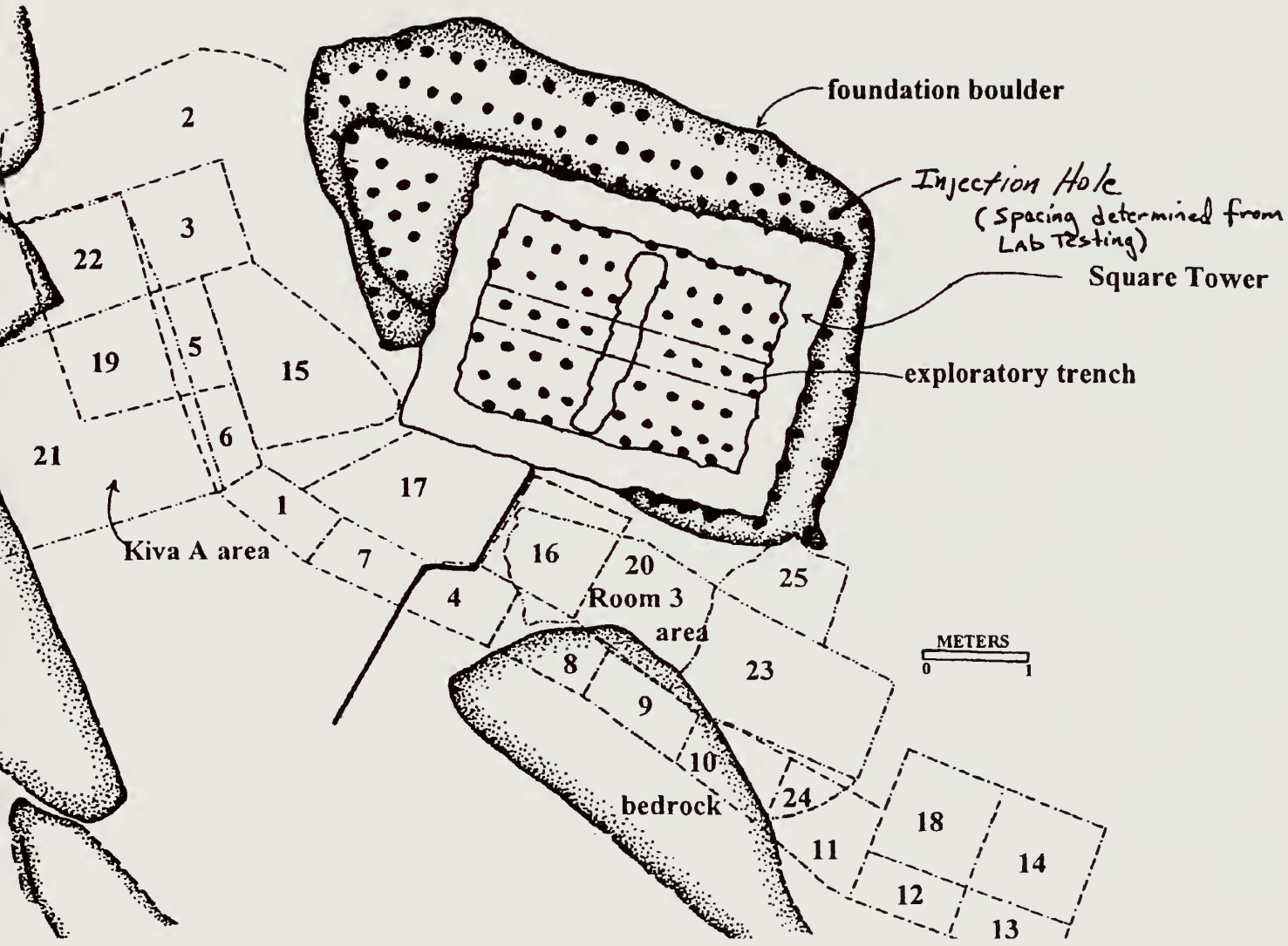
FIGURES

US DEPARTMENT OF INTERIOR, NATIONAL PARK SERVICE
HOVENWEEP NATIONAL MONUMENT

SQUARE TOWER UNIT

STORMWATER DIVERSION SCHEME

July 2001	Figure 1



US DEPARTMENT OF INTERIOR, NATIONAL PARK SERVICE HOVENWEEP NATIONAL MONUMENT SQUARE TOWER UNIT	
TYPICAL INJECTION HOLE LAYOUT	
July 2001	**Figure 2**

APPENDIX A

SQUARE TOWER PRESERVATION HISTORY

SQUARE TOWER PRESERVATION

1960

1) wall built under boulder, stones set in Portland cement mortar

1990

1) cut willow to stop them from rubbing against sandstone boulder and walls--vegetation directly in contact with wall

1991

1) cut willow again
2) problems brought to attention Heyder, Cartwright
3) Griffitts begins experiments (lab) in winter 91/92, Conservare OH recommended for further experimentation

1992

1) willow cut back to ground surface, vegetation up and down canyon cut so drainage wouldn't get blocked in flood
2) Steve Rudolph built diversion berm at southeast corner of tower, enlarged by stab crew
3) built gabion
4) mudded in joint between stab wall and boulder
5) treated experimental boulder in campground with Conservare OH--cored boulder
6) photo study to see if any change in profile since earliest known photos--1892
7) regional people become aware of enormity of problem

1993

1) Advisory Group meets
2) Frank Matero shown problem
3) trail into canyon closed
4) excavation of fill in tower-drain installed from inside out
5) excavations for French drain around boulder--kiva located
6) experimented with boulder closer to Square Tower, different application technique--cored boulder
7) applied lime mortar to areas of advanced erosion at base of tower and in void in boulder
8) set up points for monitoring movement of tower--started monitoring movement
9) HABS team documents Square Tower, Hovenweep Castle and Hovenweep House
10) another meeting with region, SHPO
11) backfilled area exposed during archeological testing

1994

1) excavation resumes--becomes obvious that no way to put in drain without damaging kiva---area backfilled after testing and documentation completed
2) set ceramic screws for monitoring deterioration
3) sent samples of soils and water to lab in Durango
4) monitoring for movement of tower every 6 weeks of so

5) used 12" bit to drill cores from experimental boulders
6) checked HABS preliminary drawings

1995

1) advisory group meets to discuss past actions, results, future activities: Engineer Todd Rutenbeck of Bureau of Reclamation, Geologist Mary Griffitts (VIP/employee Mesa Verde), Conservator Frank Matero of the University of Pennsylvania, and MEVE archeologists Larry Nordby, Linda Towle, Kathy Fiero.
2) repointed exterior of Square Tower
3) removed two stones from stab wall to examine face of boulder behind wall--seems ok
4) regraded around west and south sides of boulder construction drylaid walls
5) documentation of interior and exterior of tower by Nordby
6) before and after repointing--monitoring to determine if tower moving
7) drainage from interior to exterior of tower modified slightly, metal drain removed and plastic hose placed through opening
8) Conservator Oliver documents graphically condition of boulder, Mary Griffitts discusses geology of area with Anne
9) Fiero, Colyer place moisture/temperature sensors around tower; will read sensors once a month
10) interviewed Al Decker--he can't remember much about project at Square Tower in 1960, apparently Lancaster and Pinkley said to build a wall and they did--not sure the reasons behind the decision

1996

1) moisture meters read every month but December
2) boulder poulticed to remove salts
3) stone stabilizer Conservare OH (ethyl silicate) applied to boulder on six separate days

1997

1) vegetation cut, moisture meters read monthly
2) grouting of depressions in boulder
3) boulder poulticed to remove salts
4) stone stabilizer Conservare OH applied to boulder on three separate days
5) Conservare reacted with rainwater creating a silica deposit on the boulder
6) Oven-off was tried in an effort to remove the deposit to no avail
7) Conservator Anne Oliver was contracted to examine the deposit and boulder and make recommendations

1998

1) moisture meters read monthly
2) vegetation cut, floor of tower cleaned, drains checked
3) preservation maintenance plan completed by Anne Oliver, conservator
4) hydrology study initiated.

1999

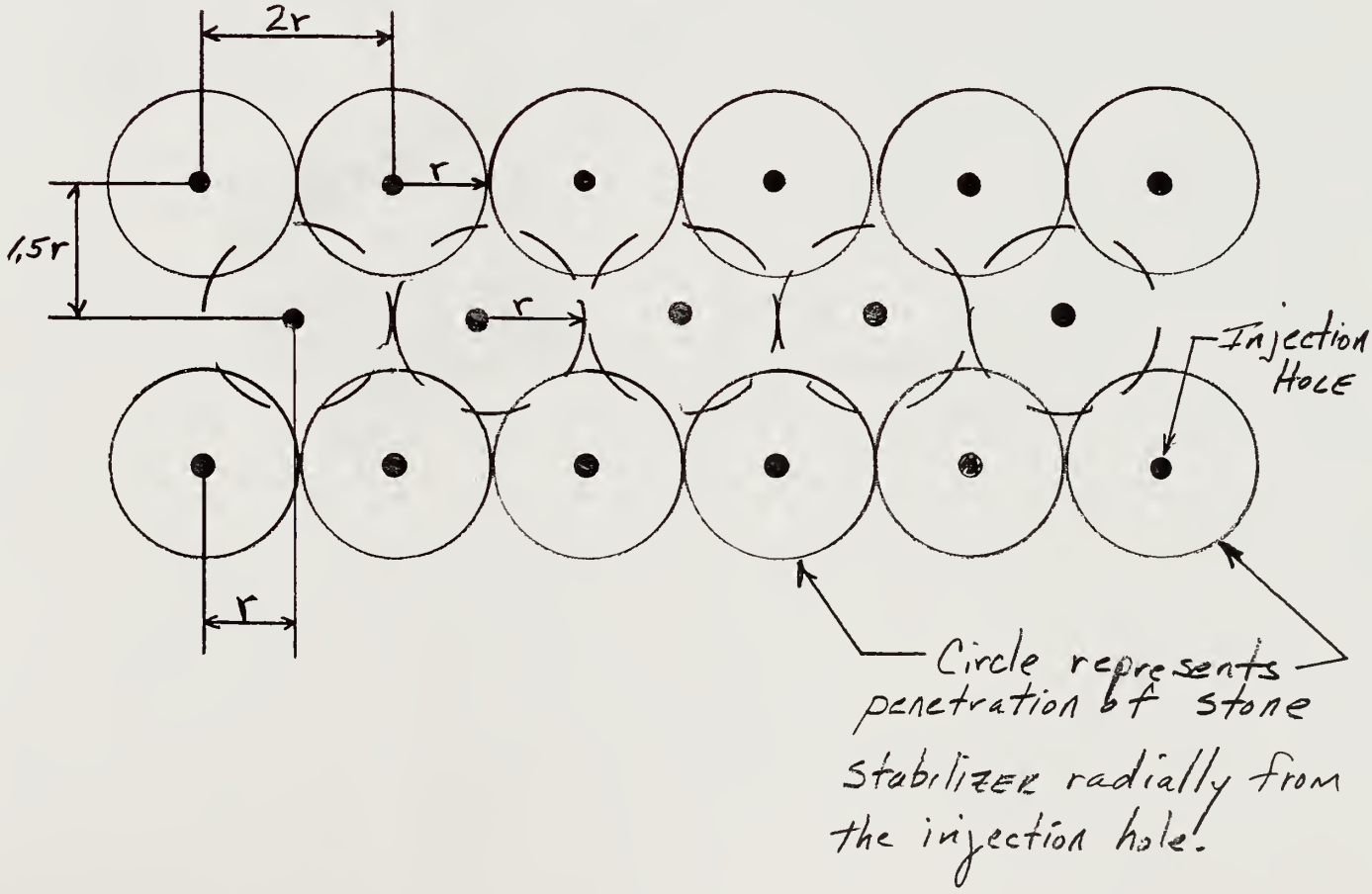
1) advisory group meeting
2) moisture meters read monthly
3) field work for topographic map of immediate area completed
4) grout in one area on east face of boulder removed and area treated with Conservare OH, void partially refilled
5) five pipes placed around Square Tower for monthly monitoring of level of water table
6) permeability of boulder measured and recorded
7) erosion rate of boulder measured with depth gauge against monitoring pins

APPENDIX B

INJECTION HOLE SPACING DETERMINATION

Injection hole spacing will depend on the permeability of the foundation rock and the penetration characteristics of the stone stabilizing solution. Manufacturers recommend both Lab & Field testing

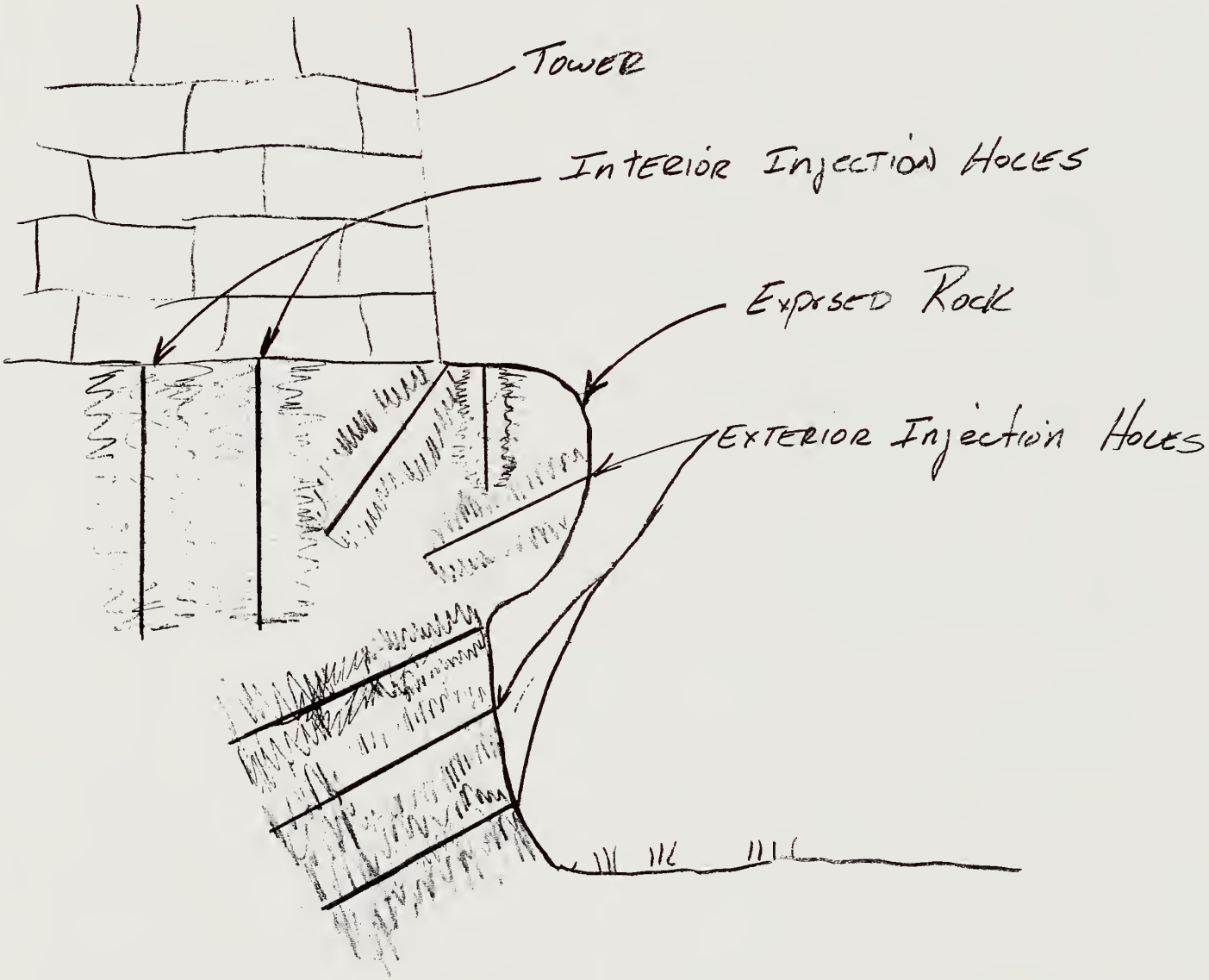
One testing determines the Average permeation of stabilizer, hole spacing can be determined as follows, where r = the radius of penetration



Gannett Fleming

SUBJECT SQUARE TOWER - HOUSATONIC STONE STABILIZATION
BY MWW DATE 7/01 CHKD. BY DATE

SHEET NO. 2 OF 2
JOB NO. 36541.092



APPENDIX C

DRILLING AND STONE-STABILIZATION INFORMATION

Conservare®

H100 Consolidation Treatment

stone & masonry strengthener & water repellent

Of all materials currently and historically employed in construction, masonry is one of the most durable. What has become apparent in recent years, however, is that masonry materials are not as enduring as once believed.

Placed in contemporary urban environments, these "timeless" materials decay at an alarming rate. Some deterioration may be attributed to the masonry's natural weathering process. The majority of the deterioration, however, is the result of oversights in use and maintenance of the masonry, and of the impact that industrialization has had on our environment, i. e. "acid deposition".

The intent of all conservation treatments is to restore the structural integrity to crumbling, decaying masonry and/or provide a means of controlling future decay. The failure of many conservation treatments lies in their inherent dissimilarity to the masonry for which they are proposed as a preservative.

When selecting a conservation treatment, an important consideration is to identify those treatments which display physical and chemical characteristics most similar to the masonry itself.

Conservare® Consolidation Treatments are based on silicic ethyl esters. Their extremely small molecular structure enables them to penetrate deeply into deteriorated masonry surfaces, collecting at contact points between individual stone grains. An internal catalyst and atmospheric humidity then convert the liquid consolidant into a glass- like silicon dioxide (Si02) gel which binds the stone particles together.

Exhibiting chemical characteristics and thermal expansion/ contraction characteristics which are virtually identical to that of natural stone, the newly deposited Si02 cementing matrix replaces the stone's natural cement which has been lost due to weathering influences.

Conservare® H100 is recommended for these substrates. Always test. Coverage is in square feet/meters per gallon.

Substrate	Type	Use?	Coverage
Architectural Concrete Block	Smooth Split-faced Burnished Ribbed	no no no no	N/A
Concrete	Brick Tile Precast Panels Pavers Cast-in-place	yes yes yes yes yes	30-60 sq. ft. * 3-6 sq. m.
Fired Clay	Brick Tile Terra Cotta Pavers	yes yes yes yes	30-60 sq. ft. * 3-6 sq. m.
Marble, Travertine, Limestone	Polished	no	N/A
	Unpolished	yes	30-60 sq. ft. * 3-6 sq. m.
Granite	Polished	no	N/A
	Unpolished	yes	50-80 sq. ft. 5-7 sq. m.
Sandstone	Unpolished	yes	30-60 sq. ft. 3-6 sq. m.
Slate	Unpolished	yes	50-80 sq. ft. 5-7 sq. m.

Laboratory and field testing are necessary to confirm desired results and application procedures.
*Coverage rates vary, depending on degree of deterioration and recommended application procedures.

DESCRIPTION AND USE

For badly deteriorated stone that requires consolidation and protection from water, Conservare® H100 is a combination consolidation/ water- repellent treatment. This ethyl silicate treatment, modified with a silane water repellent, replaces the natural binding materials while protecting the treated surface from water- related deterioration.

Conservare® H100 may be used on most types of sandstone, limestone, cast stone, stucco, brick and terra cotta. All patching and pointing materials should be in place before application of Conservare® H100.

ADVANTAGES

- **One component — easy-to-use.**
- **Low viscosity allows deep penetration. Will not form hardened surface crust.**
- **The new binder is mineral — similar to the original stone — no synthetic polymers.**
- **Rapid tack free drying — no dirt attraction.**
- **Forms no byproducts harmful to the masonry.**
- **Good vapor permeability — the treated surface "breathes."**
- **New binder is acid resistant — resists acid rain.**

Limitations

- Effective consolidation requires thorough laboratory and field pretesting. Contact PROSOCO for information on the recommended test programs.
- Limited shelf life — remains storage-stable for 12 months in sealed containers. Treated areas may bond to silicone and polyurethane molds (frequently used for casting replacement stone). Use a release agent to prevent mold from adhering to the treated surface.
- Not suitable for some types of marble.

TECHNICAL DATA

ACTIVE SUBSTANCE: Silicic ethyl ester.
SOLID CONTENT: 47%
FORM: Colorless to slight yellow.
SPECIFIC GRAVITY: 0.936
FLASH POINT: 110°F (40.5°C) (ASTM D 3278)
WT./GAL.: 7.79 lbs

PREPARATION

Protect people, vehicles, property, metal, glass, plants, painted and all nonmasonry surfaces from product, splash, fumes and wind drift. Protect and/or divert pedestrian and auto traffic.

The Importance of Pretesting
Since building materials differ in their nature and degree of deterioration, each conservation project poses unique problems and requirements. To gain a full understanding of the ongoing deterioration and determine necessary stabilization/conservation measures, a number of laboratory and field tests are required.

Laboratory testing:
a. Evaluates the physical and chemical characteristics of the substrate(s) to confirm whether consolidation is possible.
b. Identifies the cause(s) of deterioration and surface preparation procedures necessary for conservation treatment.
c. Determines the most appropriate conservation agent(s) and field application procedures.

For more information on the recommended testing program, read the Conservare® Stone Testing Brochure and contact your PROSOCO representative to arrange a job-site visit.

On-site Testing: Following lab testing, a test area should be cleaned and allowed to dry. An application of Conservare® H100 Consolidation Treatment (or Conservare® OH100) is made following specific recommendations provided by the laboratory analysis. The job site test area should be as large as possible and representative of the condition of the entire project. The test area is necessary to confirm application procedures under job site conditions and allow calculation of the masonry's consumption rate. The on-site tests also provide a visible sample of the effects of the treatment on actual job surfaces. Additional core samples can be taken from the test area and tested to verify depth of penetration and proper application procedures.

Surface Preparation
Following lab and on-site testing, clean the building with the appropriate Sure Klean® cleaner. In most cases, surface contaminants such as carbon crust, salts, pigeon droppings, mildew and atmospheric stains must be completely removed to assure thorough penetration of the Conservare® H100. * In addition, surface sealers and repellents which may have been applied must be thoroughly removed. Contact Customer Care at 800-255-4255 for additional cleaning recommendations.

*If preconsolidation is necessary, further evaluation will be required to ensure that no undesirable reactions take place between the consolidation treatment and the surface contaminants which may interfere with further conservation measures, i. e. subsequent cleaning, general consolidation, patching/repair, etc.

Surface & Air Temperatures
Protect surface to be treated from direct sunlight for several hours before application. If possible, start treatment when surfaces are shaded. Keep surface temperature relatively cool to prevent too rapid evaporation of Conservare® H100 and to ensure proper penetration. Do not apply during rain, to wet surfaces or when there is a chance of rain. Protect from rain for two days following application. Surface and air temperatures should be between 50°F - 90°F (10°C - 32°C) during application.

APPLICATION

Before applying, read Surface Preparation under Preparation and "Precautionary Measures" under Safety Information.

Use in concentrate. DO NOT DILUTE OR ALTER. Stir or mix well before use.

Application Instructions
Apply by low-pressure spray, brush or dipping. Larger surfaces should be treated using low pressure spray equipment, small areas with spray tanks. Mobile objects such as sculptures may be treated indoors by dipping or with the use of compresses. Contact Customer Care at 800-255-4255 or your local PROSOCO sales manager for additional information.

Ensure proper penetration and prevent crust formations by applying Conservare® H100 in repeated applications referred to as "cycles." A cycle consists of three successive saturating applications at 5-15 minute intervals. Typical treatments involve two or three cycles (6-9 separate applications). Allow 20 to 60 minutes between cycles. Laboratory testing will determine the optimum delay between applications and between cycles. Additional material should be applied until excess material remains visible on the surface for 60 minutes following the last application. Once this degree of saturation is achieved over the entire surface, the first treatment is complete. Immediately flush excess surface materials using industrial grade MEK (methyl ethyl ketone). If a second treatment is necessary, allow two to three weeks curing time following first treatment.

NOTE: Laboratory testing will determine the absorption profile and conservation capacity of the substrate(s). From this information, the optimal delay between saturating coats, and dwell time between cycles will be prescribed. The work area should be limited to a size that can be treated within the prescribed time periods.

Proper timing of the application process will maximize penetration of the consolidation treatment. Deep penetration is critical to the long term benefits of any consolidation treatment.

Coverage rates will vary with the condition of the stone, density, surface texture and application conditions. On-site testing will determine the consumption rate.
The amount of material needed for consolidation may range from as high as 80 square feet per gallon to less than 30 square feet per gallon depending on surface porosity and should be verified by on-site testing.

Post-treatment
Excess material should be removed before application of repair materials. Areas properly treated with Conservare® H100 can receive PROSOCO's BMC® silicone emulsion paints after the consolidation procedures have been completed.

SAFETY INFORMATION

WARNING
COMBUSTIBLE LIQUID AND VAPOR
MAY CAUSE IRRITATION
HARMFUL IF INHALED
FOR USE BY PROFFESSIONAL APPLICATORS ONLY
KEEP OUT OF REACH OF CHILDREN

Precautions:
Contains: Tetraethylsilicate, Di-n-butyltindiluarate, Isobutyltriethoxysilane, ethyl alcohol and an organic tin compound. May affect the brain or nervous system causing dizziness, headache or nausea. Eliminate local and remote ignition sources that may cause fire or explosion. Use care when applying to heated surfaces. Ethyl alcohol will continue to evolve during product curing. **Use only with adequate ventilation.** Provide adequate cross-ventilation in interior applications. Protect passersby and building occupants from product, mists and wind drift. Shut down and cover ventilation systems that may allow vapors or mists into occupied building. May cause eye, skin and respiratory irritation. Avoid eye contact. Wear splash goggles or a face shield to prevent eye contact. Avoid prolonged skin contact. Wear gloves and long-sleeved work clothing or splash-resistant clothing as needed. Do not breath vapors or mists. Wear a NIOSH-approved dust/mist respirator if mists are present. Wear appropriate respiratory protection if TLV of any component is exceeded.

Storage and Handling: Store and transport upright with lid tightly in place. Store in a cool, dry place away from heat and ignition sources. Close and tighten lid after each dispensing. Do not reuse container or remove the label. **Do not aerosolize or atomize.** Use minimum effective pressure during application. Wash thoroughly after handling. Do not alter, dilute product or use for applications other than specified. **If spilled,** keep from drains and soil. Absorb with inert media. Dispose of contaminated absorbent, container and product in accordance with local, state and federal regulations. Refer to the MSDS for additional cautionary information.

First Aid
Ingestion: Do not induce vomiting. Call a physician, emergency room or poison control center immediately.
Eye Contact: Rinse thoroughly for 15 minutes. Get immediate medical assistance.
Skin Contact: Remove contaminated clothing and wash thoroughly with soap and water. Seek medical assistance if persistent irritation develops. Launder contaminated clothing before reuse.
Inhalation: Remove to fresh air. If not breathing, give artificial respiration. Get medical attention.

Shelf life is 1 year from the date of manufacture in tightly sealed, unopened container.

24 Hour Emergency Information: INFOTRAC at 1-800-535-5053

WARRANTY

The information and recommendations made are based on our own research and the research of others, and are believed to be accurate. However, no guarantee of their accuracy is made because we cannot cover every possible application of our products, nor anticipate every variation encountered in masonry surfaces, job conditions and methods used. The purchasers shall make their own tests to determine the suitability of such products for a particular purpose.

PROSOCO Inc. warrants this product to be free from defects. **Where permitted by law, PROSOCO makes no other warranties with respect to this product, express or implied, including without limitation the implied warranties of merchantability or fitness for particular purpose.** The purchaser shall be responsible to make his own tests to determine the suitability of this product for his particular purpose. PROSOCO's liability shall be limited in all events to supplying sufficient product to re-treat the specific areas to which defective product has been applied. Acceptance and use of this product absolves PROSOCO from any other liability, from whatever source, including liability for incidental, consequential or resultant damages whether due to breach of warranty, negligence or strict liability. This warranty may not be modified or extended by representatives of PROSOCO, its distributors or dealers.

CUSTOMER CARE

Factory personnel are available for product, environment and job-safety assistance with no obligation. Call 800-255-4255 and ask for Customer Care - technical support.
Factory-trained representatives are established in principal cities throughout the continental United States. Call Customer Care at 800-255-4255, or visit our website at www.prosoco.com, to find the name of the Conservare® representative in your area.

ConserVare®

OH100 Consolidation Treatment

penetrating stone & masonry strengthener

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Substrate	Type	Use?	Coverage
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	Unpolished	yes	50-80 sq. ft. 5-7 sq. m.
Granite	Polished	no	N/A
	Unpolished	yes	50-80 sq. ft. 5-7 sq. m.
Sandstone	Unpolished	yes	30-60 sq. ft. 3-6 sq. m.
Slate	Unpolished	yes	50-80 sq. ft. 5-7 sq. m.

Laboratory and field testing are necessary to confirm desired results and application procedures. Coverage rates vary, depending on degree of deterioration and recommended application procedures.

When selecting a conservation treatment, an important consideration is to identify those treatments with physical and chemical characteristics similar to the masonry itself.

Conservare® Consolidation Treatments are based on silicic ethyl esters. Their extremely small molecular structure enables them to penetrate deeply into deteriorated masonry surfaces, collecting at contact points between individual stone grains. An internal catalyst and atmospheric humidity then convert the liquid consolidant into a glass-like silicon dioxide (Si02) gel which binds the stone particles together.

Exhibiting chemical characteristics and thermal expansion/contraction characteristics which are virtually identical to that of natural stone, the newly deposited Si02 cementing matrix replaces the stone's natural cement which has been lost due to weathering influences.

DESCRIPTION AND USE

Conservare® OH100 is a ready-to-use consolidation treatment that stabilizes masonry by replacing the natural binding materials, lost due to weathering, with silicon dioxide. When properly applied, Conservare® OH100 penetrates deeply, does not form a dense surface crust, and retains the substrate's natural vapor permeability. In addition to the general consolidation of severely deteriorated masonries, Conservare® OH100 is an effective pretreatment for friable substrates that need to be strengthened before cleaning, patching or coating. Conservare® OH100 may be used on most types of natural stone, concrete, stucco, brick, terra cotta, etc.

ADVANTAGES

- **One component — easy-to-use. Strengthens deteriorated stone.**
- **Low viscosity allows deep penetration. Will not form hardened surface crust.**
- **The new binder is mineral — similar to the original stone — no synthetic polymers.**
- **Rapid tack free drying — no dirt attraction.**
- **Forms no byproducts harmful to the masonry.**
- **Good vapor permeability — treated surfaces "breathe."**
- **New binder is acid resistant — resists acid rain.**

Limitations

- Effective consolidation requires thorough laboratory and field pretesting. Contact PROSOCO for information on the recommended test programs.
- Limited shelf life — remains storage stable for approximately 12 months in sealed containers. Treated areas may bond to silicone and polyurethane molds (frequently used for casting replacement stone). Use a release agent to prevent molding

compounds from adhering to the treated surface.
- Not suitable for some types of marble.

TECHNICAL DATA

ACTIVE SUBSTANCE: Tetra ethyl silicate.
ACTIVE CONTENT: 100%
FORM: Colorless to slight yellow.
SPECIFIC GRAVITY: 0.997
FLASH POINT: 104°F (40°C)
WT./GAL.: 8.30 lbs.

PREPARATION

Avoid application near fire or flame. Applicators should avoid smoking at all times. Protect people, vehicles, property, metal, glass, foliage, painted surfaces and all nonmasonry surfaces from contact with product, fumes or wind drift. Protect and/or divert pedestrian and auto traffic.

Take care to avoid exposing building occupants to fumes. When applying to occupied buildings, cover air intakes and air conditioning vents that may come into contact with the product. Maintain adequate ventilation when working on interior surfaces. When working in an enclosed area, self-contained breathing apparatus should be worn.

The Importance of Pretesting
Since building materials differ in their nature and degree of deterioration, each conservation project poses unique problems and requirements. To gain a full understanding of the ongoing deterioration and determine necessary stabilization/conservation measures, a number of laboratory and field tests are required.

a. Evaluates the physical and chemical characteristics of the substrate(s) to confirm whether consolidation is possible.
b. Identifies the cause(s) of deterioration and surface preparation procedures necessary for conservation treatment.
c. Determines the most appropriate conservation agent(s) and field application procedures.

For more information on the recommended testing program, read the Conservare® Stone Testing Brochure and contact your PROSOCO representative to arrange a job-site visit.

On-site Testing: Following lab testing, a test area should be cleaned and allowed to dry. An application of Conservare® OH100 Consolidation Treatment is made following specific recommendations provided by the laboratory analysis. The jobsite test area should be as large as possible and representative of the condition of the entire project. The test area is necessary to confirm application procedures under job site conditions and allow calculation of the masonry's consumption rate. The on-site tests also provide a visible sample of the effects of the treatment on actual job surfaces. Additional core samples can be taken from the test area and tested to verify depth of penetration and proper application procedures.

Surface Preparation
Following lab and on-site testing, clean the building with the appropriate Sure Klean® product. In most cases, surface contaminants such as carbon crust, salts, pigeon droppings, mildew and atmospheric stains must be completely removed to assure thorough penetration of Conservare® OH100. * In addition, surface sealers and repellents which may have been applied must be thoroughly removed. Contact Customer Care at (800) 255-4255 for additional cleaning recommendations.

*In cases where even the most sympathetic cleaning program would remove an unacceptable level of surface detail, Conservare® OH100 Consolidation Treatment may be applied to the soiled surface to preconsolidate the stone. If such pre-consolidation is necessary, further evaluation will be required to ensure that no undesirable reactions take place between the consolidation treatment and the surface contaminants which may interfere with further conservation measures (i. e. subsequent cleaning, general consolidation, patching/repair, etc.).

Surface & Air Temperatures
Protect surface to be treated from direct sunlight for several hours prior to beginning application. When possible, initiate treatment when surfaces are shaded. Keep surface temperature relatively cool to prevent too rapid evaporation of Conservare® OH100 and to ensure proper penetration. Do not apply during rain, to wet surfaces or when there is a chance of rain. Protect from rain for two days following application. Surface and air temperatures should be between 50°F - 68°F (10°C - 20°C) during application. Relative humidity should be greater than 40%. Excessive surface heating can be prevented by shading with awnings.

APPLICATION

Before applying, read Surface Preparation section and "Precautionary Measures" under Safety Information.

Dilutions
Use in concentrate. **DO NOT DILUTE OR ALTER.** Stir or mix well before use.

Application Instructions
Apply by low-pressure spray, brush or dipping. Larger surfaces should be treated using low-pressure spray equipment, small areas with spray tanks. Mobile objects such as sculptures are best treated indoors by dipping or with the use of compresses. Contact Customer Care at 800-255-4255 or your local sales manager for more information.

Ensure proper penetration and prevent crust formations by applying Conservare® OH100 in repeated applications referred to as "cycles." A cycle consists of three successive saturating applications at 5-15 minute intervals. Typical treatments involve two or three cycles (6-9 separate applications). Allow 20 to 60 minutes between cycles. Laboratory testing will determine the optimum delay between applications and

between cycles. Additional material should be applied until excess material remains visible on the surface for 60 minutes following the last application. Once this degree of saturation is achieved over the entire surface, the first treatment is complete. Immediately flush excess surface materials using industrial grade MEK (methyl ethyl ketone) or mineral spirits. If a second treatment is necessary, allow two to three weeks curing time following first treatment.

Note: Laboratory testing will determine the absorption profile and conservation capacity of the substrate(s). From this information, the optimal delay between saturating coats, and dwell time between cycles will be prescribed. The work area should be limited to a size that can be treated within the prescribed time periods.

Proper timing of the application process will maximize penetration of the consolidation treatment. Deep penetration is critical to the long-term benefits of any consolidation treatment.

Coverage Rates
Coverage rates will vary with the condition of the stone, density, surface texture and application conditions. On-site testing will determine the consumption rate.

The amount of material needed for consolidation may range from as high as 80 square feet per gallon to less than 30 square feet per gallon depending on surface porosity and should be verified by on-site testing.

Post-treatment
Areas properly treated with Conservare® OH100 can receive stone repair materials, regrouting materials and PROSOCO's BMC® silicone emulsion paints after the consolidation procedures have been completed. After curing apply the appropriate Sure Klean® Weather Seal water repellent to ensure protection from further water damage.

SAFETY INFORMATION

WARNING!
COMBUSTIBLE LIQUID AND VAPOR
MAY BE HARMFUL IF SWALLOWED
VAPOR HARMFUL
FOR USE BY PROFESSIONAL APPLICATORS ONLY
KEEP OUT OF REACH OF CHILDREN

Precautionary Measures
Contains: Ethyl alcohol, Ethyl Silicate, Organic tin compound, D-n-butyltindilaurate. May affect the brain or nervous system causing dizziness, headache or nausea. Causes eye, skin and respiratory tract irritation.

Vapors may ignite explosively. Keep away from heat, sparks and flame. Do not smoke. Vapors may ignite explosively and may travel along the ground or by ventilation to ignition sources far from the application site. Extinguish all flames and pilot lights, and turn off stoves, heaters, electric motors and other sources of ignition during use and until all vapors are gone. Powered ventilation and application equipment must be explosion proof. Always bond and ground when transferring between containers. Do not cut, grind, weld, or drill on or near this container, even if empty. Retains product residues and vapors and may be hazardous when empty.

Use only with adequate ventilation. Do not breathe vapors or mist. Ensure fresh air entry during application and drying. Ethyl alcohol will evolve during curing. When applying to exteriors of occupied buildings, make sure all windows, exterior intakes and air conditioning vents are covered and air handling equipment are shut down during application and remain so for 1 hour following application. Avoid exposing building occupants to fumes and mists. If you experience eye watering, headache or dizziness or if air monitoring demonstrates vapor/mist levels are above applicable limits, wear an appropriate, properly fitted, NIOSH approved respirator during and after application. Can be absorbed through skin. Avoid contact with eyes, skin and clothing. Wear splash goggles and protective clothing to avoid splash to eyes and skin. Wash thoroughly after handling.

First Aid
Ingestion: If swallowed, call a physician immediately. Do not induce vomiting except at the instruction of a physician. If vomiting occurs, keep head below waist to prevent entry of liquid into lungs.
Eye Contact: Rinse eyes thoroughly for 15 minutes. Get medical assistance.
Skin Contact: Rinse thoroughly. Get medical attention if irritation persists. Launder contaminated clothing before reuse.
Inhalation: Remove to fresh air. Give artificial respiration if not breathing. Get immediate medical attention.

Storage and Handling
Store away from heat and open flames in cool, dry place with adequate ventilation. Keep tightly closed when not dispensing. Vapors may pressurize container. Use care when opening. Do not use pressure to empty. Do not reuse or remove the label. If spilled, follow all precautionary instructions. Keep from water and soil. Contain and absorb with inert material. Dispose of contaminated absorbent, container and unused contents in accordance with local, state and federal regulations.

Do not alter or dilute the product except as specified. Do not use for any other purpose. Always protect passersby, building occupants and nonmasonry surfaces. Refer to the MSDS for additional precautionary information.

NOTICE: Reports have associated repeated and prolonged occupational exposure with permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents may be harmful or fatal.

Container Disposal
Hazardous when empty. Follow all precautionary instructions. Drain thoroughly and dispose of in a sanitary landfill (check local restrictions) or send to a properly licensed reconditioner.

Shelf life is 1 year from date of manufacture when product is in a tightly sealed, unopened container.

WARRANTY

The information and recommendations made are based on our own research and the research of others, and are believed to be accurate. However, no guarantee of their accuracy is made because we cannot cover every possible application of our products, nor anticipate every variation encountered in masonry surfaces, job conditions and methods used. The purchasers shall make their own tests to determine the suitability of such products for a particular purpose.

PROSOCO Inc. warrants this product to be free from defects. **Where permitted by law, PROSOCO makes no other warranties with respect to this product, express or implied, including without limitation the implied warranties of merchantability or fitness for particular purpose.** The purchaser shall be responsible to make his own tests to determine the suitability of this product for his particular purpose. PROSOCO's liability shall be limited in all events to supplying sufficient product to re-treat the specific areas to which defective product has been applied. Acceptance and use of this product absolves PROSOCO from any other liability, from whatever source, including liability for incidental, consequential or resultant damages whether due to breach of warranty, negligence or strict liability. This warranty may not be modified or extended by representatives of PROSOCO, its distributors or dealers.

CUSTOMER CARE

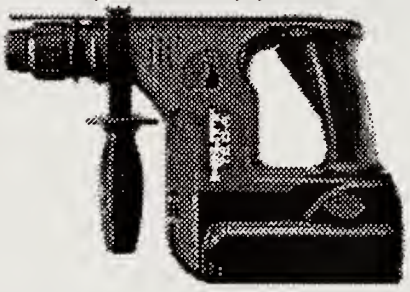
Factory personnel are available for product, environment and job-safety assistance with no obligation. Call 800-255-4255 and ask for Customer Care.

Factory-trained representatives are established in principal cities throughout the continental United States. Call Customer Care at 800-255-4255, or visit our website at www.prosoco.com, for the name of the Conservare® representative in your area.

Drilling & Chiselling Hammer Drills

TE 6-A (375W, 4.7kg, cordless)

36 volt power for top performance



Uses

- Drilling anchor holes and small openings in concrete, stone and masonry. Recommended drill bit diameter range: 4 – 16 mm
- Drilling in wood, plastic and steel using the key-type or quick-release chuck for drill bits with cylindrical shanks of up to 13 mm diameter
- Driving screws using the special bit holder

Features

- 36 volt battery with 2.4 Ah cells and 86 Wh energy capacity for high performance and battery capacity at low current (easy on the battery and the machine)
- Electropneumatic hammering mechanism: increases performance and reduces stress on the machine and insert tools
- Universal charger with conditioning charge mode for older batteries
- Belt adaptor: reduces the weight of the machine to 2.8 kg, making drilling work much less tiring

Technical data

- Power input: 375 W
- Nominal battery voltage: 36 V
- Energy capacity: 86 Wh
- Speed under load: 0-890 r.p.m.
- Hammering speed under load: 0-5000 blows/min.
- Weight of machine with battery: approx. 4.7 kg

Insert tools

- TE-CX drill bits

- TE-C drill bits

But, there´s much more.

For more information about the **entire rotary hammer programme**, national availability and specifications, product demonstrations or an advisory discussion, select your local Hilti organisation from the "Contact" menu.

Drilling & Chiselling Insert tools

TE-C drill bits

TE-C drill bits with SDS connection end

Benefits

- High drilling performance, long life expectancy
- Stepped helix crown: high drilling comfort, accurate hole geometry, optimised material removal

Programme

- 17 to 28 mm diameter
- Working lengths from 100 to 550 mm

For use in hammer drills

- TE 2
- TE 5
- TE 6-A
- TE 15-C
- TE 25

But, there´s much more.

For more information about the **entire insert tools programme**, national availability and specifications, product demonstrations or an advisory discussion, select your local Hilti organisation from the "Contact" menu.

Drilling & Chiselling Insert tools

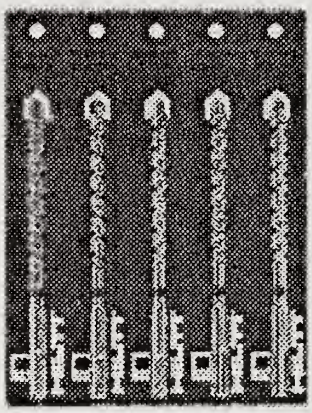
TE-CX drill bits

TE-CX drill bits with SDS connection end

Benefits

Solid carbide head

- High life expectancy under extreme conditions
- Optimal drilling performance, very smooth drilling
- Constant hole geometry over the entire drill bit life
- Less sensitive to rebar contact

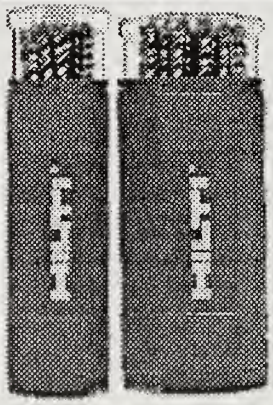


Cold-formed double flute/helix

- Higher drilling performance and longer drill bit life expectancy owing to optimised drilling dust removal

Programme

- 5 to 16 mm diameter
- Working lengths from 50 to 540 mm
- Packaged individually or attractive multipack-box of 10 and 25 units



For use in hammer drills

- TE 2
- TE 5
- TE 6-A
- TE 15-C
- TE 25

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