CONSERVATION OF ARCHITECTURAL SURFACES PROGRAM FOR
ARCHAEOLOGICAL RESOURCES: CLIFF PALACE
MESA VERDE NATIONAL PARK

Prepared by:
Frank Matero, Project Director
Claudia Cancino, Project Fellow-Documentation
Rynta Fourie, Project Fellow-Analysis and Treatment

The Architectural Conservation Laboratory and Research Center
Graduate Program in Historic Preservation
Graduate School of Fine Arts
University of Pennsylvania

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# TABLE OF CONTENTS

1.0 PROJECT BACKGROUND .................................................................4  
   1.1 Scope of Work  

2.0 DOCUMENTATION .............................................................................8  
   2.1 Objectives  
   2.2 Photo-documentation  
   2.3 Field recording  
    2.3.1 Architectural survey  
    2.3.2 Illustrated glossary  
    2.3.3 Recording conditions in situ  
    2.3.4 Digital transfer  
    2.3.5 Treatment recording  
   2.4 Summary of conditions and deterioration mechanisms  
    2.4.1 Subtractive conditions  
    2.4.2 Additive conditions  

3.0 ANALYSIS AND CHARACTERIZATION OF SURFACE FINISHES ..........35  
   3.1 Objectives  
   3.2 Sampling  
    3.2.1 Sampling location  
    3.2.2 Sample preparation  
   3.3 Microscopical analysis  
   3.4 Image analysis and micromorphology  
   3.5 Instrumental analysis  
   3.6 Analysis of representative spaces  
    3.6.1 Kiva Q  
    3.6.2 Kiva K  
    3.6.3 Room 121  
    3.6.4 Room 64  

4.0 CONSERVATION TREATMENTS .......................................................62  
   4.1 Objectives  
   4.2 Selection of treatment areas  
   4.3 Treatment history  
   4.4 Prevalent conditions  
   4.5 General treatment methods and materials  
    4.5.1 Thin layer plaster and wash reattachment  
    4.5.2 Injection grouting  
    4.5.3 Edging and compensation  
    4.5.4 Cleaning  
    4.5.5 Floor protection  
   4.6 Individual treatment reports  
    4.6.1 Kiva Q  
    4.6.2 Kiva K  
    4.6.3 Room 121  
    4.6.4 Room 64  

May 2002
5.0 GENERAL OBSERVATIONS ........................................................................................................95
   5.1 Architectural applications
   5.2 Composition and properties

6.0 APPENDICES
   6.1 Standards and guidelines for condition survey and conservation treatments of architectural surface finishes
   6.2 Graphic glossary of conditions and treatments
   6.3 Condition and treatment AutoCAD drawings
   6.4 Sample analysis
       6.4.1 Kiva Q
       6.4.2 Kiva K
       6.4.3 Room 64
       6.4.4 Room 121
   6.5 Schedule of mortar coupons
   6.6 Project team
   6.7 List of materials and suppliers
1.0 PROJECT BACKGROUND

1.1 Scope of Work

A phased program to develop coordinated methods for the survey, analysis, stabilization, and interpretation of the masonry and architectural surface finishes of selected cliff dwellings in Mesa Verde National Park, Colorado was initiated by the Architectural Conservation Laboratory (ACL) at the University of Pennsylvania (UPenn) beginning in 1994 (Fig. 1). The program is based on a five-fold approach including: (1) archival research into the published and unpublished archaeological reports and field notes on the masonry and finishes as-found and their conditions during and after excavation; (2) technical characterization and analysis of selected samples using wet-chemical, microscopical, and instrumental analytical techniques; (3) the detailed recording of existing finishes and their conditions, (4) environmental monitoring of site conditions; and (5) the design, testing, and execution of a treatment program specifically focused on the in situ stabilization of plain and embellished architectural surface finishes.

Eighty years of documentation of the architectural fabric of the cliff dwellings in Mesa Verde National Park have made it clear that the extensive and unique plasters and painted finishes covering the interiors and exteriors of the structures are deteriorating at an alarming rate. At some sites, such as Kiva C, Mug House, up to 25% of this fragile fabric has been lost since excavation in 1959. This can be attributed to several factors: (1) excavation has exposed building surfaces to unstable environments, (2) water lines and paved surfaces introduced into the park years ago for public convenience have caused water damage to sites, and (3) a lack of treatment knowledge for the preservation of the surface finishes resulted in deferral of the problem for many years. A general inventory of the location and condition of all surface finishes in 18 cliff dwellings was undertaken by the park in 1985 and 1987, verifying and documenting the severity of the problems (Phase 0).

Beginning in 1994, the University of Pennsylvania and the National Park Service (NPS) collaborated on a multi-phased program to address the conservation issues (Fig. 1). During Phase 1 (1994), documentary research on Mesa Verde’s masonry tradition and extant finishes, and in particular those at Mug House, was undertaken using earlier archaeological field reports to establish the extent and previous condition of the architectural finishes from the time of excavation to the present. During Phase 2 (1995), a detailed conditions survey of the masonry, plasters and washes at Mug House was
made by developing and applying standardized nomenclature and objective recording techniques developed by UPenn in 1994. Those areas determined to require immediate emergency stabilization were treated using temporary measures. This methodology was developed during Phase 1.

During Phase 2, work focused on the characterization and analysis of the finishes and mortars, including layer structure (stratigraphy), execution techniques, composition and overall physico-chemical properties. This was performed in conjunction with the finishes typology considered in relation to existing information on the broader implications of the architectural use, technology, and meaning. Deterioration mechanisms were also studied and an environmental monitoring program was designed and installed by English Heritage researchers John Fidler and Barry Knight for assessment of site conditions. Stabilization techniques were tested in the laboratory on actual samples and facsimiles as well as on site in order to evaluate the most appropriate treatment options. A pilot conservation treatment program was designed, tested, and applied at Mug House (Kiva C) from 1996-97 as a model program for stabilization of the surviving earthen finishes at the park during Phases 3 and 4.

Phase 4, accomplished in 1997, concluded the fieldwork by completing the model conservation treatments required for the stabilization and protection of the surface finishes at Kivas C, E and F and Room 28 at Mug House and Kiva E at Long House. These treatments were monitored over two years.

Phase 5 was conducted during the summer of 1998 and included a full range of projects. Documentation and reassessment of the condition of the plasters at previously surveyed sites were begun by NPS conservators Angelyn Rivera and Ann Oliver based on methodologies developed the year before. Limited areas of plaster considered to be in emergency condition were also temporarily stabilized. A conditions survey and architectural recording of selected areas of Cliff Palace was begun in 1999 using recording methodology developed in previous years including digital recording methods (Adobe Photoshop® and AutoCAD®). Finally experimental temporary shelter methods for Kiva C, Mug House were designed, installed and monitored for one year.

Phase 6, conducted during 1999, was designated a study season in preparation for a publication and exhibition on the past and present conservation of Mesa Verde. However, limited work continued at Cliff Palace focused on the emergency treatment of
the important mural paintings in Room 121, Square Tower in Cliff Palace under Frank Matero and Jeanne Marie Teutonico (English Heritage). Work also continued on the front-country park-wide survey of finish conditions. The environmental monitoring team also returned to assess their data at Mug House and remove the monitoring apparatus and temporary pilot shelters installed the year before.

Phase 7, begun in 2000 has allowed the implementation of the above model program at Cliff Palace through unprecedented funding from a matching grant from Save America’s Treasures. A two-year project was designed to complete the finishes conditions survey and assessment of the 18 front-country alcove sites and complete the stabilization and conservation of Cliff Palace, the park’s largest and most visited cliff site. Conservation work at Cliff Palace has been undertaken by an international and multi-disciplinary team of conservation experts and graduate students and includes conditions survey, materials analysis, and treatment. This report summarizes the research and fieldwork executed during Phases 6 and 7 as part of the Save America’s Treasures program.

The Mesa Verde project has allowed participants the opportunity to address through research and field experience, the theoretical and technical issues surrounding the stabilization and interpretation of archaeological ruin sites. The ultimate objectives of the program have been to record, stabilize, and interpret this fragile architectural fabric for scholars and the public alike and to integrate simple preventive conservation practices into park maintenance so that further loss and damage can be prevented and future major remedial intervention avoided.
CONSERVATION OF ARCHITECTURAL SURFACE PROGRAM FOR ARCHAEOLOGICAL RESOURCES
C.A.S.P.A.R.

PHASE 0

Preliminary Research
Silver 1980-81

LEVEL 1 CONDITION SURVEY
MAJOR FRONT COUNTRY
ALCOVE SITES
(SILVER 1985, FETTERMAN 1989)

PHASES 1 - 4

MUG HOUSE PILOT CONSERVATION PROJECT
1995 - 1997

MATERIAL ANALYSIS
AND CHARACTERIZATION

CONDITION SURVEY
METHODOLOGY AND DIAGNOSIS

MODEL TREATMENTS
Kivas C, E, F / Rm 28

ENVIRONMENT MONITORING
Kiva C / Rm 28

PHASES 5 - 6

PRELIMINARY PRESERVATION PLAN
ALCOVE SITES
1998-2002

LEVEL 2 CONDITION
ASSESSMENT OF MAJOR
ALCOVE SITES
1998-2002

LEVEL 3 CONDITION SURVEY
AND TREATMENT PROGRAM
CLIFF PALACE
1998-1999

REMOTE ENVIRONMENTAL MONITORING
AND EXPERIMENTAL SHELTER DESIGN
KIVA C AND MUG HOUSE
1998-2000

PHASE 7

FRONT COUNTRY SITE ASSESSMENT
AND TREATMENT PRIORITY SCHEDULE
1999-2002

MODEL ALCOVE SITE
PRESERVATION PLAN
CLIFF PALACE 1999-2002

SITE PROTECTION PROGRAM
1999-2001

PARK-WIDE PRESERVATION
AND MANAGEMENT PLAN
FOR FRONT COUNTRY
ALCOVE SITES

Figure 1: CASPAR project history
2.0 Documentation

2.1 Objectives

As stated in the *Charter for the Protection and Management of the Archaeological Heritage* (1990), documentation and survey are the cornerstones of archaeological site preservation.

...*The protection of the archaeological heritage must be based upon the fullest possible knowledge of its extent and nature. General survey of archaeological resources is therefore an essential working tool in developing strategies for the protection of the archaeological heritage.* ..."}

Survey and documentation provide the foundation for all cultural resource management and must precede any intervention activity. Traditionally, documentation for conservation has long been associated with the physical state or condition of an object or site immediately before and after intervention (AIC 2001). No doubt this can be attributed to the physical changes most conservation treatments affect, as well as the contributions that documentation can make toward an increased understanding of the original appearance or technology of the object or site. But it has also been through the study of existing condition as a record of past change that conservators have seen the value of documentation and recording in developing a more accurate knowledge of material alteration and deterioration. This is especially the case for understanding long-term trends and patterns of decay, as well as the efficacy of treatment performance and durability predictions. By studying condition as the cumulative result of change over time through scientific observation and description, one can come closer to understanding alteration mechanisms and to identifying and managing deterioration as that deleterious change.

The road to accurate and effective diagnosis must therefore begin with a conscious methodology employing descriptive symptomatic recording, preferably executed over time. In this way, the variables of condition type, location, extent and severity can be observed alone, together, and in combination with other factors such as material design including construction and composition, environment, use and modification, maintenance and previous conservation.

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Within recent years, the technology of producing more accurate and comprehensive documentation has increased dramatically through the development of newer imaging and computer graphic software programs such as AutoCAD® and Geographic Information Systems (GIS) such as Arcview® and the creation and adaptation of non-destructive investigation and monitoring apparatus. These tools have promoted the development of condition assessment surveys as critical diagnostic vehicles that go far beyond earlier interests in recording the immediate physical status before and after treatment. As powerful graphic methods, these digital aids allow the manipulation and analysis of large data sets and long term recording, which ultimately should result in better conservation and management decisions. However the true value of any condition survey program must begin with a clear definition of what information is required and why. All recording is deceptively subjective, always performed with a specific objective or from a particular point of view.

The conservation of architectural remains at archaeological sites presents great difficulties in the development and implementation of resource management programs. Current practice in the conservation and interpretation of such sites attempts to maximize documentation and the retention of original material in situ, while at the same time, often requiring interpretation of the remains in a manner which is both sensitive to their preservation as well as intelligible to the public. This is a difficult problem for any structure in a fragmented state and especially for fragile elements such as painted plasters, which are best understood in their original context but also highly susceptible to deterioration and loss.

A great many agents and phenomena, ancient and modern, transform sites over time and in different ways. A variety of natural and cultural processes including natural decay mechanisms and human actions continually alter a building’s fabric and form over time. Daily maintenance, intermittent repair, use and re-use (including ritual activity), neglect, decay, abandonment and recovery are among the diverse yet plausible processes that translate past actions and events into present conditions. As a result, the physical condition of any structure or site is a record of the interaction of many different determinants over the course of its existence. For archaeological sites these include (in general order of occurrence):

- original design, materials and construction techniques
- subsequent changes through use, human alteration and natural aging
- micro- and macro-environments and climate
- disuse and/or abandonment
- destruction and/or burial
- excavation
- stabilization, display and maintenance
These determinants characterize individual episodes in the formation of all sites and as such shape the “life cycle” of materials, structures and places. Such models, commonly used by archaeologists to explain multi-variate change over time, (Harris 1979, Schiffer 1987, Brown 1993) have less frequently been adopted by conservators to study and explain the condition history of cultural resources (Dowman 1970). By considering performance, deterioration and treatment in a more holistic and integrated manner--linking design, environment, and human agency--conservators can develop and apply documentation and recording methods focused on etiological concerns.

Fundamental then to the role of condition survey as a diagnostic tool is the concept of a site or building’s life history and the interpretation of condition as “accumulated evidence” of natural and cultural events mapped onto the physical form and fabric. This requires a reverse reading of the site or building by first observing and describing, i.e. recording and then interpreting the effects of the alterations leading to an understanding of what, where, when, how, and why such changes occurred. Clearly each site and material has a unique history, based on a unique combination of factors, yet the mechanisms of such alteration processes can be studied independently and the cumulative and resultant effects explained synchronically and diachronically by an insightful reading of the evidence (Fig. 2).

The process of analysis must therefore begin with the construction of an understandable and reproducible language describing the evidence observed. Once such a system is constructed, tested, and in place, the collection, management and correlation of the data afforded by recent advances in digital technology can allow for sophisticated readings and flexible interpretations. This can then be applied toward the development of a greater range of conservation treatment options and management strategies including long-term monitoring and preventive conservation.

All condition assessment surveys depend on qualitative and quantitative recording that describes the type, location (macro or micro), status (active or inactive), extent and degree of severity for each condition observed. Wherever possible, this should be performed over time where photographic or other past descriptive information exists. The medium or format by which this is done depends on what is being described, the size and scale of the work, the degree of accuracy required, and the equipment, skill and time available. The first step in recording any condition involves the use of a structured classification system and precise, exclusive language and graphics.
Because many decay mechanisms can be caused by various and complicated scenarios involving intrinsic and extrinsic factors, and because similar symptoms may result from different causes or different symptoms from the same cause, simple descriptive terminology based on the clearly stated observation of discernible physical characteristics is always preferable during the initial survey process. In this way observations can be recorded which are free from the causal implications often associated with many commonly used terms (e.g., spalling) and in a more useful manner before a fuller understanding of the problem can be gained through other subsequent or parallel investigative and analytical techniques.

This usually requires the creation of a defined and coherent terminology, often accompanied by photographic and schematic illustrations, and a designated graphic system for mapping conditions and materials. Classification schemes are usually designed to serve a specific end, be it in preparation for treatment or to monitor deterioration or intervention. They represent an artificial hierarchical typology of the variables observed which, when considered with other information, can be termed pathography, or the descriptive science of studying and recording physical conditions, and in particular, deterioration.

Based on the experiences of the model pilot conservation program for Kiva C at Mug House from 1994 to 1996, NPS researchers began the documentation and reassessment of the condition of the surface finishes at previously surveyed sites based on methodologies developed the year before.

The aim of that assessment program was to establish a Prioritized Treatment Schedule for the remedial and long-term preventive conservation of the architectural finishes in at least 18 significant alcove sites. This was supplemented by a corresponding preliminary survey for backcountry sites (Fig. 3).
This information will allow the park to develop a phased strategic plan to schedule and budget all future conservation work. After the field assessment was completed the data was entered into an Access® database where architectural and condition information was later queried for correlations between condition, construction, location and previous stabilization.

In 1999 following the above park-wide survey, the National Park Service and the Architectural Conservation Laboratory and Research Center of the University of Pennsylvania began a new term of collaboration as part of the Save America’s Treasures grant program.

<table>
<thead>
<tr>
<th>Treatment Priority Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>5MV00625: Kiva K</td>
</tr>
<tr>
<td>Deterioration Type</td>
</tr>
<tr>
<td>missing</td>
</tr>
<tr>
<td>detachment / fading</td>
</tr>
<tr>
<td>detachment</td>
</tr>
<tr>
<td>erosion</td>
</tr>
<tr>
<td>granular disintegration</td>
</tr>
<tr>
<td>less partial, may also include less to substrate</td>
</tr>
<tr>
<td>less substrate, may also be less partial</td>
</tr>
<tr>
<td>non-structural cracking, may be isolated or map cracking</td>
</tr>
<tr>
<td>other, basic mortar</td>
</tr>
</tbody>
</table>

**Treatment Recommendation (s)**
- finish conservation: grouting
- finish conservation: reattachment
- finish conservation: edging
- backfill: partial

<table>
<thead>
<tr>
<th>Condition Rating</th>
<th>Importance Rating</th>
<th>Access Rating</th>
<th>Treatment Priority</th>
<th>Treatment Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
<td>10</td>
<td>6 sq. ft.</td>
</tr>
</tbody>
</table>

**RATINGS**
- Condition: 5 = Poor, 4 = Fair-Poor, 3 = Good-Fair, 2 = Good, 1 = Excellent
- Importance: 5 = High, 4 = Medium, 3 = Low
- Access: 5 = Public Trail, 4 = Off Trail, 3 = Remote
- Treatment Priority: 5 = High, 4 = Medium, 3 = Low

![Figure 3: Access® database condition survey for priority treatments at Cliff Palace, NPS, 1998.](image-url)
The Conservation of Architectural Surfaces Program for Archaeological Resources (C.A.S.P.A.R) was designed to complete the conditions survey and assessment of surface finishes and to implement remedial treatments and preventive conservation measures at Cliff Palace, the park’s largest and most visited cliff site. 18 spaces were identified as high priority (ratings 8-10) for documentation, recording and treatment. The criteria for selection were based on severity of condition, archaeological significance, and public access (Fig. 4).

<table>
<thead>
<tr>
<th>Space</th>
<th>Treatment Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kiva K</td>
<td>10</td>
</tr>
<tr>
<td>Kiva Q</td>
<td>10</td>
</tr>
<tr>
<td>Open Area 25, 26 (Exterior Room 70, 71, 72 – Speaker Chief House)</td>
<td>9</td>
</tr>
<tr>
<td>Open Area J (Exterior Room 25, 26, 27)</td>
<td>9</td>
</tr>
<tr>
<td>Kiva N</td>
<td>9</td>
</tr>
<tr>
<td>Kiva J</td>
<td>9</td>
</tr>
<tr>
<td>Kiva H</td>
<td>9</td>
</tr>
<tr>
<td>Room 58 (East, North and West)</td>
<td>8</td>
</tr>
<tr>
<td>Room 64 (Exterior West)</td>
<td>8</td>
</tr>
<tr>
<td>Room 121 (East, North, West and South)</td>
<td>8</td>
</tr>
<tr>
<td>Room 40, 41, 42 Exterior (Open Area M South and East)</td>
<td>NI</td>
</tr>
</tbody>
</table>

Figure 4: Spaces selected as high priority for condition recording and treatments at Cliff Palace.
As stated earlier, one of the objectives of CASPAR was to develop a comprehensive conditions recording and documentation program including:

- The development of an efficient reproducible method of recordation using 35 mm rectified photography to create base images for graphic field annotation of detailed conditions.

- The creation of a systematic and expandable lexicon of conditions terminology for architectural finishes and especially earthen materials, complete with written description, photographic and schematic illustration, and colored graphic symbols for mapping.

- The assembly of existing graphic and database software to manipulate the graphics and textual digital information in order to record conditions now and in the future, and to assist in conditions diagnosis and interpretation, including the identification of the causes, patterns, and trends of deterioration.

During the two field campaigns in 2000 and 2001, the program was able to complete the recording of the 18 pre-selected spaces of Cliff Palace as high priority. Each season the conditions of the spaces were recorded and the spaces surveyed in the previous campaigns were field checked in order to record any change in condition and treatment.

**2.2 Photo-documentation**

An accurate and effective diagnosis must begin with a methodical recording of conditions that can be evaluated over time. The first step in this process requires the definition of a structured recording system that defines the language and the graphics to be used in the project. The medium or format next should be chosen, once the degree of accuracy, the scale of the work, and the type of final product have been defined.

As in the Kiva C model pilot project, existing conditions were field annotated on photographic elevations. Before the 2000 field season, the conditions recording did not provide an end product in which digitized annotated conditions could be viewed superimposed over the photo-elevations. The final product was a very detailed annotated drawing of the wall conditions. Without the photographs underneath the annotated conditions, the digitized
record of the actual architectural spaces and their material conditions were highly abstracted and their field use was a very difficult task (Figs. 5 and 6).

Figure 5 and 6: Condition recording without photomontage elevations –Cliff Palace- Kiva Q, Sectors 10 - 11

In order to address these problems, a new process of creating a permanent photomontage background was initiated during the summer of the 2000 field season and improved during fall 2000.

Over the course of one month, Katherine Dowdy, an archaeologist specializing in site documentation, photographed the masonry and plaster within 5 kivas, 6 rooms and 7 open spaces. An "ideal" image size, or surface area recorded in each photograph, was first determined to allow sufficient, detailed capture of subtle yet significant conditions such as map cracking, for further graphic annotation. This requirement will vary for each project depending on the specific conditions to be recorded and the degree of detail required and the architectural configuration. At Mesa Verde an average total distance of 55 inches from the wall was established to assure adequate overlap from one image to the other, accounting for areas of distortion normally occurring around the edges. Plumb lines were hung to indicate in each image the determined 30-inch wide sector, while the top and bottom margins were delineated by the tops of walls and the ground surface accordingly, thereby allowing the architectural form to dictate to some degree the vertical dimension of the recording module.
Equipment employed included a Pentax 28mm perspective control ‘shift’ lens mounted on a 35mm single lens reflex camera. While larger formats were originally considered in order to obtain what is commonly believed to be a finer image quality, this was found to be cost prohibitive both in the field and in post-processing when utilizing photo-CD technology. Similarly, digital photography was considered; however at the time of the project, the available digital photo-technology within the budget range of the project was not equal to that of the quality of standard emulsion film technology. With this in mind, the 35mm film format was selected due to the relative ease in handling and operation as well as the greatly reduced expense of photo-CD production.

Initially several black and white films and a number of lighting scenarios were tested to determine the best approach in obtaining image quality and detail of the various plaster conditions. Kodak TMAX 100 ® black and white film was selected for the enhanced contrast required to accentuate certain surface conditions.

One tall and one very small tripod were necessary for all the photo documentation not only to stabilize the camera when using the slower film speeds, but also in order to produce consistent results throughout the recording process. Measurements were taken to find the exact center of each sector photographed and to determine the 55-inch distance from the wall. Use of the tripods with bubble levels assured that the film plane was parallel to the wall each time to eliminate as much distortion as possible. Important to note, however, is that the inherent irregularities of the wall surfaces and curvature of the kiva walls dictated that these photographic images were only marginally rectified or scaleable. This was not critical as the primary purpose of the photographs was to provide a background base image for overall dimensions and superimposed graphic annotation of surface conditions.

Experimentation with supplemental lighting consisted of a small flash unit held away from the camera at an angle to produce a small degree of raking light. The high degree of irregularities in the wall surfaces could be either enhanced to show greater surface detail, or exaggerated so as to appear greater than they actually were. Light from the flash, in other words, can produce at least two conditions: the flattening out of some surfaces, effectively erasing the appearance of cracks and bulges; or an exaggeration of cracks and bulges so that they appear more severe than is actually true. Each sector of wall was then photographed with natural light only and again with raking flash to allow selection of the truest or best representation of the surface conditions. On the average, however, the images produced with the natural light only were chosen for printing. A flash (or a slave on occasion)
was used to fill in the very darkest areas of an image, or to even out images with both dark and light occurring simultaneously.

After field photography, photo-documentation continued with the digitizing of each photograph, selecting negatives that were scanned onto a CD-ROM, producing high-resolution images. The photographs were later manipulated using Adobe Photoshop® 5.5 software in order to correct any perspective distortion, crop images, and change contrast and sharpness where necessary, and to create a good base image for the conditions graphic overlays (Fig. 7).

Figure 7: Individual photographs joined together in Adobe Photoshop® 5.5.
Photomontages were created for 18 architectural spaces. The individual photographs were joined together to form panoramic images or “roll-outs” of the walls of the kivas, room elevations, and open areas. The process of photomontage was further completed through the use of AutoCAD Overlay® 2000 software to manipulate the photomontages for uniformity (Fig. 8).

A grid system was created for each photomontage dividing the space into a number of sectors that could later be used to graphically record the conditions in the field. The program allowed for the placement of the photomontage and created a series of layouts in order to print each of the sectors (Fig. 9).

Joining and rectifying the photographs as a complete montage elevation should always occur first before detailed sector recording of conditions is attempted so that anomalies (e.g., misalignment, perspective distortion, contrast) can be corrected on the base photographs allowing accurate conditions to be overlaid on the sector photos at any scale.
2.3 FIELD RECORDING

2.3.1 Architectural Survey

In preparation for the documentation of the architectural features, materials and previous and existing conditions of each space, standards and guidelines were prepared (See 6.1). This was accomplished in part through revising NPS and previous ACL project glossaries for material conditions and architectural terminology for earthen archaeological sites. The 31-page manual was created to aid in establishing consistent field recording among surveyors at Mesa Verde and also to establish a standard lexicon of terminology for similar sites throughout the greater Southwest (Fig. 10).

The manual identifies architectural type, context, orientation, exposure, plan, elevation, and function as well as materials, features, masonry construction and previous stabilization campaigns. There is also a comprehensive section on surface finishes that provides detailed information on the type of surface finish, layers, schemes, design components, and application methods.
This manual was created and developed in order to complete a detailed sector-by-sector Architectural Survey of each room, open area or kiva at Cliff Palace (See Appendix 6.3). The five-page survey form was divided into four sections: from a general level survey that describes each space to a detailed survey that classifies each sector. Part of the challenge in creating this survey form was to standardize the description and characterization of each space without losing the details and peculiarities of each sector.

2.3.2 Illustrated Glossary

The architectural information collected in the Architectural Survey was a preliminary step for the conditions recording, visually sensitizing the surveyors to observe the subtleties of materials and construction before recording condition. Consistent condition recording requires the elaboration of a defined and coherent terminology that describes and explains each condition based on simple observations of the architectural fabric and the earthen plasters. A new illustrated glossary (See Appendix 6.2) was developed for conditions and conservation treatments that included descriptive definitions accompanied by a distinct colored graphic for the actual recording, a detailed schematic drawing that explains and clarifies each condition and treatment with photographs of representative conditions taken during the 2000 field season to provide illustrative examples (Fig. 11).
Graphic recording systems were developed using color and symbol to define discrete condition types and subtypes within each. Both linear and overall pattern symbols based on standard AutoCAD® graphics were employed depending on the condition category and type. For example, subtractive conditions such as loss, detachment, delamination, and cracking were represented with various linear patterns, while additive conditions such as various surface deposits and bio-growth were represented by overall dot patterns. All subtypes of loss were represented in red and repair campaigns were identified in blue. In other cases, graphic symbols were further refined so that linked subtypes were expressed as variations on a specific pattern such as diagonal hatching and cross hatching for detachment and delamination and solid and dashed lines for various modes of cracking. A graphically compatible and easily legible classification system was thus created that allowed a visual reading both within condition categories (same type) and across condition categories (different types). At the same time past conditions and previous treatments were referenced through complementary graphic overlays and notes. The result is a graphically meaningful and legible system that takes advantage of color, graphic symbol and letter-related text for additional notes.
2.3.3 Recording Conditions *in situ*

During the summer of 2000 and 2001, photomontage printouts of each sector were used for field recording of the conditions for each new space where no previous documentation existed. The previous year's digitized condition elevations (with underlying photomontages) were also field-checked for accuracy. In an attempt to ensure consistency within a given space, one researcher rechecked the documentation of the conditions of each space to prepare for the digitization process (Fig. 12).

Figure 12: Conditions recording, Cliff Palace, Room 40, 2001.

Figure 13: Mylar transparencies with conditions field-recorded manually over photographs
The field-recorded information was collected using transparent Mylar sheets over the photo sector underneath. The Mylar overlay allowed the recorder to graphically record loss and repair campaigns on one side and other related conditions on the reverse (Fig. 13). A field recording system slightly different from the final digitized form was used to allow the surveyor to quickly record condition in the field using a greater range of colors and hatch patterns.

2.3.4 Digital Transfer
All field-recorded information (survey forms, graphic conditions, and photographs) was subsequently imported into different digital formats. Three graphic and database software programs were selected based on their compatibility to combine graphic, textual and numeric data. Adobe PhotoShop® was used to manipulate the CD-ROM raster image, combining and refining the photo elevations of each space.

AutoCAD® and CAD Overlay® were used to trace the architectural elements and the conditions and to import the raster photomontages from Adobe PhotoShop® (Fig. 14). AutoCAD® and CAD Overlay® read both raster and vector images, and therefore translated the information from raster photos into vectored drawings. Through these programs, architectural elements and surface conditions could be traced similarly to the how the conditions were recorded with the Mylar overlays in the field survey. Depending on site conditions and budget, it may be possible to record conditions directly in the field if laptop computers are available. In order to use the maximum level of flexibility of AutoCAD® a series of layers were created in the master drawing in order to record each condition. In this way, the conditions can be observed individually or in combination.

The joining of the individual sector images provides a comprehensive visual representation of the surfaces and spaces allowing further analysis of patterns of deterioration relative to location and orientation within the entire space. The program also can quantify individual conditions by surface area calculations. This can be linked with other compatible programs such as Access Database® or Geographic Information System.

To date, 18 spaces have been recorded and all the information has been digitized using this system (Fig. 15). The final product is a series of CAD drawings that illustrate the conditions and treatments of the masonry and surface finishes through photographic detail and enhanced annotations (See Appendix 6.3). The display of the conditions on the drawings in the context of supporting documentary information allows a working prediction of causes, trends, patterns, and degree of severity. This prognosis can later be supplemented and
confirmed using other methods of investigation and analysis leading to the point of diagnosis and intervention.

Figure 14: Digitalization process - ACL, 2001.

Figure 15: Priority spaces recorded at Cliff Palace.
As printed drawings, the conditions were presented in two main groups: “loss and repair” in the upper register elevation and “other conditions” in the lower register elevation (Fig. 16). Also in the upper drawing, specific embellishments and designs related to complex schemes are shown. A detailed legend, notes, and orientation plans and elevations accompany each space.

Figure 16: Condition drawings Kiva N, Cliff Palace - 2002

Full elevations allow conditions to be observed in the context of the entire space. Individual sectors of each space were also printed to allow for easy field monitoring of conditions and an evaluation of treatments (Fig. 17). The graphic condition survey is an irreplaceable tool that allows the conservator not only to record the conditions of the site at any given moment in time, but also to gain an accurate understanding of its behavior through time.
To date, the project has recorded all the conditions of the priority spaces from the 2000 and 2001 campaigns. In addition, the project has standardized the previous recording system in order to make the drawings compatible and understandable through time.

A Microsoft Access® 2000 database software also was designed at ACL for storage, retrieval, and querying of the Architectural Survey data gathered in the field (Fig. 18). Data entry was completed for all the spaces. The data will allow researchers to test the relationship between condition and the variables of original design, materials, and construction.

Along with the Microsoft Access® 2000 architectural database, an extensive archival image database was constructed at the ACL using Cumulus® software. Cumulus® allowed for the storage of the condition drawings and the approximately 2000 historic and contemporary images of the Cliff Palace and Mug House projects. This digital archive will allow researchers to obtain graphic information about a series of categories such as general conservation (by space or treatment), plaster or mortar analysis, documentation and treatments. Finally, a project web site was created as a communication tool for all phases of the project.
2.3.5 Treatment Recording

The overall recording of existing conditions in the context of supporting documentary information about construction, past uses, treatments, and maintenance ultimately allows the development of treatment schedules based on diagnostic assessment. Once the ACL tested and defined the types of treatments to be applied in each space, the glossary was expanded in order to graphically record them. (See Appendix 6.2).

The large-scale drawings for the treatments section are also divided in two main groups: those conditions relevant to the treatments applied and treatments recorded (Fig. 19). The use of AutoCAD® allowed for the digitization of the treatment type over specific types of conditions. In this way, treatments may be monitored in the future for their efficacy. Treatments were recorded following a specific hatch pattern and color according to the treatment type and edging ratio formulations. Sample locations were also recorded and shown in the sector layouts. The project recorded all the treatments applied to each space in the 2000 and 2001 field campaigns and also translated the treatments applied in 1998 (See Appendix 6.3).
2.4 SUMMARY OF CONDITIONS AND DETERIORATION PROCESSES

The following observations are a summary of the major conditions and deterioration processes observed during the project. When considered in conjunction with other factors such as environment and microclimate, wall orientation and exposure, wall composition, construction technology, and previous interventions, these observations suggest a complex etiology for the surface finishes of alcove sites. The summary observations described below are intended to accompany and supplement the graphic data provided as print out and on screen and are organized by condition type. In this way, multiple interpretations of conditions can be explored to reveal patterns and trends as well as anomalies related to time, location, and condition type. With the application of “smart” mapping programs such as Arcview®, predictive modeling of conditions as indicators of future damage offer expanded analysis and opportunities of better risk assessment for cultural resources at any scale.

Although specific deterioration for each site will be a function of the unique conditions encountered, the following general correlative observations can be made on the basis of the
visual survey and the shared alcove context, architectural design and construction, and composition of the mortars and surface finishes:

- Room/space location and orientation, in terms of exposure and grade, are significant factors in determining the overall condition of the stone, mortar, and architectural finishes of alcove sites, all other factors being equal. This is predominantly due to the deleterious effects of water on the earthen materials either as direct precipitation (melting snow and rain) or as ground water from percolation and rising damp through the sandstone.

- Room construction and use-history appear to play an important role in affecting the early condition history of the finishes. Partial vitrification and embrittlement from intense burning both during and after occupancy, instability from the application of numerous plaster layers over time, use-related damage and the presence of carbon soot deposits between layers as well as the ubiquitous loss of roofs after abandonment have all affected the durability and hence condition of the finishes both before and after burial and excavation.

- Excavation and subsequent selective exposure to the elements, even in a protected environment such as the cliff alcoves, have caused the most significant damage to the fragile surface finishes. This is clearly evident in the increasing loss observed over time since excavation.

2.4.1 SUBTRACTIVE CONDITIONS (See Appendix 6.3)

**LOSS / PARTIAL LOSS**

Total loss is the final and ultimate stage of deterioration for surface finishes. It is the most extreme condition and obviously non-recoverable; however the careful recording of total and partial loss is a useful indicator of past and current patterns and trends, especially when datable through earlier photo-documentation. When viewed in conjunction with partial loss, active deterioration characterized by specific conditions such as detachment, delamination and flaking can be understood as the preface to total loss. In most kivas nearly all loss has occurred across the upper walls and along the upper quarter of the lower or banquette walls. This is due to the overall vulnerability of these areas to weather exposure during occupation from roof leaks (prehistoric repairs are often found in the upper walls), after abandonment from associated roof collapse, and
after excavation and rebuilding during stabilization. Early pre-stabilization photographs often show masonry and roof collapse, exposed upper walls and total plaster loss. The lower banquette walls—being concealed and possibly protected by fallen roof debris and aeolian deposits—are generally intact, a situation common for most kivas in cliff sites. A comparison of the extent of surviving plaster evident immediately after excavation and stabilization illustrates the loss of plaster that often results after excavation. At Kiva C more than 25% (surface area) of the existing plaster finishes recorded in 1960 was subsequently lost over the past 40 years of exposure, most of the loss occurring along the upper banquette.

Most partial loss also occurs along this upper banquette wall face, often directly below areas of total loss, as well as along the base of the banquette. Conversely the entire middle zone of the banquette walls retains the most complete finishes, especially on the pilasters. This pattern—although dependent on the specifics of room orientation, namely exposure and proximity of the space to the alcove’s rear wall, surrounding wall height and configuration, and the number of superimposed finish layers—generally reveals the critical relationship between design, construction and weatherability.

The finishes on the walls directly under the flat banquette ledges between the pilasters and recess succumb to the wind-driven rain and melting snow that accumulate on these flat horizontal upper surfaces along the outer sections. This pattern of precipitation has been observed in action and can be deduced from the succession of related conditions along the upper banquette wall beginning at the top with total loss, detachment and deformation of the remaining plaster edges, to partial loss and delamination lower down the wall. The tell-tale evidence of new and old soil wash patterns in these locations down the upper and lower walls (monitored over two years) clearly points to active water flow channeling, and the probable sequence of saturation, swelling and shrinking of the clay fraction of the finishes, salt formation, deformation, blistering and detachment of the layers, debris accumulation in the detachment, and eventual mechanical failure and loss. These conditions recently have been induced in sequence through laboratory simulation in preparation for treatment testing and evaluation. Changes in partial loss over time clearly indicate the active nature of this condition in exposed areas.

Conversely, the lower walls along the rear of the alcove display less differential damage relative to the banquette shelves and no soil wash presumably due to the protection afforded by the alcove. However what can often be observed along the lower rear walls
is severe delamination and flaking, salts, and interlayer root masses. These conditions suggest typical moisture problems related to cyclical wetting from ground water percolating through the sandstone and emerging at the less permeable shaley deposits along the rear of the alcove.

Overall patterns of ground-water emergence for the entire alcove are further complicated by the orientation of the alcove's shaley layers, which affects the location and quantity of water emerging from the rock. For example those kivas and rooms located along the rear of the northern half of Mug House, up-slope of the shaley seam exhibit far more salts presumably due to the initial discharge of water at this end. Conversely, rooms along the rear of the southern half, down-slope of the shaley seam, display less efflorescence and water damage where protected from wind-driven rain and snow.

Based on this evidence, room location within the alcove, especially as it relates to rear wall moisture determined by the activity of water percolation and the orientation of the shale seam, subterranean ground elevation, as well as exposure to the weather are all critical in determining plaster conditions. No doubt the immediate physical context of each space, such as the surrounding wall heights, will create unique climatic environments for each architectural feature and associated surface finishes. Nevertheless, the specific combinations of conditions reveal the importance of siting within the alcove and the complexity of primary and secondary factors in the explanation of basic decay mechanisms.

After environment, composition and layer structure of the finishes in association with the deposition of carbon soot and embrittlement from intense burning play an important role in determining condition. All surface finishes examined thus far reveal a well-proportioned ratio of kaolinite/illite clay binders to a fine but well-graded and sorted silt and fine sand fraction, thus ensuring initial good adhesion and low shrinkage of these finishes. Cryptocrystalline calcite sometimes found in the soil used to prepare the plasters and also possibly subsequently deposited from bicarbonate rich ground water helped to give good durability to these finishes. The possible presence of organic plant additives as recorded in late nineteenth century ethnographic accounts, could have also provided short-term durability, initial increased plasticity, water retention and thus shrinkage reduction, and water resistance. No evidence of these additives was found during analysis with FTIR. The general lack of map cracking in protected areas, free
from subsequent wetting and drying, confirms the technical skill attained in the original formulation and application of these surface finishes, i.e., free from shrinkage.

Layer structure, and indirectly masonry construction, is without doubt a significant factor in finish condition. With very few exceptions, each plaster layer applied probably represents a single campaign, evidenced by carbon soot build-up and separation fractures that often occur between layers over time. Of all the building and room types, kivas, without exception, contain the greatest number and most complex application of surface finish layers and interlayer soot deposits. This may well be due to the largely ceremonial function of these spaces and the direct association of plaster and wash application, plain or painted, with ritual, possibly on an annual cycle such as the historically recorded Hopi Powamu ceremony. Visual interpretation of the finish stratigraphies into architectural campaigns was easily achieved for the studied architecture at Mesa Verde utilizing the existing photomontage as a base for colored reconstructions.

Given the weak and brittle nature of these earthen finishes (when dry), layer stability is generally inversely proportional to the number of layers applied to the surface. As with other plastered masonry, the earthen finishes adhere best to the earthen mortar joints regardless of keying, and less so to the stone. Interlayer delamination often results from poor adhesion caused by carbon soot deposits at these interfaces. Once detached, salts and roots find ideal environments to develop further thus exacerbating the problem of delamination, salt formation, and moisture retention. Some kivas are carefully constructed with regular, well-shaped and finished stones, especially for the pilasters and lower banquette wall. This has the effect of insuring a smooth, curvilinear surface upon which to apply the numerous thin earthen plasters and washes needed to complete the architecture. Kivas, whose masonry is roughly shaped, finished and coursed, usually have a thick initial leveling plaster of several centimeters applied to the masonry substrate followed by subsequent thin finish plasters and washes, some of which appear to have been burnished. As a result this causes unique detachment problems given the vulnerability of the thick base plaster.

**DELAMINATION/FLAKING**

A subset of partial loss characterized as active surface (flaking) and interlayer (delamination) failure found extensively along the lower banquette walls, especially in combination with salts and previous root growth.
**DETACHMENT**
Loss of bond between the plasters and their masonry substrate occurring either as open or blind separation. Found as a narrow linear zone across much of the upper top edge of the lower banquette wall. A discreet condition often occurring in conjunction with total or partial loss since excavation due to exposure and failure resulting from

**BLISTERING**
The wetting, swelling, delamination and subsequent deformation of thin single or multiple layers of plasters and washes result in the formation of blisters of variable size and shape. Often these exist in various stages as blind, cracked, and broken forms, always in locations were water has been or still is present

**CRACKING**
Masonry cracking is generally related to structural problems such as settlement, which is always translated to the surface finishes. **MAPCRACKING** occurs in the finish alone and in isolated areas of repeat wetting and drying indicating stress failure.

**MECHANICAL DAMAGE**
Occurs in isolated areas, especially along the lower walls as random scratches that appear to be due to animal activity and as small divots from the inadvertent strike of the excavators' trowels into the plaster. Not related to any other conditions.

2.4.2 **ADDITIVE CONDITIONS**

**SOIL WASH and RUNNELS**
Occurs as a thin wash of tan-brown soil or deep runnels extending downward from the upper wall edges and banquette ledges. Soil wash flows down the surface according to divots and jogs in the masonry. The recording of variations in the soil wash patterns over time within the same areas confirms an active condition of water runoff. Active loss and areas of detachment, delamination and deformation along the upper plaster edge of the banquette walls are all found in association with soil wash and runnels above.

**EFFLORESCENCE**
Carbonates, and to a lesser degree sulfates, constitute the major soluble salts present at Mesa Verde. Salts are clearly visible as discreet nodules in the bedding mortar and stone in areas of high moisture saturation both along the front and the rear, depending on the source of moisture. Salt cycling appears to be more severe along the front wall,
where summer rains and melting winter snow causes dissolution and recrystallization within these materials. As a result, both stones and mortar in areas along the upper banquette walls to either side of the pilasters display considerable efflorescence and decay due to repetitive prolonged wetting from melting snow and rain. In open locations were rain and snow sturate the ground, severe stone decay and salts have been observed in the lower courses, for example, in Kivas H and J in Cliff Palace.

**COLOR CHANGE**
Color change is most characteristically observed as a localized reddening of the plaster, mortar and stone, most intense on the surface and gradually diminishing with depth. This is caused by the calcinations and oxidation of the iron containing minerals in the clays. Fire reddening exclusively occurs along the upper half of the banquette walls and especially on exposed stones that were covered by plaster. Burning may have embrittled the plasters resulting in loss through weathering. The location of the fire reddening along the upper half of the banquette wall suggests burning may have occurred after abandonment and roof collapse that might have protected the lower walls.

**CARBON SOOT**
The location of carbon soot staining complements the locations of fire reddening. That is to say that carbon soot blackening occurs on the upper walls of *in situ* stone and plaster fragments above the fire reddened areas and not on the last plaster layer along the lower banquette wall. Continuous overall carbon soot application has also been found in some kivas and rooms, which appear to have been selectively exposed in combination with the application of colored washes. These situations suggest the conscious application and/or manipulation of carbon sooted surfaces as a design element.

**VEGETATION and BIOGROWTH**
Ample evidence exists in the form of dead root masses between plaster layers that suggests vegetation in the past was a problem most likely associated with pre-excavation conditions where herbaceous plants found suitable environments in the collapsed earth roof debris. Root growth preference between the plaster surface and the fill (as evidenced by root salt biomorphs) and between plaster layers along the rear walls, can probably be attributed to the moist conditions and the presence of a favorable growing medium from the deteriorated wet plaster. Biogrowth or microflora of fungi and lichens appear to occur in limited and isolated locations in all cases associated with previous or current areas of moisture.
3.0 CHARACTERIZATION AND ANALYSIS OF SURFACE FINISHES

3.1 Objectives

Material characterization and analysis in the context of the Cliff Palace conservation program were undertaken to describe the microstructure and chemical composition of the earthen finishes in order to better understand their original appearance and basic properties, especially as the latter relates to decay processes and remedial and preventive treatments. Not addressed during this study were archaeometric issues of raw material sourcing (provenience) or age. The eighteen priority spaces at Cliff Palace (see Fig. 4) were studied and analyzed with the main focus of the analyses on Kiva Q, Kiva K, Room 121 and Room 64. These were chosen as representative spaces to further explore the relationship between space type and surface finishes. Microstructure and chemical composition were studied through a comparison of successive layer sequencing (i.e., stratigraphic analysis). Polarized light microscopy, reflected light microscopy, quantitative image analysis, and x-ray diffraction were also performed to analyze selected samples from the above spaces in advance of treatment.

3.2 Sampling

3.2.1 Sample Location

According to the Architectural Finishes Treatment Priority Assessment, Mesa Verde National Park, 1998-1999, the following high priority areas in Cliff Palace (5MVO625) were selected for treatment. Mortar and surface finishes samples were taken from the 18 selected spaces:

- Kiva H
- Kiva J
- Kiva K
- Kiva N
- Kiva Q
- Open Area J: Exterior facades rooms 25, 26, 27
- Open Area M and Open Area 6: Exterior facades rooms, 40, 41, and 42
- Open Area R: Exterior façade room 64
- Open Area 42: Room 58
- Open Area 25 and Open Area 26: Speaker Chief House: Exterior facades of rooms, 70, 71, 72
- Room 121: Square Tower
Sample locations were selected according to representative architectural elements, visible schemes, and condition (i.e., protected areas displaying existing damage were preferred sample locations in order to reduce damage). Samples were extracted with a scalpel and varied in size from 0.2g to 100g depending on the situation. The sample location and number were recorded on field photographs and in schedule form (See Appendix 6.4). Given the fragile nature of many of the multi-layer samples, specimens were carefully packed in individual glass and plastic sample vials in cotton and clean sand and labeled. Samples taken in previous years were merged and renumbered according to the final sample list. Sample locations were then indicated on the treatment photomontage elevations for each space.

### 3.2.2 Sample Preparation

All bulk samples from the 18-priority spaces were examined under a Nikon SMZ-U stereomicroscope in normal reflected light. Physical properties such as texture, hardness, color, size, shape and weight were noted. The samples were then compared and grouped per space by location, and sample type (e.g., modern repairs versus historical repairs). Selected representative samples for each space were embedded in a polyester-acrylic mounting medium (Bioplast®) and cross-sectioned with an Isomet® micro saw. Samples from Kiva Q, Kiva K, Room 121, and Room 64 were further analyzed in greater detail through thin section analysis. The thin-sections were vacuum imbedded with blue dye and stained with alizarin crimson to indicate pore space distribution (blue) and the presence of calcite (red).

### 3.3 Microscopical Analysis

All analytical techniques have limitations and hence several methods are needed to complement and confirm results. Through gross visual examination and low magnification reflected light microscopy, the color, texture and initial description of the finishes were recorded. Further examination of whole sample thin sections with polarized light microscopy (PLM) (Nikon Optiphot2-POL) revealed both the microstructure and fabric of the mortars including stratigraphy, determined the relative ratio of matrix and aggregates, and identified the morphology and mineralogy of the aggregates. X-ray diffraction was utilized to identify the mineralogy of the fine clay and silt fractions comprising the paste.
3.4 Image Analysis and Micromorphology

Image analysis [Bioquant Nova® for Windows, 98 BQ Nova Version 5.00.8 MR (R&M Biometrics, Inc.)] was used to better characterize the geo-physical properties of the samples. Since gravimetric analysis is not possible on these small-layered samples, image analysis provides a non-destructive method to study and describe the various components such as the ratio of matrix (paste) to aggregate. A micro-morphological description of each layer per sample was prepared to support numerical and visual results from the image analysis software and allow quantitative comparison of layers within a sample, samples within a space, and samples across spaces and sites.

Micro-morphology is a unique technique for the study of multi-phase composite materials: soils, mineral formations and transformations, and man-made composites such as mortars and plasters. The microstructure of a plaster or wash is the spatial distribution and total organization of the plaster/wash system as expressed by the degree and type of aggregation and the nature and distribution of the pores and pore space. The matrix or paste of the plaster and washes forms a more or less continuous phase, which encloses coarse material concretions, etc., and has been quantified for every plaster finish layer. Basic micro-morphological concepts recorded included fabric, matrix and structures.

The Bioquant ® Basic toolkit provides morphometric measurements and topographic maps of hand traced areas, distances and object counts. It can be used with or without a video camera. Customizable data structure allows the addition of an unlimited number of user-defined calculation arrays, as well as multiple measurement arrays of the same type. Array names are customized to reflect the features measured.

3.5 Instrumental Analysis

X-Ray diffraction analysis (XRD) was performed as the method of choice for identification of the mineralogical species of the clay/silt fraction. Previously, representative finish samples from Kiva Q and Kiva K, Cliff Palace were analyzed by George Austin of the New Mexico Bureau of Mines and Mineral Resources in April 1999. The current analysis was performed with a Rigaku D-MAX diffractometer at the Laboratory for Research on the Structure of Matter at the University of Pennsylvania. The divergent slit and the scatter slit was 0.3mm, the receiving slit and the detector was 1 degree. A copper tube mono-chromometer was used. Bulk samples were crushed in an agate mortar and pestle and dry sieved. For matrix analysis, particles less than 2μm were sedimented on glass slides. For aggregate analysis, unoriented grains were mounted on an adhesive taped “sticky” glass slide.
3.6 FINISHES ANALYSIS-REPRESENTATIVE SPACES

3.6.1 Kiva Q

Kiva Q has been analyzed and partially treated for the last four years by several researchers. The following observations are a combination of past and present field investigations, and previous (M. Slater, 1999) and current analysis. After initial archival and field investigations, representative samples from the major architectural elements of the kiva: lower banquette wall, pilasters, and upper inter-pilaster walls were selected for further study (Figs. 20 & 21).

Architecture

Kiva Q is a large, well-proportioned kiva of slightly oval plan. Its masonry is finely constructed with dressed and coursed stones and precisely positioned pilasters. Although the western portion of the kiva is destroyed (since the earliest descriptions), the remaining walls are in excellent condition and retain their finishes, especially along the banquette.

Kiva Q was first indicated in plan by Nordenskiöld (1893, 60, Pl. XI) as Estufa 51. The earliest detailed photographs by Nusbaum in 1907 (MEVE 9523/#19) and Vreeland (in Fewkes, 1911, Pl.19) display well preserved interior walls. The current bichrome scheme is clearly visible and the recent masonry deterioration and plaster loss in the lower banquette (Sectors 10 & 11) is minimal. Two niches display original closure insets that were subsequently removed after 1954. The deflector, although partially collapsed on the southern end, displays a stone slab top (missing by 1954 and possibly not original) and plastered walls. The deflector’s plaster on the northern end clearly exhibits a dark lower band that has been confirmed through field examination and cross-sectional analysis as a red dado with triangular embellishments on an upper white field on the east face. Collapse of the upper interpilaster walls in Sectors 3 & 4 are clearly visible and explain Fewkes’ repairs in those areas as well as on the deflector and at the broken northern end (Fewkes, Pl.15). Stabilization work in 1934 by Morris and Lancaster repaired the broken end walls again, removing Fewkes’ earlier stabilization. Later (date unknown), the floor was replastered.

Surface Finishes-Stratigraphy

Numerous simple and complex surface finish schemes are evident at Kiva Q including several with discreet (e.g., painted hands and animal paws) and repetitive (finger tip dado band) embellishments.

Representative banquette wall samples taken together constitute one complete sample. Sample 3 contains the three initial layers while Sample 1 continues the sequence with the
most recent five layers. Thus, one can infer that the lower banquette wall of Kiva Q originally had at least eight finish layers (Fig. 20). In contrast, the pilasters in Kiva Q have fewer finish layers. Samples 41 and 43 are representative of the lower pilasters and Samples 38 and 40 are representative of the upper pilasters. The lower pilasters display four layers while the upper pilasters have only three layers (Fig. 21). As represented by Sample 46, the upper walls between the pilasters (interpilaster wall) have only two layers (Fig. 21). These stratigraphies relate directly to the frequency with which individual architectural elements were finished during each scheme or campaign of finishing. As in most kivas, banquettes were refinished more frequently than pilasters, which were refinished more frequently than the upper, interpilaster walls. This suggests a hierarchy of treatment based on element or sphere of activity, i.e., the banquette level being the zone of sitting.

The thickness of the finish layers of most of the samples in Kiva Q is between 200-500μm. On site investigation, however, revealed that many of the finishes vary in thickness and can be further defined as plasters or washes depending on the sample location and grain size distribution. In all the samples, the first layer appears to be a coarsely textured base or leveling plaster between 500μm-1cm thick. Most successive individual finish layers are separated by a thin soot layer suggesting the passage of time between applications. Plaster layers were applied sporadically throughout the kiva, presumably to repair or level areas of significant finish loss over time, especially around niches. Washes were used to both color and delineate the space as design elements and embellishments. Washes were also applied as discreet designs, rendered as repetitive or discreet motifs such as the finger-tipped dado border in Scheme 3 and the red painted handprints and white animal paw prints in Scheme 6. Surface characteristics of the finishes in Kiva Q vary from earlier smoothly polished or burnished surfaces to the most recent layers exhibiting distinct application striations made with the hand.

On-site investigation has revealed five successive schemes for Kiva Q. Microscopic investigation of the finishes stratigraphy has confirmed the on-site investigation with one possible additional scheme. All six schemes can be considered as main schemes, however Schemes 2 and 6 are transitional in that they incorporate finished elements from earlier schemes. (Figs. 20 & 21). A conjectural sequence of schemes was made in gouache based on the Munsell color match of each layer (Fig. 22).

As in other kivas, the earliest scheme (Scheme 1) is a simple, although full finish covering all interior surfaces in a monochromatic brown plaster. All later schemes are complex, being a
Mesa Verde, Cliff Palace 5MV0625: Kiva Q: Finishes Analyses

Sample Location

Sample 1 Lower Banquette

Sample 3 Lower Banquette

Reflected Light
Magnification 12x

Polarized Light ||
Morphometric analyses

Aggregate Grain Size Distribution Samples 1 & 3

Ratio of Matrix to Aggregate Samples 1 & 3

Munsell Colors
Layer 6 - 10YR7/4
Layer 7 - 7.5YR7/4
Layer 8 - 7.5YR5/4
Layer 5 - 10YR5/4
Layer 4 - 10YR5/4
Layer 3 - 10YR5/4

Figure 20
Mesa Verde, Cliff Palace 5MV0625: Kiva Q: Finishes Analyses

Sample 43 and 41 Lower Pilaster

Sample 40 and 38 Upper Pilaster

Sample 46 Upper Interpilaster Wall

Reflected Light
Magnification 12x

Polarized Light ||

Morphometric Analyses

Ratio of Matrix to Aggregate
Sample 41

Munsell Colors
Layer 4: 10YR/7/4
Layer 3: 5YR/4/4
Layer 2: 7.5YR/5/3
Layer 1: 10YR/4/4

2: 1000
1: 500
0.5: 100

Aggregate Grain Size Distribution of Layer 1 from Samples 3, 41, 46 and 38

Munsell Colors
Layer 3: 10YR/6/1
Layer 2: 7.5YR/5/3
Layer 1: 10YR/4/4

R = 0.9831

Ratio of Matrix to Aggregate of Leveling Plaster
Samples 3, 41, 46 and 38

Munsell Colors
Layer 2: 10YR/8/1
Layer 1: 10YR/4/4

Figure 21
combination of two or more colored finishes delineating the banquette and pilasters from the upper interpilaster walls. In Scheme 3, spatial delineation has been elaborated through the use of a highly contrasting red dado and white field including the pilasters and upper walls. During Schemes 4, 5 and 6, a heavy black soot deposit was retained or intentionally smoked to create a uniform black upper inter-pilaster wall that was incorporated into the red and tan schemes. Unlike the telltale evidence of hand-application of the plasters and washes, these black-sooted areas are smoke-deposited and reveal no manual manipulation. The last (most recent) scheme (Scheme 6) is an unusual vertical bi-chrome treatment of the banquette into pink and tan hemi-circles created by the selective refinishing of the southern half of the kiva. The precise division and intent of this refinishing is evident in the clear termination of the applied wash through the center of the niche on the eastern banquette.

First (earliest) scheme:
The first scheme is a simple, full finish monochrome application. It consists of a thick brown (10YR4/4) leveling plaster that was applied all over. This scheme was probably extant for a short time as very little if any soot was found between the leveling plaster and the next finish layer.

Second scheme:
The banquette and entire pilasters were next finished with a very pale brown (7.5YR 5/3) wash. Inter pilaster upper walls retained the brown plaster of the first scheme thus creating a complex bichrome scheme. Partial diagonal red (10YR 4/8) bands on the upper banquette walls were also found as discrete embellishments on this layer.

Third scheme:
The banquette was subsequently divided into a lower red (5YR5/6) dado with grouped fingertip embellishments extending into the white (10YR8/1) field above. Entire pilasters and upper inter pilaster walls were finished white as well. The deflector displays the same red plaster with a fragment of a small rectangular niche centered on the inward (east) face. Evidence of embellishments of red triangles at the border of the dado on the white field was also found on the deflector.

Fourth scheme:
The banquette and pilasters next received an overall red wash (5YR 5/6) similar to the color of the previous dado of Scheme 3. The upper inter pilaster walls were blackened with a thick
layer of soot that appears to have been consciously retained or created as part of the scheme.

**Fifth scheme:**
The banquette and lower pilasters received a light brownish pink (10YR 7/4) wash. The upper pilasters and inter pilaster walls remained sooted black. Embellishments of two red (10 YR 6.5/4) painted handprints on Pilaster 3 and a white animal paw print on the dado below were also applied.

**Sixth scheme:**
Scheme 6 is Scheme 5 modified into an unusual hemi circular bi-chrome design by the application of a tan (7.5YR7/4) wash to the southern half of the kiva, dividing the space in half directly through the central niche on the eastern banquette wall. The northern half retains its slightly sooted earlier finish from Scheme 5. The interpilaster walls and upper pilasters remain sooted black. The southern niche retains its is red plastered interior from the fourth scheme.

**Fabric Analysis**
Quantitative analysis of the micro fabric of the plaster finishes of Kiva Q reveals both similarities and differences between layers. This is evident in the ratio of matrix to aggregate and the arrangement, size, shape and frequency of individual particles and voids within the layers as a whole, and within features themselves.

The ratio of the matrix to the aggregate is expressed in Figs. 20, 21, and 23. Fig. 23 indicates the percentages of matrix, aggregate and voids. The ratios determined for the leveling plaster (Layer 1 on most samples) reveal the highest percentage of aggregate to matrix of all the layers. With the exception of Layer 7-Sample 1, all other wash layers display a higher matrix to aggregate ratio. This confirms the distinction between plasters and washes based on the mineral matter ratio. Further analysis of the leveling plaster samples (Samples 3, 38, 41 & 46) suggest two types of leveling plasters. That on the upper walls of the kiva has a nearly equal ratio (1:1) of aggregate to matrix while the plaster on the lower walls has a higher ratio (greater percentage of aggregate). This anomaly was observed in most kivas and may be due to differential weathering of the matrix in the upper areas.

The aggregate grain size distribution patterns for the layers have also been plotted and superimposed with a representative best-fit curve (Figs. 20 & 21). The aggregate is generally
a fine sand and the grain size distribution shows a similar exponential distribution pattern; the washes possessing the best sorting. The differences in the graphs are mainly in the amount of aggregate in each layer, which can be explained by the variable thickness of the layers and therefore more mineral material.

The shape factor of an aggregate is the ratio of an aggregate’s area to the area of a circle with an identical perimeter. Effectively, this is a measurement of an object’s “roundness” on a scale from 0 (straight line) to 1 (perfect circle). Image analyses reveals that the average shape factor of the aggregate found in each consecutive layer (Samples 1 & 3) varies between 0.43 – 0.68 (Fig. 23). The boundaries or perimeters of the aggregate from each plaster layer were also measured and an average of the perimeter of the aggregate for each layer was derived. In the plaster layers from Samples 1 and 3, the perimeter of the aggregate varies between 140μm - 500μm. While the visual change from the aggregate to the matrix is abrupt, many other changes are gradual or diffuse such as calcification. Clarity depends on the magnification. The average perimeters of the aggregate from the leveling plasters in Kiva Q further suggest that there are two types. The lower wall plaster consists of an average of smaller perimeter size aggregates. A small fraction of the lower wall aggregate tends to be rounder than that found in the upper walls. This similarity in type is confirmed also by a higher ratio of aggregate to matrix in the lower walls. (Fig. 23).

Finally, the aggregate is found to be anhedral (mineral without crystal faces) and irregular with very few subhedral (crystal faces) grains. This may suggest that the aggregate was artificially prepared by grinding and possibly sieving to create the desired grain size.

Qualitative X ray diffraction (XRD) analysis identified the matrix of the red and brown plasters and washes as kaolinite and illite/smectite with calcite, feldspars and hematite. Red earth mineral pigments may have been mixed into the soil to enhance the color for certain washes. The matrix of the white colored washes was identified as gypsum, although other white pigments such as calcium carbonate and kaolinite have been found at other sites used alone or in conjunction with gypsum. Tan, buff and pink layers were also found to contain gypsum, however this could be the result of post-application contamination from ground water.

XRD revealed that the aggregate found in the plaster and washes is mainly quartz and plagioclase feldspar. (Slater 1999, p.58) Traces of nitrate sulfur were also found confirming the use of gunpowder in the late nineteenth century to blast open areas of the ruin during early pot hunting expeditions. Organic matter such as plant fibers and charcoal, crushed
<table>
<thead>
<tr>
<th>Kiva Q</th>
<th>Layer 3</th>
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<th>Layer 5</th>
<th>Layer 6</th>
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<td>78%</td>
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<tr>
<td>Aggregate</td>
<td>19%</td>
<td>22%</td>
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plaster and sandstone have also been found in leveling plasters, banquette tops, and bedding mortars. This is most likely midden material in the mud sources used either intentionally or through contamination during mixing.

3.6.2 Kiva K

Kiva K has been analyzed and treated for the last two years by several researchers. The following observations are a combination of past and present field investigations, previous unpublished research (M. Slater, 1999) and current analysis. After initial field investigation, representative samples from the major architectural elements of the kiva: lower banquette wall, pilasters, and upper inter-pilaster walls were selected for further study. (Figs. 24 & 25).

Architecture

Kiva K is a small irregularly shaped kiva. Architectural features including plaster finishes are largely intact. The masonry is extremely irregular in construction. The stones are largely unfinished and semi-coursed with large boulders used in the base of the east wall and on the north and south walls flanking the west recess. These are most likely fallen alcove rubble that was worked into the wall construction. The stones used to top the banquette are large thin leveling slabs. The pilasters are the most refined masonry, shaped, coursed and battered back as retaining buttresses for the irregular upper walls. Each upper inter-pilaster wall panel is constructed differently: coursed tabular to uncoursed, semi-coursed large irregular stones. Banquette tops possess thick (1.5”-2.25”), coarse light brownish gray plaster (10YR 6.5/2) with fragments of shale (crushed), bone, small pebbles and charcoal, all possibly midden material.

Kiva K was first recorded by Fewkes (1911, 57) and described as “the finest [kiva] in Cliff Palace and in some cases the most exceptional,” apparently for its jacal deflector. Fewkes replastered the deflector and stabilized the upper walls. Additional Morris-Lancaster (1934) and modern repairs are evident along the wall’s top stone course and in the recess.

Surface Finishes-Stratigraphy

The finish schemes for Kiva K are not very complex; finishes appear only on the banquette and front faces of the pilasters, taken to the height of the pilasters and across boulders adjacent to the pilasters, and in the recess. Black soot covers the upper inter-pilaster walls, probably more as a function of space heating than the deliberate incorporation of a black-sooted surface into the overall scheme as in Kiva Q.
Mesa Verde, Cliff Palace 5MV0625: Kiva K Finishes Analyses

Sample 19 Banquette

Sample 27 Pilaster ‘Front

Sample 24 & 23 Pilaster Side and Interpilaster Wall

Reflected Light
Magnification 12x

Polarized Light ||

Morphometric analyses

Figure 24
Figure 26
After initial investigation representative samples from the banquette, pilasters, and inter pilaster walls were taken. The sample from the banquette (Sample 19) consists of eight layers. In contrast, the pilaster faces (Sample 27) display only four layers, and the inter pilaster walls have only two finish layers (Samples 23 & Sample 24). The first layers of all the samples are plasters. Plaster layers and later washes are clearly separated by soot. Thicker soot layers are found on the pilasters and inter pilaster walls. (Figs. 24 & 25).

Interpretation of the finishes has suggested at least seven schemes. This confirms and extends the on-site investigation. Four schemes can be considered as main schemes, and three schemes can be interpreted as transitional phases. Simple plasters and washes were applied to the banquette and pilasters. In contrast, the upper interpilaster walls were left sooted after the first scheme. As in other kivas, the earliest schemes are monochromatic browns (Schemes 1-4); the later schemes may have incorporated a white dado and aura around the niches. Important shield figures are inscribed along the uppermost zone of the banquette. The most recent scheme (prior to abandonment) incorporates white/yellow pilasters and a white/yellow aura around the east niche combined with a light brown wash on the banquette. A conjectural sequence of schemes was made in gouache based on the Munsell color match of each layer (Fig. 26).

**Scheme 1:**
The first scheme was a simple light brown (7.5YR 6/4) leveling and finish plaster applied irregularly to the top of the walls and to the banquette tops and the recess floor. Sufficient soot evidence was found on this layer to suggest exposure as a first finish.

**Scheme 2:**
The banquette, recess-walls and recess floor were selectively refinished with the same light brown (7.5YR 6/4) wash as in the previous scheme. The pilasters and upper inter-pilaster walls were not refinished.

**Scheme 3:**
The same light brown (7.5YR6/4) wash was applied again as a wash to the banquette and pilaster fronts. The pilaster sides and upper-inter pilaster walls were not refinished and left sooted.
Scheme 4:
The banquette, recess-walls and recess floor were selectively refinished with the same light brown (7.5YR 6/4) wash as in the previous scheme. The pilasters and upper inter-pilaster walls were not refinished.

Scheme 5:
A tan (10YR7/3) wash was applied selectively to the banquette and pilaster fronts. The pilaster sides and upper-inter pilaster walls were not refinished and left sooted. A yellow-white (2.5Y7/3) dado and niche aura may have been applied during this or subsequent schemes making this the first complex full finish in Kiva K. The banquette tops and recess floor retained the earlier brown wash. Niche 1 (east) was fully plastered light brown inside.

Scheme 6:
The same light brown (10YR7/3) wash was applied to the banquette, banquette tops and recess floor only. The pilaster sides and inter pilaster walls were again left black with soot. Niche 1 (east) was fully plastered light brown inside. A yellow-white (2.5Y7/3) dado and niche aura may have been applied or continued during this period.

Scheme 7:
The same light brown (10YR7/3) wash was applied to the banquette, banquette tops and recess floor only. A yellow-white (2.5Y7/3) wash may have been applied as a dado and niche aura and to the pilasters during this period. Shield figures were inscribed along the uppermost zone of the banquette in the brown plaster as well.

The upper inter pilaster wall was repointed after an episode of burning due to the evidence of heavy carbon soot accumulation on the upper wall stones and not on the mortar. The sooted plaster of the banquette and boulders was covered by a last thin red wash. This suggests that Kiva K was repaired in the last campaign.

Fabric Analysis
Quantitative analysis of the micro fabric of the surface finishes of Kiva K reveals both similarities and differences between layers. This is evident in the ratio of matrix to aggregate and the arrangement, size, shape and frequency of individual particles and voids within the layers as a whole, and within features themselves. The thickness of the washes averages between 200μm – 450μm while the leveling plaster is thicker, varying between 500μm-1cm. Most of the aggregate is found to be anhedral, irregular, and very few grains are subhedral.
The ratio of the matrix to the aggregate is expressed in Fig 24. This indicates the percentages of matrix, aggregate and voids. The ratios determined for the leveling plaster (Layer 1 on most samples) reveal the highest percentage of aggregate to matrix of all the subsequent layers. With the exception of the last layer (Layer 7-Sample 19), all other wash layers display an equal ratio (1:1) of matrix to aggregate. This confirms the distinction between plasters and washes based on the mineral matter ratio. Further analysis of the leveling plaster samples (Samples 19, 23 & 27) also suggest two types of leveling plasters as in Kiva Q. That on the upper walls of the kiva has a nearly equal ratio (1:1 aggregate to matrix) while the plaster on the lower walls has a higher ratio of aggregate to matrix.

The aggregate grain size can be best described as a fine sand. Aggregate distribution patterns for the plaster and wash layers in the various samples of Kiva K are illustrated in Fig. 25. The grain size distribution of Samples 19 and 27 shows similarities for all layers and is generally well sorted.

Qualitative analysis with XRD identified the matrix as kaolinite (7:10), illite (2:10), a mix of illite and smectite (1:10) and a negligible amount of calcite (Austin 1999). The aggregate was identified from most abundant to least abundant as: quartz, clay, calcite, dolomite, and orthoclase feldspar. Macroscopically, organic matter such as vegetable fibers, charcoal, and bone were found in the leveling plasters and mortars only.

3.6.3 Room 121

Room 121 has not been previously analyzed. It was treated in 1998 due to emergency conditions. Samples removed at that time were subsequently analyzed during this study.

Architecture

Room 121 is a unique upper room in a four-story room block (not tower) enclosed by three masonry constructed walls and the natural rock of the alcove. The space is the most intact complex, fully finished room at Cliff Palace and contains among the best known examples of ancestral puebloan wall painting in the Mesa Verde region. The finishes are both prehistoric and reconstructed (1934). The south wall finish is original, the west wall finish is approximately 40% original (south end) and 60% reconstructed (north portion), the north wall finish is approximately 50% original (east half) and 50% reconstructed (west half), the east wall finish is approximately 80% original except for the upper 20% which appears reconstructed. Only one scheme was applied.
The walls are of irregular, semi-coursed masonry with a leveling coat of extruded smooth mortar averaging 1-2cm thick, being thicker at the lower wall. The reconstructed finishes are comprised of a thicker plaster with thinly applied red and white washes imitating the original design. These occur only on the 1934 repairs of the northwest corner. The original mural painting was never treated.

The earliest images of the mural paintings in Room 121 of Square Tower are by Nordenskiöld (1893, 110, Fig. 78) and McKee (1898). The loss of the entire northwest corner required Fewkes to repair the masonry up to the third story allowing visibility of the painted interior (1911, 32, Pls. 12 & 13). Fewkes’ 1908 repair was later removed and the entire corner rebuilt by Morris and Lancaster in June and July of 1934 adding conjectural doorways on the fourth story north and west elevations. The lost plaster and mural painting flanking the northwest corner was reconstructed at this time as well. All new masonry was set in cement and the surfaces pointed or plastered with “mud to match original walls”. The Tower was closed to visitation after World War II.

**Surface Finishes-Stratigraphy**

The complex, full wall finish consists of a bi-chrome scheme of a red (10R4/8) dado on a white (2.5Y8/1) field with repetitive and discreet embellishments including groupings of three red triangles separated by a red fingertip border at the dado top, a series of discreet red horizontal and vertical lines in the field, and a red bi-fold rectangular panel separated into two halves by a finger-tip bordered vertical bar with 4 zigzag vertical bands in each half on the south wall. The west wall consists of a small square window and a partial reconstruction of the painting including three sets of three triangles with a fingertip border. Only the first three triangles are original.

Wash overlap indicates that the white field was applied first, then the triangles and the fingertip border last. The top edge of the dado and the triangles’ perimeters were clearly finger applied indicating an outlining technique to create precise forms and lines. In the horizontal panel, directional striations and thickened areas of application were also found identifying the order of the application of the painting beginning with the layout of the panel perimeter, followed by the interior zigzag bands applied from top to bottom. Surface characteristics of the overall finishes in Room 121 exhibit distinct application striations made with the hand.
Evidence of old impact cuts or slashes were observed almost exclusively on the triangles and the zigzag panel. This appears in the earliest photographs and may well be ritual defacement associated with disempowerment of the symbols or space.

Representative samples were selected for subsequent examination in 2001-02. Samples were found to have only two to three layers depending on the location (Fig.27).

Only three colors were found in Room 121. A conjectural plaster finishes scheme was made in gouache based on the Munsell color match (Fig. 28-Conjectural Finishes Scheme).

**Fabric Analysis**

Quantitative analysis of the micro fabric of the surface finishes of Room 121 reveals similarities between the red and white wash layers. This is evident in the ratio of matrix to aggregate and the arrangement, size, shape and frequency of individual particles and voids within the layers as a whole, and within features themselves. The thickness of the washes averages between 200μm –450 μm while the thickness of the leveling plaster is greater, varying between 1 - 3 cm. Most of the aggregate was found to be anhedral and irregular, very few grains are subhedral. The plaster and wash layers are not separated by soot confirming a synchronic application.

The ratio of the matrix to the aggregate is expressed in Fig 27. The ratio determined for the extruded smooth mortar (Layer 1 on most samples) indicates the highest percentage of aggregate to matrix of all the subsequent layers. The wash layers in contrast display an equal ratio (1:1) of aggregate to matrix, thus being binder rich. This confirms the distinction between plasters and washes based on the mineral matter ratio.

The aggregate grain size and grain size distribution patterns for the plaster and wash layers in the various samples of Room 121 are illustrated in Fig. 27. The aggregate grain size is finer for the washes, however similarities in distribution pattern for all layers indicate a well sorted distribution.

No qualitative analysis was done on the finishes of Room 121.
Mesa Verde, Cliff Palace 5MV0625: Room 121 Finishes Analyses

Sample Location

Sample 2 White Field

Reflected Light  Polarized Light || Polarized Light X Morphometric Analyses

Sample 4 Red Dado

Reflected Light  Morphometric Analyses
Magnification 12x

Figure 27
Room 121: Conjectural Finish Scheme

North Wall

East Wall

West Wall

South Wall
3.6.4 Room 64

Architecture

The exterior façade of Room 64 is finely constructed with well-shaped, dressed and coursed masonry and displays a complex, full finish scheme. The façade contains a large central doorway with loopholes flanking the opening. The exterior of Room 64 originally extended uninterrupted to Room 59 to the south creating one large exterior wall. This was later divided by the cross-wall between Kiva R and the court of wall 67. Kiva R was also constructed after Room 64 because the wall plaster extends behind the kiva’s rear wall. Kiva R appears never to have been roofed.

The earliest published view of the exterior of Room 64 is that by Nordenskiöld (1893,63-Fig 36).

Surface Finishes-Stratigraphy

The exterior was finished with a complex, full finish scheme composed of a red leveling plaster followed by a red wash. The large battered doorway was articulated with a gray aura. The inner doorjamb reveals were red plastered. The exterior walls of Room 64 and 59 display clear evidence of the multiple application of mud balls in gray, white and yellow mortar and handprint smears. Incised pictographs of birds and a T-shaped doorway were also documented. Evidence of the application of mud balls are found elsewhere at Cliff Palace on the nearby façade of Speaker Chief House and on the cliff walls and roof behind Room 64. According to Sally Cole, rock art specialist, applications of mud as hand swipes and mud balls are still used by the Hopi today to mark and bless houses as well as individuals, e.g., women pelt grooms before marriage at home. Mud ball evidence is also found at several open rock art sites associated with figures in the area. This phenomenon is unique to the Four Corners region and according to Cole has not been found elsewhere.

Room 64 had not been previously analyzed. After initial field investigation, representative samples from the wall field, aura, and mud ball smears were selected. The wall was found to possess two red layers including the leveling mortar. The auras were applied in two campaigns--gray and yellow--directly on the red plaster. Surface characteristics of the finishes in Room 64 exhibit very little application striations made with the hand. Only three colors were found in Room 64. A conjectural plaster finishes scheme was made in gouache based on the Munsell color match. (Fig. 29 Conjectural Finishes Scheme).
Fabric Analysis
No qualitative analysis was done on the finishes of Room 64. Visual examination revealed that the plaster and wash layers are not separated by soot. This may suggest a single campaign, however it would not be likely for an exterior wall to display soot accumulation unless in association with an outside hearth as is sometimes found in open areas. The two aura colors at least suggest that the aura was reapplied and its color changed. A conjectural plaster finishes scheme was made in gouache with the actual Munsell color. (Fig. 30 Conjectural Finishes Scheme) The thickness of the plaster finishes layers averages between 200 μm – 450μm. The thickness of the leveling mortar varies but is greater, measuring between 500μm –1cm. Most of the aggregate is anhedral and irregular, very few grains are subhedral.
Mesa Verde/ Cliff Palace 5MV0625: Room 64 Finishes Analyses
Sample Location

Sample 1  Aura
Sample 2  Tan Mud Balls
Sample 3  Grey Mud Balls
Sample 6  Leveling Plaster & Red Wash

Reflected Light
Magnification 12x

Figure 29
Room 64: Conjectural Finish Scheme

Figure 30
4.0 CONSERVATION TREATMENTS

4.1 Objectives

Since 1994, Mesa Verde National Park and the Architectural Conservation Laboratory of the Graduate Program in Historic Preservation at the University of Pennsylvania have been developing and implementing a remedial and preventative conservation program for the architectural surface finishes. In 1998, conservation treatments were initiated on selected plasters and washes in Cliff Palace and Long House. The objective was twofold: to stabilize imperiled prehistoric and historic architectural finishes to prevent further loss of fabric, and to provide training to graduate architectural conservation students in the treatment of archaeological sites and in earthen materials. Treatment of selected areas started in 1998 and was completed in 2001. Treatment options were also evaluated according to their cultural appropriateness through tribal consultation. A separate but related laboratory-testing program for the development and evaluation of reattachment methods was also conducted from 1998-2002.

Conservation treatments in Cliff Palace were designed and implemented as part of the University of Pennsylvania Conservation Summer Field Program under the direction of Frank Matero, Project Director. Additional supervisory assistance was provided by Jeanne Marie Teutonico, Associate Director, The Getty Conservation Institute, Kathy Fiero, Stabilization Archaeologist, Mesa Verde National Park (NPS staff), Angelyn Rivera, Architectural Conservator, Mesa Verde National Park, Mary Slater, Architectural Conservator, Mesa Verde National Park, Kecia Fong, Architectural Conservator, University of Pennsylvania, and Rynta Fourie, Architectural Conservator, University of Pennsylvania.

4.2 Selection of Treatment Areas

Treatment areas were selected based on their high priority rating during a recent park-wide conditions assessment undertaken in 1998 and 1999 (see Fig. 4). The aim of the assessment program was to establish a prioritized treatment schedule for the remedial care and long-term preventive conservation of the architectural finishes in at least 18 significant alcove sites, and to provide a strategy for management in planning and budgeting for future conservation work. According to the Interim Report, Architectural Finishes Treatment Priority Assessment, Mesa Verde National Park, 1998-1999, the following high priority areas in Cliff Palace (5MVO625) were selected for treatment:
Kiva H
Kiva J
Kiva K
Kiva N
Kiva Q
Open Area J: Exterior facades rooms 25, 26, 27
Open Area M and Open Area 6: Exterior facades rooms, 40, 41, and 42
Open Area R: Exterior façade room 64
Open Area 42: Room 58
Open Area 25 and Open Area 26: Speaker Chief House: Exterior facades of rooms, 70, 71, 72
Room 121: Square Tower

4.3 Treatment History

During 1998-1999 a treatment-testing program was developed and implemented at Cliff Palace following prior treatment trials in Kivas C, E, and F and Room 28 at Mug House. The treatments at both sites were monitored every following year. At Cliff Palace, Room 121 of Square Tower was fully treated given its perilous condition, and treatment to Kiva Q was begun. (See Treatment-Report Conservation of Architectural Finishes, Mesa Verde National Park 1999, National Park Service, Mesa Verde National Park, Mary Slater and Angelyn Bass Riviera, October 1999). Pilot treatment tests for Kiva Q were partly unsatisfactory and further testing was done the following year. During summer 2000, Kiva K and Kiva Q in Cliff Palace received partial conservation treatment after thorough condition surveying and treatment testing during 1998 and 1999. Kiva K was fully treated during this period and Kiva Q was partially completed. During 2000 the gelatin treatment reattachment technique was expanded with good results. In the summer of 2000-2001, all high priority selected spaces in Cliff Palace were fully treated except for Kiva J due to structural complications from masonry decay. During the summer of 2001, previous treatments were again evaluated and their effectiveness was documented. Further treatment testing was performed to develop a suitable consolidation technique for unique conditions such as the red handprints in Rooms 40 and 41.
4.4 Prevalent Deterioration Conditions

Not every condition noted by the documentation team was treated. Only those conditions deemed active and resulting in loss of the finishes were addressed. The following conditions were treated:

- Plaster and wash reattachment of two types:
  - Thin layer delamination or flaking between multiple layers of wash or between the wash and the plaster with separation less than 2mm wide and with or without a heavily sooted layer.
  - Delamination between layers of wash or between wash and the plaster with a separation greater than 2mm wide, with or without a heavily sooted layer, and occurring primarily in blistered or deformed areas.

- Detachment and loss of plaster (lacunae) or washes from the masonry substrate.
- Cracked, loose or brittle mortar with plasters or washes attached.
- Surface deposits, especially soil wash and animal excrement.

4.5 General Treatment Methods and Materials

4.5.1 Thin Layer Plaster and Wash Reattachment

**Objective:** To re-establish adhesion between thin delaminated and flaking layers of wash or plaster.

**Description:** Reattachment with gelatin at 5% and 10% with 10% glycerin was used at various viscosities in a warm (body temperature) and cold (gelled) state. Occasional staining from the 10% warm treatments led to a modification of the treatment with a pre-treatment of cyclododecane (H12C24). This was found to be successful for thick, heavily sooted plaster layers of any thickness separation, with a blistered or deformed area greater than 5cm². Cyclododecane provides a temporary impermeable layer that prevents staining during treatment. It allows the adhesive to be injected between lifted plaster and either plaster or masonry substrates.

The 5% (w/v) gelatin solution with 10% glycerin was used to readhere delaminated washes on an earthen plaster substrate. The 5% solution was generally used unless stronger
adhesion was needed, in which case a 10% gelatin solution was used. The solution of gelatin with 10% glycerin performed well at adhering delaminated washes and plasters where the void was less than 2mm thick, and where washes were delaminated from each other or from the underlying plaster. The gelatin solution was not as effective in readhering or filling voids larger than 2mm wide, reattaching heavily sooted layers, and readhering washes or plaster to stone.

A material with stronger adhesive properties was needed to address problems of repeat delamination (lifting) and delamination of brittle finishes from sooted layers and stone. The materials chosen for testing were Rhoplex E-330, an acrylic emulsion, and Acrysol 6038A, a polyacrylate thickener designed for acrylic emulsion systems. These products proved to be unsuccessful due to surface staining. However, use of cold and warm gelatin treatment combined with cyclododecane has been successfully applied to the conditions described above.

**Application Method:** The area to be treated was first cleared of debris and dust with compressed air and/or a fine-bristle brush. In cases where heavy soot deposits were absent, the area was pre-wet to re-plasticize the finishes by spraying with either water or a 1:1 solution of water and isopropyl alcohol (non-reagent grade isopropyl alcohol, bottle strength of 70% in water). Fragile areas were first secured with Japanese paper and a water and isopropyl alcohol spray to temporarily secure them. Where soot deposits were evident, pre-wetting was avoided due to potential staining. The gelatin solution was then injected behind loose areas through a syringe fit with a #22 gauge needle for the warm gelatin and a #14 gauge needle for the cold gelatin. The larger needle for the cold gelatin allowed for controlled injection of the gelatin as placed droplets. After injection, the treated area was set in plane by applying slight pressure with crushed ice in a plastic bag combined with a cosmetic sponge and Hollytex® polyester fabric (or for larger areas, with Ethafoam®). Pressure was applied until the area was secure, usually less than 15 minutes. Depending on the degree of detachment and thickness of the layers, warm gelatin injection was prefaced by the application of cyclododecane to avoid staining. To apply, the cyclododecane is melted in a test tube and then applied with a bristle brush to the area to be reset. A heated spatula is placed over the applied cyclododecane surface. Warm 5 or 10% gelatin is applied and the surface is pressed down. Within two weeks the cyclododecane sublimates and all temporary darkening disappears (Figs. 31 & 32).
Mesa Verde / Cliff Palace 5MV0625: Gelatin Reattachment

Room 58

Before Treatment

During Treatment

After Treatment - Before Dry
Mesa Verde / Cliff Palace 5MV0625:
Gelatin Reattachment with Cyclododecane Pretreatment

Kiva Q

Before Treatment

During Treatment

After Treatment Before Sublimation

Figure 32
4.5.2 Injection Grouting

**Objective:** To repair plaster and mortar and to fill voids in the thicker plasters and joints. Grouting readheres detached plaster to the masonry substrate, stabilizes cracked, loose mortar, and fills voids greater than 2mm wide caused by loss of fabric or by deformation.

**Description:** A light-weight, low shrinkage grout composed of (parts by volume) 1 part Riverton hydrated hydraulic lime, 1 part ceramic microspheres, and 1/4 part fine sand, was chosen as an adhesive for larger scale reattachment, mortar stabilization, and void filling. The hydraulic lime-based grout was laboratory and field-tested for its physico-chemical and mechanical compatibility with earthen and lime-based materials. The hydraulic lime binder in the grout is compatible with the prehistoric earthen plasters and mortars made from soil. In addition to hydraulic lime, clay (kaolin) was also laboratory tested as a possible grout constituent, but was found to cause excessive shrinkage, well beyond acceptable limits for field use.

**Application Method:** Areas of large-scale detachment, deep cracks in the masonry mortar, and blind voids behind plasters were determined by visual examination and by tapping on the surface of the plaster and listening for a hollow sound. Areas where plaster fragments were loose and in danger of failure were faced with silk crepeline adhered with a 5% (v/v) solution of polyvinyl alcohol (PVOH) in water. After voids were delineated, cracks and other openings were gently blown free of loose debris with compressed air and then flushed with minimal water. Flushing with water served to reduce premature drying of the grout, remove debris, and rehydrate the earthen materials. Any openings along plaster edges and cracks were then temporarily dammed with cotton. For large cracks and open joints in the masonry requiring grouting, 3/8”-1/2” closed cell polyethylene backer rod was used instead. Before injecting the grout, 10% Rhoplex E-330 in water was injected into the voids to aid in bonding the grout to the wetted earthen substrate and masonry.

The dry grout formula ingredients (hydraulic lime, ceramic microspheres, and fine sand) were mixed with water at an approximate volume ratio of 2:1 (dry ingredients to water) at high speed in a blender for approximately 3 minutes to the consistency of heavy cream. The grout was then injected into voids through a #16 gauge steel needle-tipped syringe. Where

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possible, grout was injected behind the plaster through existing cracks and losses. After grout injection, loose areas were held in place by hand until the area was stable. This usually occurred in less than two minutes.

After grouting, the cotton or backer rod was removed from the cracks and the crepeline facing was removed with water-isopropyl alcohol. Any slight staining left by the PVOH facing adhesive was cleaned by repeated swabbing with warm water and a cosmetic sponge.

4.5.3 Edging and Compensation

Objective: To support broken plaster and fill plaster and masonry losses. Edging provides physical support and waterproofing for plaster that is broken, undercut, or displaced. Compensation returns visual continuity and integrity to areas of loss.

Filling and edging treatments were performed with selected sieved soils from the park mixed with 5% acrylic emulsion or water alone. Acrylic amendments were used in those areas of high water penetration such as recess floors and banquette tops. Fragile and disaggregated mortar in areas of water run off and penetration was consolidated with 5% acrylic emulsion. Large lacunae were filled, recessed and visually matched to the general plaster, mortar or stone color depending on the context. If the lacunae were in the plaster, generally the lower layer colors were matched. Fills were recessed approximately 1/8” -1/4” deep and all edging was detailed to be as visually unobtrusive as possible. Where necessary, watersheds were provided to protect the plasters from rain and snowmelt, especially on the banquette tops and upper banquette walls.

All fills were prepared with sieved local soils and color matched using the coupon palette of local red, yellow, and gray soils. Color reintegration of the interior red dado and white field in Room 58 was done with calcium carbonate (whiting) and local soils to visually reintegrate Fewkes’ repair in this otherwise intact interior.

Description: Many areas of plaster had broken along the upper banquette walls. Local soils were selected as the edging material of choice because they were visually and physically compatible with the finishes in situ. Soil was sieved through a kitchen sifter (comparable to U.S. Standard Sieve No. 18, passing particles ≤ 1 mm) and mixed with water alone or with 10% (v/v) Rhoplex E-330 (see above) to a relatively dry, cohesive consistency. This resulted in a firm cohesive material that displayed low shrinkage and no cracking. The soil mixtures were applied with tools and fingertips to the bottom edge of unsupported plasters, creating a
bridge between the plaster and the underlying stone or other plaster layers. Some cracks in
the wall plaster were filled first as earthen dams during grouting and as a void compensator.

In Room 121, large areas of plaster loss and large cracks (>3mm wide) were filled to provide
stability in both the prehistoric and reconstructed areas. Earthen fill formulations were
carefully evaluated to be visually compatible in color and texture with the existing finishes and
to have the desirable characteristics of workability and low shrinkage and cracking. To repair
the 1934 restoration work, test coupons consisting of locally collected soil with varying
proportions of water, hydrated (Type S) lime, and 10% Rhoplex E-330 were mixed, formed
and allowed to dry. Lime was added to modify strength and color; Rhoplex was added to
increase bond strength. Formulations containing the Rhoplex E-330 were very hard and
tended to pack unevenly and were thus rejected as a fill material. The hydrated lime
increased the workability of soil formulations, decreased the proportion of water needed to
make a cohesive mortar fill, and increased the hardness. However, soil mixes containing
lime were not always visually compatible with the earthen materials in situ. Consequently, a
10% (v/v) hydrated lime soil mix was used to fill large voids, and then the simple soil mix was
applied as a finish layer. In the reconstructed portions of the walls, fills were colored with a
lime wash matching the surrounding finish; in the prehistoric portions, the unamended soil
mix was left plain.

**Application Method:** Plasters were edged by applying the soil using fingertips and
microspatulæ. The edging was then textured with a dry natural bristle brush when
thumbprint hard to match the surrounding material. Large areas of plaster loss were
compensated by filling the lacunæ with several layers of earthen fill. The masonry and
plaster edges of the area of loss were first treated with a 10% (v/v) Rhoplex E-330 solution
brushed on to act as a bonding agent for the earthen fill. Two to three layers of a 10% (v/v)
hydrated lime soil mixture were applied using microspatulæ and a rubber spatula, then
scored with a microspatula to create keys for the next coat of earthen fill. The Rhoplex E-330
bonding agent was brushed on to underlying coats before the next coat was applied. The
final coat was a mixture of local soil and water applied in the same fashion as the previous
coats, then textured with a wet sponge or a dry natural bristle brush. Smaller voids and
cracks were filled in one coat with the simple soil mixture. The fill was applied to these small
areas with microspatulæ, wooden skewers and dental picks, then textured with a dry brush.
In places where the reconstructed plaster was covered with a white finish, a weak lime wash
was applied to the earthen fill to better match the color of the surrounding area. All fills were
recessed slightly below the existing finish level. (Figs. 33 & 34)
Mesa Verde / Cliff Palace 5MV0625: Fills

Kiva H

Before Treatment

After Treatment

Before Treatment

During Treatment
Mesa Verde / Cliff Palace 5MV0625: Edging

Speaker Chief House

Before Treatment

During Treatment

After Treatment

Figure 34
Room 58
Mesa Verde / Cliff Palace 5MV0625: Mechanical Cleaning - Soiling

Before Treatment
During Treatment
After Treatment
Mesa Verde / Cliff Palace 5MV0625: Visual Reintegration

Room 58

Before Treatment

During Treatment

After Treatment

Figure 37
Mesa Verde / Cliff Palace 5MV0625: Floor Protection

Surface Levelling

Geo-fabric Lining

Sand Fill
4.5.4 Cleaning

Objective: To remove unwanted deposits resulting from soil wash, animal activity and conservation treatments.

Description: All deposits were removed mechanically by dry brushing (for soil wash) and with wooden and plastic tools (for animal excrement) and occasionally scalpels for removal of soil-cement repairs. In Room 121 a selected area of the original red finish on the south end of the west wall was swabbed with equal parts of water and 70% isopropyl alcohol to remove accumulated dust and debris. Soil wash was removed primarily in order to monitor water flow over the surfaces (Figs. 35 & 36).

4.5.5 Floor Protection

Objective: Temporary protection of earthen floors from foot traffic and accidental impact during conservation treatments. Floor protection was left in place to provide long-term protection.

Description: Gently sweep the floor. Remove excess soil and debris; retain and label all fallen mortar and finishes. Photograph and prepare simple written descriptions of the earthen floors. Note all the features and general condition. Features such as sipapus, hearths, etc. are lined first with muslin and prefilled with sand for support. The floor is then lined with a water permeable geofabric for protection followed by a 2-3” level layer of clean sand placed on top (Fig. 38).
4.6 Individual Treatment Reports

4.6.1 Kiva Q
Treatment Date: Summer 1998-2001

Physical Condition

- The finishes in the northwest quadrant were considered to be in poor condition, where at least 80% of the remaining fabric was actively deteriorating. The area exhibited the following conditions:
  - Delamination and flaking of the washes from the plaster ground
  - Disaggregation of the washes, particularly red washes
  - Deformation and blistering of the washes
  - Detachment of plaster from the masonry
  - Accumulation of pack rat excrement in dark, sticky patches on the surface, which is cracked and lifted and which obscures the appearance of the finish
  - Active loss, evidenced by numerous fragments of the finish found on the kiva floor, ranging from tiny flakes to whole pieces <10cm²

- Finishes in the remainder of the kiva exhibit the following conditions:
  - Delamination of washes from each other and the plaster ground
  - Detachment of the plaster from the masonry
  - Active loss, evidenced by numerous fragments of the finish found on the kiva floor, ranging from tiny flakes to whole pieces <10cm²

Recent Treatment History
The kiva finishes have been temporarily stabilized in situ in the past (at least five times) by attempting to rehydrate and reattach layers with water only, or by stabilizing the surface by facing with Japanese tissue and dilute solutions of PVOH in water. Since 1994, the treatments have had the same outcome: continued flaking and delamination of areas reattached with water within a year or less of treatment, and detachment of the facing over time due to deterioration of the weak adhesive. In 1997, infilling and reattachment of discrete larger voids (>2mm wide) was undertaken by using a hydraulic lime grout. These treatments proved successful in stabilizing loose fragments without the need for further treatment, but did not address localized flaking and thin layer delamination. In 1998, 5% and 10% gelatin solutions were injected behind delaminating and detached finishes. Like past treatments, the gelatin solution failed within a year, resulting in lifting and cracking in the treated areas.
In 1999 a thickened acrylic emulsion developed and tested the year before was used to treat delamination, blistering and flaking of the finishes. The treatment was unsuccessful in reattaching thin layers and caused a slight darkening of the surface. The cold and warm gelatin test treatments combined with cyclododecane had good results and were implemented.

**Treatment Record**

In June 1998, thin layers of delaminated wash were reattached with 5-10% (w/v) solution of gelatin in water with 10% glycerin. The 5-10% gelatin treatments were generally effective in reattaching blistered and delaminated earthen finishes. Blisters and deformations set back into plane with the banquette are well adhered. Adhesion tends to be poor where thick plaster layers are detaching. The gelatin improves cohesion of the finishes, even where adhesion is poor. The 10% gelatin tends to stain and is best used with a cyclododecane barrier.

Two grout formulas, one hydraulic lime based and the other acrylic emulsion based, were field tested in discrete patches as possible treatments for reattaching delaminated washes with voids greater than 2mm wide (see below for treatment locations). Neither of the grouts was considered satisfactory for use in Kiva Q primarily due to localized saturation and discoloration of the surface. Following is a brief summary of the results:

1. Grouting with hydraulic lime grout composed of (by volume) 1 part hydraulic lime, 1 part of ceramic microspheres, 1/4 part fine banding sand, and 1 part water

   **Results:** injected grout did not fully fill the void and produced a localized stain on the surface. The area was partially cleaned by swabbing the surface with water.

2. Grouting with an acrylic emulsion grout composed of (by volume) 9 parts glass microspheres, 3 parts fine banding sand, 5 parts 20% (v/v) Rhoplex® E-330 in water, and 0.25 parts 33% (v/v) Acrysol® 6038A in water.

   **Results:** mixture segregated just after mixing (heavier sand particles settled to the bottom) making injection difficult. The solution did not fill the voids completely and produced localized discoloration of the surface. An attempt was made to clean the test areas by swabbing the surface with acetone and then with toluene; this met with...
limited success. It was not possible to poultice clean the treated area due to its extreme fragility.

The following tests were executed and the results reported:

- **Test Area A (hydraulic lime grout)**: Migration of pre-existing stain (rodent feces). Solid adhesion on the left side, loose on the right side near fecal stain.
- **Test Area B (acrylic emulsion grout)**: The blister set back into plane remains in plane. Cohesion of the plaster is improved, but adhesion is incomplete. Some staining.
- **Test Area C (acrylic emulsion grout)**: The fill is successful where it is present, some residual grout remains on the wall.
- **Test Area D (acrylic emulsion grout)**: Cohesion improved. Area feels softer than surrounding plaster.
- **Test Area E (acrylic emulsion grout)**: The fill is successful, but the area is stained.
- **Test Area F (acrylic emulsion grout)**: The fill is successful, and there is no staining.
- **Test Area G (acrylic emulsion grout)**: There is still some detachment, and the area is stained.

Treatments in 1999 were only conducted on the finish in the NW quadrant and consisted of:

- Photographic documentation before and after treatment
- Graphic documentation of conditions and treatments on photographs of the NW quadrant.
- Reattachment of flaking and delaminated washes with the thickened acrylic emulsion. Reattachment of a detached area with a modified thickened acrylic emulsion (1 part thickened acrylic emulsion, 1 part glass microspheres) designed to serve also as a void filler.
- Treatment during 2001 was a repeat of 1999 treatment.

Excrement deposited on the walls of Kiva Q from birds roosting on the wall tops and openings was removed mechanically using wooden tools and dental picks. Removal of repair mortars over original plaster and washes was mechanically removed with a surgical scalpel and stencil brushes. Removal of stained areas created by treatment tests during 1998 and 1999 was performed with a dry stencil brush.
Recommendations

- Kiva Q finishes are now stabilized, however the surfaces should be inspected and monitored annually to evaluate the effectiveness of conservation treatments. The cause of the recent masonry and finishes deterioration in the lower north wall appears to be related to moisture ingress from rain or snow on the exposed open area in the rear. The surface needs to be weatherproofed with a compacted lime- or cement-stabilized soil as done elsewhere at Cliff Palace. The kiva should be inspected and monitored annually to assess the conditions and treatments. Should exposed areas of the wall begin to delaminate, temporary seasonal protection similar to that developed for Kiva C, Mug House should be considered (Fig. 39).
Mesa Verde / Cliff Palace 5MV0625: Kiva Q Treatment

Cyclododecane treatment in Kiva Q.

Cyclododecane being melted for application.

Application of Cyclododecane.

Application of Cyclododecane with a brush.

Melting of Cyclododecane with a warmed spatula.

After gelatin injection pressure is applied to the detached plaster finish.

Figure 39
4.6.2 Kiva K

**Treatment Dates: July-August 2000-2001**

**Physical Condition**
- The plaster finishes were in poor condition, where at least 80% of the remaining fabric was actively deteriorating. The following conditions were observed:
  - Delamination and flaking of the washes from the plaster ground
  - Disaggregation of the washes, particularly red washes
  - Deformation and blistering of the washes
  - Detachment of plaster from the masonry
  - Active loss, evidenced by numerous fragments of the finish found on the kiva floor, ranging from tiny flakes to whole pieces <10cm²
  - Water staining of heavily sooted areas

**Treatment Record**
During 2000 Kiva K was treated completely. However after re-evaluation in the beginning of 2001 it was noticed that new areas along the rear upper banquette had delaminated while previously treated areas were sound. This was attributed to moisture penetration from water percolation at the rear of the alcove and was thus an active condition. Plaster delamination was also accompanied by active efflorescence and mortar decay.

During 2000 and 2001 the following treatments were performed:
- The interior of the room was photographed before, during, and after treatment in 35mm color slide and print film.
- Field and digital graphic condition survey was conducted on the interior walls and the finishes (2000).
- Blistering and delaminating areas of the red prehistoric wash were reattached with a 5% (w/v) gelatin solution with 10% glycerin treatment (2000).
- Loose fragments were stabilized by grouting with hydraulic lime grout (2000).
- Flaking and delaminating areas of the washes were readhered with the cold and warm gelatin revised treatment combined with cyclododecane (2001).
- Cracks and exposed edges were edged with acrylic-modified soil in "wet" areas.
- Losses were filled with lime-amended and non-amended soil mortar.
- Bird excrement was manually removed from the walls with dental picks.
Evaluation of 2000 Treatments

- The hydraulic lime grout was successful in filling voids and readhering loose and detached plaster.
- The 5% gelatin solution successfully readhered delaminating fragments of washes (Figs. 40-42).

Recommendations

- Kiva K finishes are now stabilized, however the surfaces should be monitored to evaluate the effectiveness of conservation treatments in the presence of active ground water infiltration. The kiva should be inspected and monitored annually to assess the conditions and treatments and plans should be made to rebury the kiva or install temporary environmental protection similar to the experimental shelter developed for Kiva C, Mug House.
Mesa Verde / Cliff Palace 5MV0625: Kiva K Treatment
Pilaster 1Sector 2A

Before Treatment

Figure 40
Mesa Verde / Cliff Palace 5MV0625: Kiva K Treatment

Sector 5A & 6A

Before Treatment 1998

After Treatment 2001

Banquette Shelf P2-3

Before Treatment 1998

After Treatment 2001

Figure 41
Mesa Verde / Cliff Palace 5MV0625: Kiva K Treatment

Sector 3A & 4A

Before Treatment 1998

Detachment at green arrows

After Treatment 2001

Detail of photograph above. One year after treatment new areas of detachment have been noted and were subsequently retreated. (green arrows)
4.6.3 Room 121

Treatment Dates: June 1998, July-October 1999

Physical Condition

- Both the prehistoric and 1934 restoration finishes were in fair-poor condition where at least 65% of the fabric was unstable and actively deteriorating.
- The restoration plaster was extensively cracked on the surface in patches and also cracked through the plaster to the masonry substrate.
- Numerous fragments of the restoration plaster, averaging 1–80cm², were partially detached from the substrate, and some had been lost. Fragmentation was associated with cracks. Detached and loose fragments were concentrated in the NW corner.
- The prehistoric portion of the east wall was uneven with fragments of plaster disrupted, cracked and loose.
- The red prehistoric wash was flaking, blistered, and delaminated in patches from the underlying plaster.
- Bird excrement streaks were numerous on the south and west walls (in evidence since the earliest photographs of the room in the 1890's).

Treatment Record

- The interior of the room was photographed before, during, and after treatment in 35mm color slide and print film (1998-1999).
- Field and digital graphic condition survey was conducted on the interior walls and the finishes (1998-1999).
- Blistering and delaminating areas of the red prehistoric wash were reattached with a 5% (w/v) gelatin solution with 10% glycerin treatment (1998).
- Loose plaster fragments in the NW corner (reconstructed portion) were faced with crepeline adhered with 5% (v/v) solution of polyvinyl alcohol in water (1998-1999).
- Loose fragments were stabilized by grouting with hydraulic lime grout (1998-1999).
- Crepeline facing was removed from the walls by spraying the surface with water, lifting the crepeline, and cleaning any PVOH residue with cotton swabs and water (1998-1999).
- Flaking and delaminating areas of the white prehistoric and historic washes were readhered with the thickened acrylic emulsion treatment (1999).
- Cracks and exposed edges were edged with acrylic-modified soil (1999).
- Losses were compensated with lime-amended and non-amended soil fills (1999).
- Bird excrement was manually removed from the walls with dental picks (1999).
Mesa Verde / Cliff Palace 5MV0625: Room 121 Treatment
West Wall Sector 2A & 2B

Before Treatment

After Treatment: Fills & Color reintegration

During Treatment

During Treatment: Grouting

During Treatment: Edging

After Treatment
South & West Wall

Figure 43
Mesa Verde / Cliff Palace 5MV0625: Room 121 Treatment
South Wall Sector 2A

Before Treatment

After Treatment

West Wall Sector 1B, 2A & 2B

Before Treatment

During Treatment: Grouting

After Treatment

West Wall Sector 2B

Before Treatment

After Treatment
• Bird deterrent systems (wire coils and a screen closure) were installed at the wall tops and openings (1999).

Evaluation of 1998 Treatments

• The hydraulic lime grout was successful in filling voids and readhering loose and detached plaster. (Grouting carried out in 1999 appears to be equally as successful.) The 5% gelatin solution successfully readhered delaminating fragments of washes in the red dado, and set blisters back into plane without staining. However, the gelatin solution did not effectively readhere flaking wash in the white field. Where the gelatin was applied, the brittle wash tended to flake and detach (Figs. 43 & 44). This was probably due to the low clay content on the white washes.

Recommendations

• While the thickened acrylic emulsion adhesive successfully readhered most areas of delaminating white field, slight staining resulted in some areas. More research should be conducted on acrylic emulsion-based adhesive treatments and their interaction with various architectural finishes.

• Room 121 should be inspected annually to evaluate the effectiveness of conservation treatments. The room should be periodically photographed to document changes in appearance over time. Bird proofing should be modified to reduce visual intrusion to the exterior architecture of Square Tower and checked periodically to insure effective prevention of bird access.
4.6.4 Room 64

Treatment Dates: Summer 2001

Physical Condition
- The prehistoric finishes were in fair-poor condition where at least 40% of the fabric was actively deteriorating.
- Numerous fragments of the reconstructed plaster, averaging 1–80cm², were partially detached from the substrate, and some had been lost. Fragmentation was associated with cracks.
- The red prehistoric wash was flaking, blistered, and delaminated in patches from the underlying plaster.
- Bird excrement streaks were numerous on the walls.

Recent Treatment Record
- The facade was photographed before, during, and after treatment in 35mm color slide and print film (1998-2001).
- Field and digital graphic condition survey was conducted on the finishes (2001).
- Blistering and delaminating areas of the red prehistoric wash were reattached with a 5% (w/v) gelatin solution with 10% glycerin treatment (2001).
- Loose fragments were stabilized by grouting with hydraulic lime grout (2001).
- Bird excrement was manually removed from the walls with dental picks (2001).
  (Figs. 45 & 46)

Recommendations
Room 64 appears stable and should be inspected annually to evaluate the effectiveness of conservation treatments. The room should be periodically photographed to document changes in appearance over time.
Mesa Verde / Cliff Palace 5MV0625: Room 64 Treatment

During Treatment.

After Treatment

Sector 1 & 2 Before Treatment. See treatment of the marked area in Fig. 46

Sector 1 & 2 After Treatment.

Sector 2 & 3 Before Treatment.

Sector 2 & 3 After Treatment.

Figure 45
Mesa Verde / Cliff Palace 5MV0625: Room 64 Treatment

Gelatin treatment of a blister in Sector 2.

Gelatin treatment of a blister in Sector 2 continues.

Gelatin treatment of a blister in Sector 2 continues.

Gelatin treatment of a blister in Sector 2 completed.

Sector 2 Before Treatment

Sector 2 After Treatment: Before Dry

Figure 46
5.0 GENERAL OBSERVATIONS

5.1 Architectural Application

Earthen mortars and surface finishes, i.e., plasters and washes, constitute a significant component of ancestral puebloan architecture. As defined for this study, applied surface finishes have been typed according to their average layer thickness, texture, and use. Plasters tend to be thicker, generally greater than 1 mm, and coarser in texture. Washes are thinner layers, generally less than 1 mm, and of finer texture. Plaster and wash applications appear to be by hand; however for finely detailed embellishments, vegetable (possibly yucca) brushes and finger tips where used to “paint” the finish on the surface. Some finish layers appear to have been burnished while others show hand and finger application marks.

According to field examination, the following observations can be made on the application and use of plasters and washes at Cliff Palace and other alcove sites.

Finishing was an elective, not required architectural component and both interior and exterior spaces were finished with both applied plasters and washes. Wall finishes (when applied) are often related to masonry construction. Thicker plaster finishes were frequently used as the preparatory base leveling surface for irregular masonry while washes were almost always applied directly to regular or dressed masonry, plasters, or other washes. Extruded and smoothed mortars also functioned as leveling coats for washes and later plaster finishes (e.g., Room 121).

Finishes were used to color surfaces and to delineate interior and exterior walls through the use of dados, fields, and banding. Interior and exterior openings--doors and vent holes--were frequently articulated by light colored auras (gray and yellow) outlining the opening. The most commonly finished exteriors were the elevations defining an open area or plaza--usually colored red. Of all the spaces examined, kivas were found by far to contain more superimposed finishes (sequential campaigns) than any other space type: usually 4-6 campaigns as opposed to 1-2 campaigns for rooms. Embellishments (wall painting) were found primarily in interiors, predominantly in kivas, but also in special rooms such as at Spruce Tree House and Room 121 of Cliff Palace. Kiva schemes tend to become more complex through time, incorporating more elements (dado, banding, aura, embellishments) in the last schemes. A scheme appears to exist for a period of time, generally becomes sooted, and is then renewed or replaced. Renewal through reapplication is probably tied to ceremonial ritual. In the highly symbolic mural painting of Room 121 in Square Tower,
evidence of the selected defacement of the embellishments only and no over painting was found suggesting possible dis-empowerment of the images, a situation observed at other sites worldwide.

In Kiva Q and Kiva K, clear distinctions can be observed in the treatment of the essential architectural elements: banquette, pilasters, and upper (inter pilaster) walls. The banquette is always manipulated to be the smoothest surface either through the careful shaping, dressing, masonry coursing, and application of washes or a thick leveling coat of plaster on the masonry substrate. The banquette always has the most finish layers and displays the greatest concentration of incised pictographs, parallel striations and grids being the most common. Both of these occurrences probably relates to the increased zone of activity along the lower walls through sitting.

The pilasters are often an extension of the banquette masonry but are often only half finished on their face with plaster or washes. They are also the location for individual embellishments such as painted or impressed handprints, and zoomorphic or anthropomorphic figures.

The upper walls are often of coarser masonry construction and not finished. Niches are often carefully finished and colored differently red, white, and yellow. The floors and banquette shelves are almost always plastered with a thick 1-2" layer of gray, coarse, shaley mortar with inclusions of debris (bone, charcoal, vegetable fiber), possible from middens. Floors are plastered smooth and are rarely red in color like the walls.

5.2 Finish Composition and Properties

Clear knowledge of the varying properties of these composite materials and their manipulation for different uses is evident in the composition of the mortars, plasters and washes. Finish layers can be defined as plasters or washes depending on their thickness and texture. Plasters tend to be thicker, generally 500μm-1cm thick while washes are thinner layers, generally between 250-500μm thick. In all samples, the first layer serves as a coarsely textured base or leveling plaster followed by successive thin washes usually separated by a soot layer. A further indicator of finish type, however, is the granulometry or grain size distribution. All finishes are composed of a fine fraction of silt and some clay and a course fraction of aggregate, generally fine sand. The matrix is a combination of clay and silt fractions. Aggregate grain size distribution is even and well-sorted for most finish layers. The ratio of matrix to aggregate appears to relate to thickness and therefore use as a plaster or
wash. Plasters tend to have slightly more aggregate than matrix while washes have equal
ratios or a greater percentage of matrix.

This would affect the critical working properties of plasticity, adhesion, and shrinkage;
especially important in the successful application of large areas of plasters and washes on
the walls and floors. Such properties would also have been important in the production of
pottery with the same or similar materials and no doubt the technological knowledge in
making plasters and pottery was shared.

Color was a major consideration in the choice of clays and clayey soils for surface finishes,
more so than for mortars. The predominant material of choice for plaster was the red mesa
top loess whose color, clay binder and grain size distribution was ideal for plasters and
washes.

As already state, nearly all successive individual finish layers are separated by a thin soot
layer. Soot is a black carbonaceous deposit of fine particles deposited on the surface from
the burning of fuel, probably wood in this case. The repetitive occurrence of a single soot
layer between finishes indicates the passage of time between finish applications. Sooted
surfaces were incorporated into design schemes and may have been intentionally created in
some spaces (Kiva Q) for specific schemes rather than being the resultant deposition from
hearth heating.
6.0 APPENDICES
APPENDIX 6.1 Standards and guidelines for condition survey and conservation treatments of architectural surface finishes
STANDARDS AND GUIDELINES FOR CONDITIONS SURVEY AND CONSERVATION TREATMENTS OF ARCHITECTURAL SURFACE FINISHES

MESA VERDE NATIONAL PARK

THE ARCHITECTURAL CONSERVATION LABORATORY AND RESEARCH CENTER

UNIVERSITY OF PENNSYLVANIA

May 2002
I. ARCHITECTURAL SUMMARY DATA

General architectural description of the site and structure to be recorded.

Site Name/Number:
The official name and alpha-numerical designation assigned to each site within Mesa Verde National Park (e.g., Cliff Palace/5MV0625).

Recorder:  First initial and last name of recorder(s).

Date:    Initial date survey begun, written as numerical month/day/year, (e.g. 7/21/98).

Structure Name/No.:
The current architectural space name and alpha-numerical designation assigned (e.g., Kiva J; Open Area J; Room 121). Numbers in parentheses refer to earlier designations identified by the prefix N for Nordenskiöld and F for Fewkes.

Structure type:
The four types of architectural spaces are kivas, open areas, rooms, and miscellaneous structures, which are defined as follows:

Kiva:  Typically, a kiva is circular or keyhole shaped, but it may also be rectangular or d-shaped. The construction traits that are common, but not necessarily required, in kivas include a banquette, pilasters, and sometimes a recess. Features that are common in kivas are a central hearth, a low deflector wall, a ventilator complex (including tunnel and shaft), and a sipapu. Kivas were generally roofed with a cribbing technique and were generally entered via roof hatches.

Room:  An architectural space that is enclosed on four sides by constructed walls or natural features, such as the alcove wall. A room has a roof (a constructed roof, or evidence thereof, or the top of the alcove) that encloses the structure. Most rooms are quadrilateral, but some are circular, ovate, or irregular.

Open Area:  A space in a site that is defined by exterior walls of surrounding structures, retaining walls, changes in the horizontal plane, natural barriers, or some combination thereof. It does not have any roof structures and is generally open along at least one side. Open Areas can be any size or shape. Some open areas are quite large, essentially plazas or courtyards that were located atop kiva roofs. Others were situated atop room roofs, and were defined on at
least one side by the edge of the roof below. Connecting spaces within a site, such as the “hallway” at Spruce Tree House, are another type of Open Area.

**Miscellaneous structure:**
This category pertains to walls that cannot be defined as part of a room or kiva structure, usually being retaining walls. Miscellaneous structures that create facades within open areas are described as miscellaneous structures rather than open area wall segments.

**Structure context:** Overall physical disposition of the structure in its immediate environment.

*Free-standing:* Single structure with no immediate adjacent neighbors as defined by one or more shared or abutted walls, ceilings or floors.

*Contiguous:* Grouping of two or more units in close proximity with shared or butted walls, ceilings or floors.

**Structure position:** Disposition relative to the surrounding grade surface.

*Surface:* The structure was built on the original grade.

*Semi-subterranean:* The structure was built partially below the original grade.

*Subterranean:* The structure was built totally below the original grade.

*Bedrock/Boulder:* The structure was built on top of exposed bedrock or boulder.
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FOR ARCHAEOLOGICAL RESOURCES
Mesa Verde National Park

Upper ledge: The structure was built on an upper narrow shelf or projection of rock, much longer than wide, formed on a rock wall or cliff face that may be within an alcove.

Upper story: enter the story number (2, 3, 4, 0) above or below the 1st story.

Orientation: Direction that structure, and its front (if one exists), was built to face.

Exposure (Protection):
Structure disposition with regard to environmental elements, such as wind-driven rain and snow or ground-water. This relationship is usually defined by the structure’s position relative to the alcove opening, to other structures, or to geologic joints and their associated seeps and springs.

Protected: Structure located in the rear of the alcove, well-behind the drip-edge and/or sheltered by walls > 2m in height

Semi-protected: Structure located midway within the alcove, behind the drip-edge, and/or sheltered by walls > 1 m in height

Unprotected: Structure located in the front of the alcove, at or beyond the drip-edge, and/or otherwise exposed to the weather without wall or alcove shelter.

Moisture conditions:

Wet/Dry: Presence or absence of active site moisture from wind-driven rain and snow or ground-water, usually visible as vegetation, microflora, efflorescence or dampness.
Structure plan: Configuration of unit established at 0.5 m above grade or floor.

Elevation: The vertical relationship of the structure among other surrounding structures (in terms of number of stories as indicated by floor/roof evidence). The stories need not be the same height.

Structure function: Architectural type based on overall form and attributed function/use of architectural space.

Non-kiva ceremonial structure: Any ceremonial structure that is not considered to be a kiva.
Granary (food storage): Small isolated structure which was designed with the capability of being fully sealed, usually located in a small alcove. Usually round or semi-circular, but sometimes consists only of a horizontal wall which encloses a small alcove.

Kiva: See definition under “Unit Type.”

Living room: A room that was used for habitation rather than storage.

Mealing room: A small structure or feature that was used primary for vegetal food processing activities. Sometimes a small subterranean or semi-subterranean masonry room with a jacoal coping or other structural support for metates.

Non-food storage: A room that was used for storage of nonfood materials.

Open area (other than Plaza): See definition under “Unit Type.”

Plaza: An open area within a habitation site that is enclosed partially or wholly by exterior walls of other structures, small walls or barriers, and/or other physical or symbolic delimiters. Area may contain a variety of feature types, including hearths, mealing bins, tool grinding areas, etc.

Tower: A surface structure that can be circular or quadrilateral and was constructed with multiple stories. Towers may or may not have multiple levels of floors and ceilings, but are generally built higher than a single-storied structure.
II. MATERIALS AND METHODS OF CONSTRUCTION OF THE OVERALL STRUCTURE

Floor sub-features:

Hearth: A pit feature which was utilized for fires and fire-related activities. They can be various sizes and shapes, but are most often round or oval with a basin-shaped bottom. They are usually oxidized from intense heating, and fill consists of many layers of ash and charcoal. Often hearths are slab-lined or coped around the surface.

Deflector: A feature associated with hearths. It is usually an upright slab or short free-standing masonry or jacal wall that serves to deflect the ventilator air flow from directly blowing on the hearth. It is located between the ventilator portal and the hearth in kivas.

Sipapu: A small pit feature that is specific to pit structures. It is generally small and cylindrical in shape. It is often lined with a ceramic or plaster lining at the lip of the feature and is usually filled with sterile sand.
Floor materials:

Unmodified/ modified rock: Original floor construction utilizing natural or worked rock.

Packed soil: Original floor construction of packed soil and debris.

Plaster: Original floor construction of single or multiple layers of plaster.

Single layer: Floor plaster is comprised of only one layer.

Multi-layer: Floor plaster is comprised of multiple layers.

Wall sub-features:

Upper wall: The wall segment of a kiva that is above the banquette and above and behind the pilasters. It is generally circular in shape.

Banquette: The lower wall of the kiva that projects out from the upper wall and is usually in plane with the pilasters.

Pilaster: An engaged pier that serves to support the roof of a structure, usually found in kivas.

Recess: For those kivas that have a keyhole shape, the notch which usually does not extend below the banquette level.

Ventilator Portal: An opening through a wall which enhances airflow through a room.
Shelf: Generally stone or stones built into a wall that protrude from the main plane of the wall face. Sometimes bedrock protrudes into a room and was modified for use as a shelf.

Niche: A small cubby hole built into a wall. They are usually about the size of a building stone, and are sometimes lined with plaster and/or carefully shaped liner stones. They are most often rectangular, but may be other shapes as well.

Wall peg: A small length of wood that extrudes from the wall surface.

Loop: A piece of fibrous material (small twig, twisted cord, etc.) that is embedded in the wall at both ends, thus forming a loop. This feature type may be assigned to a loop that is no longer complete. For example, two similar pieces of fiber or wood extruding from the wall within close proximity to each other may be featured together as one loop if it appears that they used to be a single piece.
Socket: A pocket, usually constructed into a wall, that was designed to support a beam (viga) in a roof structure.

Wall entryway: An opening in a wall which allows access into or out of a structure. Many wall entryways are rectangular with a slight tapering in width near the top. Other wall entryways are T-shaped, but they are not restricted to these shapes.

Wall materials:

Unmodified/modified rock: Walls constructed of unmodified or worked bedrock or boulders, which may include the alcove walls, ledges, or other massive stone.

Stone masonry: Walls constructed of surface or quarried stone units

Stone Type: Basic geological classifications: sedimentary, igneous, metamorphic. Define subtype if known, eg.: conglomerate, sandstone, siltstone, mudstone.

Earth: Walls constructed of predominately earthen materials

Unmolded adobe: Hand-formed and dried earthen units. Molded adobe: Moulded and dried earthen units. Puddled earth: Hand formed earthen units applied in plastic state. Terrones: Blocks of dry cut soil. Jacal: A mud-plastered construction method. The superstructure consists of vertical and horizontal poles tied together into position. In cross section, the jacal construction is double-sided, as both interior and exterior wall facets contain mortar. Upright slabs are generally used as basal footing.

Wall construction: Overall construction technique of unit recorded.

Excavated: Carved out of the bedrock.

Single: Wall is one stone in thickness.
Double: Wall is two stones in thickness.

Double with fill: Wall is two stones thick with either rubble or mortar fill.

Compound: Wall is a combination of one or two stones thick, often alternating to create a masonry bond.

Compound with rubble core: Compound wall with either rubble or mortar fill.

Obscured: Not discernable due to concealment.

Unknown: Construction can not be assigned due to poor preservation.

Wall coursing: Horizontal placement of individual stones or masonry units.

Uncoursed: Stones are randomly placed with no apparent pattern or style and with no distinct horizontal rows. Commonly, stones do not overlap from course to course and running joints are not present. Typically, stone size will vary greatly and wall plane is uneven.

Semi-coursed: Stones are randomly laid with some degree of distinct rows. Stones are more uniform in size and overlap in areas, reducing the likelihood of running joints. This method is a blend of uncoursed and fully coursed.

Fully coursed: Stones are laid in distinct rows and have joints that overlap the previously laid course. Stones are usually of uniform size and shape and are placed in order to create an even wall plane.

Coursed-patterned: A fully coursed wall with chinking stones placed in the joints in a decorative and patterned manner.

Single upright: Wall consists of a single row of upright slabs.
**Double upright:** Wall consists of a double row of upright slabs.

**Obscured:** Coursing not discernable due to concealment.

**Unknown:** A value cannot be assigned due to poor preservation.

![Wall Types]

**Bonding:** Method of joining stone units.

**Dry-laid:** Masonry is laid in stone-to-stone contact without the use of mortar.

**Dry-laid, mudded:** Masonry is laid up dry and the remaining voids surface filled with mortar. The mortar does not add to the strength of the wall.

**Wet-laid:** The placement of stone units within a mortar matrix, so that the strength and durability of the constructed wall is dependent on the capability of the mortar to bond the masonry and carry and distribute the weight of the wall.

**Obscured:** Bonding not discernable due to concealment.
Stone form: 3-dimensional shape of stone unit, often implied by surface outline.

Irregular: Unmodified stone of unit dimension, often lacking parallel faces.

Irregular massive: Unmodified boulders, often in situ as alcove rock fall.

Ovoid: Stones that are oval in shape (this includes river cobbles).

Tabular: Worked, rectangular-shaped units whose length is three or more times their height.

Blocky: Worked, rectangular-shaped units whose length is less than three times their height.

Airfoil: The shape of a cross-section of the wing of an airplane.

Lenticular: Stones that are rhomboid or diamond-shaped when the face of the wall is viewed.

Upright slab: Large flat slabs placed upright to form wall or floor sections.

Stone shaping/finish: Method of shaping stone units and/or finishing stone surfaces as a primary or secondary operation.

Unfinished: Surface or quarried stone with no secondary surface finish beyond natural fracture from unit shaping including natural bed faces (for sedimentary rock) and joints.

Edge-directional: surface derived from primary unit shaping or secondary finishing characterized by discreet surface spalls on the arrises of the stone unit by percussion.
**Face-directional:** Surface derived from primary unit shaping or secondary finishing characterized by discreet surface spalls on the faces of the stone unit by percussion.

**Pointed:** Surface derived from secondary finishing characterized by short discreet grooves, usually directionally oriented, cut into the face of the stone unit by percussion.

**Pecked:** Surface derived from secondary finishing characterized by small individual dimples in an overall pattern pounded onto the face of the stone unit by percussion.

**Ground:** Surface derived from secondary finishing characterized by a smooth or finely striated texture created by abrasive rubbing and grinding.

**Obscured:** Surface finish not visible due to applied plasters or washes.

**Unknown:** Surface finish cannot be assigned due to poor preservation.

**Mortar joint:** Surface profile of original mortar joint.

**Flush:** Mortar joint is worked smooth and level with surrounding stone units with no or slight overlap onto contiguous stone faces.

**Extruded:** Mortar joint extends out beyond the surrounding stone units with no further working, usually rough and irregular in texture and profile.

**Extruded-smooth:** Mortar joint extends out beyond the surrounding stone units and is smoothed over covering not more than one-third of the stone surfaces.

**Recessed:** Mortar joint lies below the level of the surrounding stone arises, usually irregular in texture.

**Unknown:** Original mortar joint cannot be assigned due to poor preservation or repair.
Obscured: Mortar joint is concealed by applied surface finishes.

Original and stabilization mortar types:
Visual classification typology based on general physical appearance determined by color, texture, and inclusions.

Mortar surface attributes:
Additional gross physical characteristics related to emplacement and/or composition

Chinking: The insertion of small stone chips into the mortar joint while wet, usually inserted edge-wise and flush in single or multiple rows within head and bed joints.

Impressed: The creation of discernable surface imprints from fingers and hands, tools, cord, maize cobs, pottery sherds, and other objects.

Incised: The small-scale incision of a design into the mortar, created with a sharp tool, usually after the finish has dried.

Smeared: The smoothing of the mortar surface by directional wiping by hand.

Burnished: A smooth, faceted surface created by rubbing the applied plaster or wash with smooth hard stones, potsherds, or other tools.

Striated: Fine parallel grooves left in the dried plaster or washes, presumably from skins or brushes used in application.

Use alteration: Intrinsic chromatic alteration of the mortar from burning, usually ranging in color from red to brown to purple-black, attributable both to hearth fires or occupational or post-occupational burning.

Sooted: Deposition of black carbonaceous soot from the burning of organic matter either from hearth fires or occupational or post-occupational burning.

Obscured: Mortar joint is concealed by applied surface finishes.

Unknown: Original mortar joint surface cannot be assigned due to poor preservation.
Mortar type:
This classification of mortar was developed by Larry Nordby and Mary Griffits. Mortars types are subdivided into “Original” and “Stabilized” types. These are distinguished in the coding system by the suffixes “A” for “aboriginal” or original fabric, and “S” for stabilization or modern types. The descriptions of the different types are included here. For more details on the microscopic properties and sources of these types, refer to the original document, “Cliff Palace Building Materials: Classification and Selection,” by Mary O. Griffitts and Larry V. Nordby, 1999.

Original Type Code:
Enter one of these if the mortar conforms to one of the following Original (Ancestral Pueblo) Types; these all have the suffix "A". Mortar samples collected from Cliff Palace were used to create a provisional mortar typology for the site, when integrated with the Oak Tree House typology. These samples are as follows:

Type IA:
This type has a distinct reddish color, with an exterior color of 5YR7/6 (reddish yellow). It is hard, dense, and does not abrade easily. Macroscopically, specimens show numerous small inclusions of angular reddish iron (2.5 YR 6/6--light red), oxidized sandstone, and gray platy shale fragments. It also contains unrounded caliche fragments, concretion bits, wood, twigs, and charcoal. Hard and dense, it does not abrade easily. Almost 20% carbonate content.

Type IIA:
This specimen is of light brown color, with an outer Munsell color is 7.5 YR 7/4 (pink) and to 7.5 YR 6/4 (light brown). Overall texture is sandy to silty, and it abrades or rubs easily. Macroscopic characteristics include many unburnt twigs, grass glumes or other plant parts, small non-rounded shale fragments and broken bits of sandstone. Ten percent carbonate content.

Type IIIA:
This sample was collected from the interior south wall of Room 86 (1). Munsell color is 10 YR 6/1 (gray) to 10 YR 7/2 (light gray). This mortar appears ash-based, containing small burned organic inclusions such as charcoal fragments up to 2 mm in diameter, and small twigs; calcite crystals filling pores in some parts (probably secondary due to water seepage); no large pebbles.

Type IVA:
This mortar has a somewhat silty texture, but abrades or rubs less readily than Type IIA. It crumbles more easily than Type IA. Munsell color ranges between 10 YR 7/4 (very pale brown) and 10 YR 6/4 (light yellowish brown). Macroscopically, this mortar contains caliche as rounded and angular fragments, and bits of broken gray shale. These show as large, pale chunks as large as 2 mm in diameter. There are also a few organics. Carbonates account for approximately 40% of the mass.

Type VA:
This sample was collected from the exterior south wall of Room 68 (1). Munsell color is 10 YR 8/3 (very pale brown). The mortar is porous, having a few rounded particles up to 2 mm in diameter, but most grain size appears to be homogeneous without a microscope.

Type VIA:
This sample was collected from the exterior west wall of Room 61 (1). This mortar has a distinct color and is very dense and compact. There are a few particles up to 1.0 mm in diameter, but most grain size is very fine. Munsell color is 7.5 YR 6/4 (light brown).

Type VIIA:
This sample was collected from the west wall of Room 29 (1). Its most distinctive characteristic is the presence of round pebbles up to 5 mm in diameter. It is porous, sandy, and abrades or rubs easily. Munsell color is 10 YR 7/4 (very pale brown).

Type VIIIA:
This sample was collected from the southern façade of Miscellaneous Structure 14, which defines Open Area 18, and is a significant architectural construct at Cliff Palace. It is porous, and has large rounded grains up to 3
There is also some charcoal with fragments up to 4 mm in diameter. Munsell color is 10 YR 7/4 (very pale brown).

**Stabilization Type Code:**

If the mortar type conforms to one of the following Modern (Stabilization) types, fill out this field. All modern types have the suffix "S" added. The types are as follows:

**Type IS:**
This mortar type contains many rounded pebbles, probably from the addition of commercial aggregate or sands to a soil-based mix. Some of the pebbles are up to .5 cm in diameter. Munsell color is 5 YR 6/4 (light reddish brown) to 5 YR 6/6 (reddish yellow). The origins of this mortar are unknown.

**Type IIS:**
This mortar type can be identified by virtue of its smooth surface finish and trowel-marked surface. It is very common, and was emplaced by Fewkes, since photographs of the period show his workmen and him with it. It is the most frequent modern mortar in Cliff Palace, occurring most often in upper wall sectors of kivas, where it contrasts with the sooted and plastered original wall surface. Munsell color is 7.5 YR 7/4 (pinkish yellow).

**Type IIIS:**
This mortar type is similarly colored to its Type IIS (7.5 YR 7/4), and can be distinguished primarily by its lack of slick finish. It does have trowel and metal tool markings, however. It also has a flakey texture and weathering pattern, in addition to a larger number of small mud/clayball inclusions.

**Type IVS:**
This mortar was probably produced by adding sand to soil, and is consequently very grainy. To the naked eye, the sand grains are suspended in a fine-grained matrix, producing unusual globular masses. Color is 7.5 YR 7/6 (reddish yellow). It may actually encompass the new type VIIS (below), but macroscopically they appear quite different in texture.

It seemed possible that this material could be a variety of the Rhoplex altered mortar used most recently for preservation work at Mesa Verde, but samples of the two were compared and found quite different. Origins are uncertain, but other additives to soil-based mortars were used in the late 1960s up until at least the mid-1970s. This suggests that the mortar was used by Al Decker or
Ron Crawford during that same period. One common material was Duraweld, a commercially available concrete adhesive.

*Type VS:*  
This mortar is the most recent stabilization material: soil mixed with Rhoplex, an acrylic polymer. If so, it was added after 1977. Clay and organic material occur. Irregular small lumps of caliche with sharp edges are common, along with bits of sandstone up to 1.0 cm in diameter. Munsell color is 5 YR 6/3 (light reddish brown).

*Type VIS:*  
This mortar class includes all Portland cement based mortars, most of which are some kind of gray in color. The addition of colorants that creates subclasses within this type at other sites at Mesa Verde, but none have as yet been delineated at Cliff Palace. Probably used between 1935 and 1970 for whatever work was done, especially for areas needing strength. Often over pointed with soil or soil–based mortars, especially Types IS, IIS, IIIS, or IVS. If the over pointing has since deteriorated, Type VS may be the most recent replacement of the earlier types.

*Type VIIS:*  
This type was collected from the north wall of Room 44 (1), and has a Munsell color of 7.5 YR 6/6 (reddish yellow). This type was emplaced as part of a soil cement mixture that incorporated calcium aluminate cement (Lumnite brand) as the cement. This mixture produces a sandy to grainy, highly abradable mortar. It was put in by Ron Crawford of Mesa Verde National Park in the late 1970s to early 1980s, although no records of the exact year remains.
III. SURFACE FINISHES

Description of the surface finishes of the last (most recent) visible scheme in each individual segment.

Site name/number:
The official name and alpha-numerical designation assigned to the site (e.g., Cliff Palace/5MV0625).

Structure Name/No.:
The current architectural space name and alpha-numerical designation assigned (e.g., Kiva J; Open Area J; Room 121). Numbers in parentheses refer to earlier designations identified by the prefix N for Nordenskiöld and F for Fewkes.

Recorder: First initial and last name of recorder(s)

Date: Initial date survey begun, written as numerical month/day/year, (e.g. 7/21/98).

Segment Name/No.:
The current segment type (see above and “segment designations” key of the binder) and alpha-numerical designation assigned (e.g., UW2; V; B6).

Architectural segment type and designation:
Architectural spaces are divided into segments to define a practical unit to which quantitative and qualitative descriptions can be assigned. Segmentation depends upon the type of architectural space being analyzed. When a particular space has more than one architectural segment of a given type, then segments of that type are also assigned numbers and/or directional indicators. Guidance on how segments should be assigned is provided below for each of the primary types of architectural space.

Rooms: The designation of wall segments in a room will be assigned based on a cardinal direction and whether the wall face is interior or exterior to the room. Generalize the direction of the wall to the nearest cardinal direction (N, S, E, W). There are exceptions and definition of a wall segment allows for various interpretations in differing situations. A room’s ceiling and floor also may be each designated as segments if they are surveyed. A circular room, for instance, might only have one interior wall segment, since there are no corners or abutments.
For every room, wall segments are assigned to interior wall faces. If the exterior face of a wall is shared by another room, then that wall face is identified with the room to which it is interior. For example, if Room 4 is south of Room 3, and the south wall of Room 3 is also the north wall of Room 4, then the north face of that wall will be designated Room 3 South Interior and the south face of that wall will be designated Room 4 North Interior.

If a wall is not shared with another structure, it is designated as the exterior wall face of that structure. For example, the north wall of Room 3 in the example above is not contiguous with any other structures. This wall would have two segments related to Room 3: Room 3 North Interior and Room 3 North Exterior. The exception to this rule is when the exterior face of a wall is part of a larger contiguous wall that defines an open area. In that case, the wall segment relates to the open area for which it creates a facade.

**Kivas:**

Kivas generally have five types of architectural segments: banquette, pilaster, upper wall, recess, and deflector (see previous section entitled “General Construction Materials and Methods” for definitions). A kiva’s floor may also be designated as a segment if it is surveyed.

Since kivas are generally circular or keyhole shaped, the walls are divided into segments differently from rooms. The construction method of kivas most often involves a single wall that runs around the entire perimeter, unless they were repaired during the modern period. This construction pattern is better divided into segments based on bottom-to-top horizontal bands, rather than the four cardinal directions used for rooms and open areas.

The division of these horizontal bands into architectural segments primarily relates to the numbering and location of the pilasters (see diagram below). Each
face of each pilaster is assigned a segment number based on where the ventilator is. As you face the wall as you are standing in the kiva, the face of the first pilaster to the right of the ventilator is segment P1 (pilaster 1), with the sequence of increasing pilaster numbers running clockwise. Some pilasters may have fallen, but they still get a number if they were ever there at all. Each side (as opposed to the face) of each pilaster is also a segment, identified first by the pilaster number and then by the direction that the side is oriented toward (N, NW, NE, S, SW, SE, W, E). For example, the south-oriented side of a pilaster designated as P2 would be called segment P2S.

After each pilaster has been assigned a number, then the upper wall may be divided into segments. The first upper wall segment (UW1) is bounded on the left by the edge of the recess and on the right by left edge of pilaster 2 (P2). Assuming in this example that the kiva has six pilasters, then segments UW2 through UW4 would each be bounded on the left by the pilaster with the same number as that upper wall segment, and bounded on the right by the pilaster with the next higher number as that upper wall segment. For example, UW4 is bounded on the left by the right edge of P4 vertical line through the midpoint of P4 and is bounded on the right by the left edge of P5.

The division of a kiva’s banquette into segments is the same as the process for dividing its upper wall into segments except that the dividing lines between banquette segments are vertical lines through the midpoints of adjacent pilasters. In addition, the left side of the first banquette segment and the right side of the last banquette segment are bounded by a vertical line through the midpoint of the ventilator portal. (Note: In the rare case that the ventilator portal is not located below the recess, then this division should be based on a vertical line through the midpoint of the recess.) For example, again looking at a kiva with six pilasters, the first banquette segment (BQ1) would be bounded on the left by a vertical line through the midpoint of the ventilator portal and on the right by a vertical line bisecting the midpoint of pilaster 2 (P2). The last banquette segment (BQ5) would be bounded on the left by a vertical line bisecting the midpoint of pilaster 5 (P5) and on the right by a vertical line through the midpoint of the ventilator portal.
Finally, each of the walls of the recess is considered to be an architectural segment, with each assigned a directional designation (N, NW, NE, S, SW, SE, W, E). For example, the south wall of the recess would be given the segment designation “RecS.” If it is surveyed, the bottom of the recess should be given the designation “RecBottom.”
**Open Areas:** Open areas by definition are not fully enclosed by walls. Open areas are defined by a combination of facades, miscellaneous structures, and inferred boundaries. Wall segments are only assigned to actual wall faces that enclose the open area. To assign wall segments to an open area, the boundaries of the area need to be identified. Four boundaries are generally identified, although fewer may be assigned if the shape lends itself to this method. Boundaries may include façades, miscellaneous structures, ghost boundaries, fallen (missing) walls, or inferred boundaries.

**Façades:** The exterior walls of adjacent structures, which are designated as wall segments interior to the open area.

**Miscellaneous structures:** Usually retaining walls; miscellaneous structures that create façades within open areas are described as miscellaneous structures rather than open area wall segments (see below for a more detailed description of miscellaneous structures).

**Ghost boundaries:** Traces of evidence that walls were originally in place, such as mortar lines on the alcove. Ghost boundaries are not designated as wall segments.

**Fallen or missing walls:** Similar to ghost boundaries, in that there is evidence of a wall that is no longer present. These are not designated as wall segments. The exception to this is if there is enough remaining fallen wall material that a condition assessment may be assigned to the wall.

**Inferred boundaries:** Usually changes in grade that imply the edge of a usable surface. This may include edges of roofs of lower structures, natural changes in grade, or the outside ledge of an alcove. Inferred boundaries are not designated as wall segments.

To summarize, open area boundaries first should be identified, and wall segments should then be assigned to façades, miscellaneous structures, and fallen or missing walls, but not to ghost boundaries, or inferred boundaries.

When designating wall segments in open areas, two primary factors may be considered in their identification. First, the wall segment is always identified in terms of the cardinal direction in which the wall bounds the open area (N, S, E, W). As with room wall segments, the directions should be generalized to the nearest cardinal direction for simplicity’s sake. Secondly, in some cases an open
area’s bounding wall may be divided into more than one segment when different parts of the wall were built during different construction campaigns. An example is the west interior wall of Open Area 23 (see diagram below). While this wall functions as the eastern boundary of the open area, in terms of construction campaigns, it was obviously built in two parts, as it is comprised of the exterior walls of Rooms 3 and 4. Each part relates to a different space, and each part has noticeably different construction characteristics. Therefore, the west interior of OA 23 would contain two segments: one for the façade of Room 3 and another for the façade of Room 4.

Furthermore, wall segments interior to the open area should always be described in association with the open area. Exterior wall faces of open areas are generally interior wall faces of surrounding rooms and are described in association with those rooms. In a case where the exterior face of an open area wall is not interior to any other architectural space, that wall segment should be described in association with the open area to which it is exterior (this does not happen very often).

Miscellaneous structures:
Miscellaneous structures are walls that were not constructed to enclose a structure. They often create the boundaries of open areas, as with retaining walls. Designating the segmentation of walls of miscellaneous structures is different from designating the segmentation of wall façades that are exterior walls of structures. Even if a miscellaneous structure is a retaining wall that makes up a boundary of an open area, the wall segment is designated based on the miscellaneous structure number, rather than the open area. For example, if the eastern boundary of open area 3 is a retaining wall, and the retaining wall is designated miscellaneous structure 32, then the wall segments for the retaining wall would be “MS 32 East Face” and MS 32 West Face,” and not “Open Area 3 East Wall Interior” and Open Area 3 East Wall Exterior.” A miscellaneous structure may have one, two, or rarely, more than two wall faces. These should be designated based on the cardinal direction that they face.
Some further guidelines for miscellaneous structure segment designation are:

- Name miscellaneous structure wall segments in relation to the miscellaneous structure and not in relation to an open area they help to define.
- A retaining wall will probably have only one exposed wall face.
- Name miscellaneous structure wall segments by the cardinal direction that is closest to the direction to where the exposed wall face is facing.

**Segment orientation**: Direction that segment faces.

**Exposure**: Structure’s disposition with regard to environmental elements, such as wind-driven rain and snow or ground-water. This relationship is usually defined by the structure’s position relative to the alcove opening, to other structures, or to geologic joints and their associated seeps and springs.

*Protected*: Structure is located in the rear of the alcove, well-behind the drip-edge and/or sheltered by walls greater than 2m in height.

*Semi-protected*: Structure is located midway within the alcove, behind the drip-edge, and/or sheltered by walls greater than 1m in height.

*Unprotected*: Structure is located in the front of the alcove, at or beyond the drip-edge, and/or otherwise exposed to the weather without wall or alcove shelter.

**Moisture conditions**: Presence or absence of active site moisture from wind-driven rain and snow or ground-water, usually visible as vegetation, microflora, efflorescence or dampness.

**Location**: Whether the segment is located on the interior or exterior of the architectural space.

**Vertical position**: The vertical position of the segment within the context of the entire structure.
Approximate maximum number of layers:
Maximum number of surface finish layers visible (only in the segment area recording).

Scheme no.: Sequential finish campaigns beginning with the last (most recent) scheme as no. 1. Generally only the last scheme will be recorded.

General scheme: The combination and placement of individual and combined surface finish components and embellishments. (see below).

No finish: Originally exposed masonry with no application of surface finishes including extruded smooth plaster or soot.

Partial finish: The presence of one or more finish components (see below) in combination with originally exposed masonry surfaces. The wall segment is not fully finished.

Full finish: The presence of one or more finish components covering the entire wall or unit.

Scheme complexity: The number of surface finish components and embellishments.

Simple: The presence of only one finish component defining the finish scheme.

Complex: The presence of more than one finish component defining the finish scheme.

Component/color (Munsell designation):
The discreet application of finishes characterized by location, shape or delineation. Component color identification is recorded by matching the cleaned surface of the finish to the Munsell color standard under daylight illumination recording the Munsell number and color name.

Full wall: A layer or layers of plaster or wash that entirely cover the masonry or unit.

Dado: A band of plaster and/or wash on the lower third or half of a wall that is finished differently from the rest of the wall.
Field: Plaster and/or wash applied to the upper half to two-thirds of a wall. It is often in association with a dado.

Aura: A solid border of plaster and/or wash applied around a door or opening in the masonry. It is usually a different color than the field and may extend from the dado.

Floor band: A band of plaster and/or wash applied to the bottom of a wall, usually extending 10 - 20 cm in height. It can also be an extension of the material used to finish the floor.

Wall band: Discrete or continuous vertical or horizontal bands of plaster and/or wash, usually 10 - 20 cm wide, occurring singularly or grouped, applied to interior and exterior walls.

Surface finish type(s):

None (exposed masonry): The original, intentional absence of any surface finish, including soot, as defined below to the substrate.

Extruded smooth mortar: Mortar that extends beyond masonry courses and onto the surface of the wall covering at least ¾ of each masonry unit. It usually occurs in discreet areas and was often utilized as a surface leveling and filling technique. Thickness can vary.

Applied plaster: A discreet layer or layers of plaster, greater than 1 mm thick, applied over the substrate, and which has been worked to create a relatively continuous, relatively uniform surface.

Wash: A discreet layer or layers of thinly applied finish less than 1 mm thick, which is applied directly over the plaster or substrate.

Finish texture:

Finger and hand prints: The application impressions of finger- and/or hand-prints left in the dried plaster and washes.

Striated: Fine parallel grooves left in the dried plaster or washes, presumably from skins or brushes used in application.
Burnished: A smooth, facettted surface created by rubbing the applied plaster or wash with smooth hard stones, potsherds, or other tools.

Indeterminate: Surface texture is illegible or severely damaged.

Use alteration: Intrinsic chromatic alteration of the plaster or wash from burning, usually ranging in color from red to brown to purple-black, attributable both to hearth fires or occupational or post-occupational burning.

Sooted: Deposition of black carbonaceous soot from the burning of organic matter either from hearth fires or occupational or post-occupational burning.

Unknown: Surface texture which is illegible or damaged.

Embellishment: A discreet image or repetitive motif applied onto or inscribed into the plaster and/or washes.

Embellishment numbers: Assign each embellishment a sequential number per segment.

Embellishment motif:
Common designs include zoomorphs (animal shapes), anthropomorphs (humanoid figures), geometrics (geometrical shapes), grids and scores, actual and representational handprints, dots, daubs, and other abstract images. Applied and incised designs are often used together.

Application method:

Additive/Applied: The small-scale surface application of a wash, applied as a design with the aid of a tool such as a yucca paint brush, stick, or fingertips to the wet or dry finish.

Reduced/Incised: The small-scale incision of a design into the plaster or wash, created with a sharp tool, usually after the finish has dried.

Impressed: The small-scale impression of a design into the plaster while it is still plastic and before it has dried. Observed impressions
include: maize cobs, potsherds, stick ends, fingertip and handprints.

*Daubed:* The small-scale surface application of a design to the plaster or wash by distinct daubing actions. This often presents itself as “mudball” marks on the surface of the finish.

*Other:* Describe.

**Embellishment Mode:** Occurrence of discreet or repetitive designs

**Embellishment Location:** Occurrence on sub-features or finish elements

**Description:** Specific written and graphic description of the last finish scheme (Scheme 1) within the recorded segment. Other schemes may be described depending on legibility. (The last finish scheme should be indicated on mylar overlay of photomontage elevation. All finish evidence [elements and embellishments] to be recorded on individual sector overlays during condition recording).
IV. PREVIOUS DOCUMENTATION

All archival documentation including written reports, field notes, photographs, drawings, and interviews pertaining to the site, unit and section recorded.

*Date:* Known or approximate (circa) date of the record. (Copy dates of photographs- should not be confused with actual dates).

*Photographer:* If known

*Negative number:* If marked

*Photo location:* Location of original negatives, prints or copies.

*Subject:* Unit name/no., element or feature, interior/exterior designation, and compass direction (N, S, E, W) of the surface photographed.
APPENDIX 6.2 Graphic glossary of conditions and treatments
<table>
<thead>
<tr>
<th>ARCHITECTURAL FEATURE</th>
<th>Major building features such as wall profiles, openings, beam pockets, sipapus, hearths, niches, banquettes, etc., outlined to distinguish them from material conditions and repairs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL LOSS</td>
<td>Complete absence of mortar or surface finish exposing masonry beneath. (see section x-x')</td>
</tr>
<tr>
<td>PARTIAL LOSS</td>
<td>Absence of one or more finish layers. (see section y-y')</td>
</tr>
<tr>
<td>LOSS - DATED</td>
<td>Loss since a specific date. Textual annotation &quot;X&quot; indicates date from previous documentation.</td>
</tr>
<tr>
<td>REPAIR</td>
<td>Subsequent alterations made for structural, aesthetic or functional reasons including rebuilding, mortar infill and pointing, replastering, and conservation treatments.</td>
</tr>
<tr>
<td>REPAIR GENERAL</td>
<td>Undocumented repair.</td>
</tr>
<tr>
<td>REPAIR LANCASTER</td>
<td>Repairs executed under Al Lancaster.</td>
</tr>
<tr>
<td>Condition</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Repaired</strong></td>
<td>By known individuals other than Lancaster or Fewkes. Textual annotation signified by &quot;X&quot; should indicate last name.</td>
</tr>
<tr>
<td><strong>Cracking</strong></td>
<td>Fractures of variable length and orientation, greater than or equal to 0.40 mm. in width, with or without associated planar displacement of the finish, and differentiated by depth and pattern.</td>
</tr>
<tr>
<td><strong>Cracking Finish</strong></td>
<td>Linear cracking through single or multiple finish layers.</td>
</tr>
<tr>
<td><strong>Cracking Masonry</strong></td>
<td>Linear cracking through finishes, masonry and/or masonry joints.</td>
</tr>
<tr>
<td><strong>Map Cracking</strong></td>
<td>Fine network cracking.</td>
</tr>
<tr>
<td><strong>Blistering</strong></td>
<td>Small-scale swelling and/or rupturing of a thin uniform layer(s) of finish.</td>
</tr>
</tbody>
</table>
## Glossary of Conditions

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delamination/Flaking</td>
<td>The lifting, separation and partial loss of one or more finish layers resulting in an uneven, irregular contoured surface. Flaking is small-scale thin lamellar loss of the surface finish(s).</td>
</tr>
<tr>
<td>Detachment</td>
<td>Planar discontinuities or voids at the masonry/finish interface detected by a hollow sound produced when tapping on the surface. May be blind or in association with delamination/flaking.</td>
</tr>
<tr>
<td>Displacement/Deformation</td>
<td>A significant deviation from the plane of the wall resulting after finish application, usually associated with structural failure.</td>
</tr>
<tr>
<td>Disaggregation</td>
<td>Surfaces that display active friability by grain loss under finger pressure.</td>
</tr>
<tr>
<td>Mechanical Damage</td>
<td>Isolated physical damage due to impact or abrasion caused by falling rocks and debris, animal, insect or human activity, including excavation.</td>
</tr>
<tr>
<td><strong>STONE-MORTAR DECAY</strong></td>
<td>General isolated degradation of the masonry and mortar evidenced by loss, flaking and disaggregation.</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>SURFACE DEPOSITS</strong></td>
<td>Surface accumulations defined by source:</td>
</tr>
<tr>
<td>Animal</td>
<td>Animal or bird excrement deposited before or after excavation</td>
</tr>
<tr>
<td>Carbon</td>
<td>Black soot from the burning of organic material.</td>
</tr>
<tr>
<td>Soil</td>
<td>Deposits caused by soil rundown from upper walls or ground back splash, also remnants of pre-extraction fill.</td>
</tr>
<tr>
<td>Salts</td>
<td>White crystalline deposits composed of water-soluble salts, sometimes visible as biomorphs of root systems of previous pre-extraction plant growth.</td>
</tr>
<tr>
<td><strong>BIOLOGICAL GROWTH</strong></td>
<td>The presence of microflora such as algae, fungi or lichens.</td>
</tr>
<tr>
<td><strong>VEGETATION</strong></td>
<td>The presence of higher plant forms, including their roots.</td>
</tr>
<tr>
<td>FILL LINE</td>
<td>Former level of accumulated debris from building materials and natural sediment.</td>
</tr>
<tr>
<td>-----------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>COLOR CHANGE</td>
<td>Intrinsic chromatic alteration of the surface, usually reddening, attributed to high temperatures from fire.</td>
</tr>
<tr>
<td>GRAFFITI</td>
<td>Incised or painted non-historic defacement.</td>
</tr>
<tr>
<td>SURFACE-UNIQUE</td>
<td>Unique condition not described above which requires further explanation. (Include explanation on overlay or on sector description sheet.)</td>
</tr>
<tr>
<td>DESIGN</td>
<td>A discrete image or repetitive embellishment impressed, incised, or applied to the plaster, washes, or stone.</td>
</tr>
</tbody>
</table>
## Gelatin Reattachment Treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Condition</th>
<th>Treatment Method</th>
</tr>
</thead>
</table>
| **Warm 5% Gelatin**        | Blistering, delamination, flaking, detachment, displacement, and/or deformation of finish layers <2mm in thickness; total area <5cm². | • Dry-clean debris from area.  
• Inject warm 5% (w/v) gelatin solution in water with 10% glycerine.  
• Apply pressure for 1 minute with Hollytex® and Ethafoam®.  
• Keep moist with 1:1 water/isopropyl alcohol spray. |
| **Warm 10% Gelatin**       | Blistering, delamination, flaking, detachment, displacement, and/or deformation of finish layers ≥2mm in thickness; total area <5cm². | • Dry-clean debris from area.  
• Inject warm 10% (w/v) gelatin solution in water with 10% glycerine.  
• Apply pressure for 1 minute with Hollytex® and Ethafoam®.  
• Keep moist with 1:1 water/isopropyl alcohol spray. |
| **Cold 5% Gelatin**        | Blistering, delamination, flaking, detachment, displacement, and/or deformation of finish layers ≤2mm in thickness with soot; total area <5cm². | • Dry-clean debris from area.  
• Inject cold 5% (w/v) gelatin solution in water with 10% glycerine.  
• Apply pressure for 15 minutes with Hollytex® and Ethafoam®. |
| **Cold 10% Gelatin**       | Blistering, delamination, flaking, detachment, displacement, and/or deformation of finish layers ≥2mm in thickness with soot; total area <5cm². | • Dry-clean debris from area.  
• Inject cold 10% (w/v) gelatin solution in water with 10% glycerine.  
• Apply pressure for 15 minutes with Hollytex® and Ethafoam®. |
| **Warm 10% Gelatin + Cyclohexadecane** | Blistering, delamination, flaking, detachment, displacement, and/or deformation of finish layers <2mm in thickness with soot; total area >5cm². | • Dry-clean debris from area.  
• Apply melted cyclohexadecane on surface.  
• After solidification of cyclohexadecane, inject warm 10% (w/v) gelatin solution in water with 10% glycerine.  
• Apply pressure for 15 minutes with Hollytex® and Ethafoam®. |
## INJECTION GROUTING TREATMENTS

<table>
<thead>
<tr>
<th>TREATMENT</th>
<th>CONDITION</th>
<th>TREATMENT METHOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACRYLIC EMULSION GROUT</td>
<td>Blistering, delamination, flaking, detachment, displacement, and/or deformation of finish layers &gt;2mm in thickness with soot; total area &gt;5cm².</td>
<td>- Dry-clean debris from area.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Inject acrylic emulsion grout with microspheres.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Apply pressure for 1 minute with Hollytex® and Ethafoam®.</td>
</tr>
<tr>
<td>HYDRAULIC LIME GROUT</td>
<td>Delamination and detachment of plaster.</td>
<td>- Dry-clean debris from area.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Dam openings with cotton, clay, or mortar.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Inject grout of 1:1:4 hydraulic lime, ceramic microspheres, fine sand, and water (vol.).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Fill/edge after set.</td>
</tr>
</tbody>
</table>

## MECHANICAL CLEANING TREATMENTS

<table>
<thead>
<tr>
<th>DRY BRUSHING - SURFACE DEPOSITS</th>
<th>Surface deposits: salts, animal, carbon, soil, wash, and soil-cement splash.</th>
<th>- Use firm, dry stencil brush in circular movements.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>- Use scalpel if necessary.</td>
</tr>
<tr>
<td>DRY BRUSHING - TREATMENT STAIN</td>
<td>Blistering, delamination, flaking, detachment, displacement, and/or deformation of finish layers &gt;2mm in thickness with soot; total area &lt;5cm².</td>
<td>- Use firm, dry stencil brush in circular movements.</td>
</tr>
</tbody>
</table>

## FILLING AND ENDING TREATMENTS

| REPOINTING/EDGING                | Mortar loss, plaster detachment from masonry substrate.                                                        | - Use mortar of color selected, sieved soil with water or amemended with 5% of acrylic emulsion.     |

## SAMPLE LOCATION

| Location and code for plaster samples to analyze at the ACL | OAJ-001 |
6.3 Condition and treatment AutoCAD drawings
6.4 Sample analysis
APPENDIX 6.4.1 - Kiva Q Sample Analysis
Samples 19, and 22 - 28 are fallen plaster. The locations of samples 30 - 36 are uncertain. Samples 40 and 43 are from the side of pilaster 3.
<table>
<thead>
<tr>
<th>Site Name Number</th>
<th>Sampler Date</th>
<th>Unit#</th>
<th>Sample #</th>
<th>Location</th>
<th>Description</th>
<th>Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>R.Fourie Aug.2000</td>
<td>Kiva Q</td>
<td>1</td>
<td>Sector 11, Wall North side beneath pilaster</td>
<td>Large plaster piece that was detached. It is ideal for treatment testing. It is 8x 4cm. The final coat is 10YR 7/4. The oldest layer is 10 YR6/3. Visual analysis with stereomicroscope revealed 3 layers, the middle layer has on both sides a dark soot-like layer. It could be the cause of staining layers. This flake has been treated with gelatin in the field. Staining has occurred. During the process of staining removal with warm water, the flake completely detached and was kept for testing. It weighs 17.85g.</td>
<td>Thin-section Cross-section</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>R.Fourie Aug.2000</td>
<td>Kiva Q</td>
<td>2</td>
<td>Sector 14, Wall under pilaster</td>
<td>Plaster. This sample is 3cm². It looks similar than sample 1. The final coat is 10YR 7/4. The oldest layer is 10 YR6/3. It doesn’t seem to have the same dark soot-like layers. However there seem to be on the back, where the older layers are, very thin layers that wasn’t part of the first sample. It weighs 1.59g.</td>
<td>Cross-section</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>R.Fourie Aug.2000</td>
<td>Kiva Q</td>
<td>3</td>
<td>Sector 14, Wall</td>
<td>Plaster. This is a thick sample. It is 5mm thick and 2cm². The most recent layers are soot like. The substrate is a red plaster with 2 thin red washes. The red washes have the soot like color as final coat. The soot layer is not continues. It is 10YR 3/1. The red wash and plaster is 7.5YR6/3. The plaster has a relief-like texture indicating that it was pressed into stone joint. There is some residue of yellow sandstone and like mortar. It weighs 2.81g.</td>
<td>Thin-section Cross-section</td>
</tr>
<tr>
<td>Location</td>
<td>Author(s)</td>
<td>Area</td>
<td>Section/Wall</td>
<td>Description</td>
<td>Sample Details</td>
<td>Notes</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------</td>
<td>------------</td>
<td>--------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Cliff Palace</td>
<td>R.Fourie</td>
<td>Kiva Q</td>
<td>4</td>
<td>Sector 6 Wall above banquette</td>
<td>This sample consists of two pieces 1 cm² and 2 cm². Its final coat is soot like layer. It consists of at least two red washes. It doesn't have a thick substrate like sample 3. However it is the same colors. The red wash 7.5YR6/3. The black is just more intense. It is 10YR 3/1. There is just more soot on the layer. I don't think this sample was exposed to gelatin treatment. It weighs 0.60g.</td>
<td>Cross-section</td>
</tr>
<tr>
<td>Cliff Palace</td>
<td>R.Fourie</td>
<td>Kiva Q</td>
<td>5</td>
<td>Sector 6 Wall above banquette between pilasters</td>
<td>This sample consists of three pieces, two that are 1 cm² and one that is 1.5 cm². It is the same as sample 4. The difference is just an extra white layer on top of the soot like layer. It also has the red wash the color is 7.5YR6/3. The black is 10YR 3/1. The white is 2.5Y 8/1. It weighs 0.36g.</td>
<td>Thin-section</td>
</tr>
<tr>
<td>Cliff Palace</td>
<td>R.Fourie</td>
<td>Kiva Q</td>
<td>6</td>
<td>Sector 2 Wall</td>
<td>This sample consists of one piece. It is 1.5 cm². The final color is the soot like. It is 10YR 3/1. There is some residue of the white campaign that was mentioned in the previous sample but further investigation is necessary. The sample consist of red washes same as the previous samples. The red wash the color is 7.5YR6/3. It weighs 0.60g.</td>
<td>Cross-section</td>
</tr>
<tr>
<td>Cliff Palace</td>
<td>F.Matero</td>
<td>Kiva Q</td>
<td>7</td>
<td>Deflector Southside: Fewkes repair with prehistoric repair. (red wash)</td>
<td>This sample is 7cm x 3cm. It weighs 50gm. It consists of a yellow wash as final color with grayish mortar. This is a recent repair that simulates the top original thick mortar. There are some historic red washes visible where the repair was smeared over the original plaster. The repair has organic matter visible such as roots and grass. Tool marks for smoothing out the final yellow plaster finish is visible very faintly. The yellow color is 2.5Y 7/4. The gray mortar is 2.5Y 6/2. It weighs 68.47g.</td>
<td>Thin-section</td>
</tr>
<tr>
<td>Location</td>
<td>Author</td>
<td>Date</td>
<td>Kiva</td>
<td>Sample</td>
<td>Description</td>
<td>Details</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------------</td>
<td>---------------</td>
<td>------</td>
<td>--------</td>
<td>-----------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>F.Matero R.Fourie Aug.2001</td>
<td><strong>Kiva Q</strong></td>
<td>8</td>
<td></td>
<td><strong>Deflector West side:</strong> Fewkes repair. Deflector mortar is yellow.</td>
<td>This sample is 8cm x 2cm. It consists of a yellow wash as final color with grayish mortar. Same as sample 7. However this includes historic repair. That was part of a new campaign. This piece of mortar was removed and it revealed the niche. The sample has the bottom left corner shape of the niche because it was smeared over the edge of the niche. This is a recent repair that simulates the top original thick mortar. The mortar has organic matter visible such as roots and grass. Tool marks for smoothing out the final yellow plaster finish is visible very faintly. The yellow color is 2.5Y 7/4. The gray mortar is 2.5y 6/2. It weighs 69.18g.</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>F.Matero R.Fourie Aug.2001</td>
<td><strong>Kiva Q</strong></td>
<td>9</td>
<td></td>
<td><strong>Deflector Southside:</strong> Second campaign</td>
<td>This sample is 3cm x 2cm. It consists of a gray mortar as substrate, a thin yellow plaster finish followed by a thick red wash covered with a soot like layer as the final campaign. This sample indicates either two campaigns or a historic repair. The yellow color is 2.5Y 7/4. The gray mortar is 2.5 Y 6/2. The red plaster is 7.5YR 7/4. The soot like layer has some grayish substance over it is 7.5YR 5/1. It weighs 15.65g.</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>F.Matero R.Fourie Aug.2001</td>
<td><strong>Kiva Q</strong></td>
<td>10</td>
<td></td>
<td><strong>Deflector West side:</strong> Fewkes repair</td>
<td>This sample consists of four pieces. The largest is 4cm 2cmx 0.5cm and the smallest is 1.5cm x 1.5cm x 0.5cm. It is similar to sample 7 except the sample is thinner. The historic gray mortar is not included in the sample however there are some gray residues indicating that the sample was just not taken very deep. The most recent layer is the yellow plaster finish that is Fewkes repair with slight tool marks. The yellow color is 2.5Y 7/4. The next layer is the gray mortar, the color is 2.5Y 6/2. The gray mortar is followed by a historic red plaster finish. The red plaster is 7.5YR 7/4. Finally a yellowish and like residue. Indicating the presence of historic mortar and stone. The red plaster is 7.5YR 7/4. The deflector might have had reddish top with lower area painted black.</td>
</tr>
<tr>
<td>Location</td>
<td>Description</td>
<td>Sample Characteristics</td>
<td>Notes</td>
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<tr>
<td>Kiva Q 11</td>
<td>Deflector Southside: Fewkes repair with prehistoric repair. Niche</td>
<td>This sample is just mortar no finishes visible. It is the same sample 2. It was removed just deeper inside niche. The sample consists of four pieces about 3cm² each. It is a grey mortar, 10 YR6/3. It looks porous, organic matter is visible. The question here is, is it historic repair or recent repair. The expected answer is that the mortar is historic repair. It weighs 38.70g.</td>
<td>Cross-section</td>
<td></td>
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</tr>
<tr>
<td>Kiva Q 12</td>
<td>Deflector Southside: Niche</td>
<td>This is a very small sample 2mm². This sample was removed inside the niche. It looks like the red plaster finish that is found on the deflector.</td>
<td>Cross-section</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kiva Q 13</td>
<td>Deflector Niche</td>
<td>Piece of wood and animal feces found inside the mortar from the niche.</td>
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</tr>
<tr>
<td>Kiva Q 14</td>
<td>Deflector Southside: Scrapings of red triangle</td>
<td>This is a very small sample 4mm². Red plaster finish with bright red (triangle) and soot. There is possibly white caliche layer over red of triangle. The red plaster is 7.5YR 7/4, the red triangle color seem to vary from 10YR7/4 and 10YR5/4, however this color was difficult to establish since the sample was so small.</td>
<td>Cross-section</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kiva Q 15</td>
<td>Deflector Southside: Scrapings of the white. Top right of deflector covered with soot</td>
<td>This is a very small sample. It consist of a white powder a few granules. It is part of the first campaign which is the triangle campaign part red Possibly caliches.</td>
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<tr>
<td>Kiva Q 16</td>
<td>Deflector Southside: Red wash with soot</td>
<td>This sample consists of two pieces 0.5mm². It is a red plaster finish with the typical soot like layer. Possibly white wash under black soot. The red plaster is 7.5YR 7/4. This sample represents the first campaign found on the deflector. It weighs 0.69g.</td>
<td>Cross-section</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Kiva Q 17</td>
<td>Deflector East Second campaign</td>
<td>This sample consists of one 1cm² It is a red plaster finish with the typical soot like layer and gray mortar substrate. The red plaster is 7.5YR 7/4. This sample represents the second campaign found on the deflector. It weighs 1.24g.</td>
<td>Cross-section</td>
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<tr>
<td>Kiva Q 18</td>
<td>Deflector East Repair on top of pre-historic repair mortar</td>
<td>This small sample that consists of 6 pieces the largest is 0.5cm² and the smallest is 0.03mm². It is a yellow mortar 2.5Y 7/3. It weighs 2.11g.</td>
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</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>F Mateo R. Fourie Aug. 2001</td>
<td><strong>Kiva Q</strong></td>
<td>19</td>
<td>Sector 11: Fell Plaster</td>
<td>This is a large sample. It consists of 6 pieces. Largest is 2cm x 1.5cm x 0.2cm. This is a plaster finish flakes that fell from the wall. It has substrate embossing. The substrate could have been stone; it has the tool picked markings in the embossing and a sandy residue that resembles the sandstone. It has several layers of red wash finish. It also has a bright red finish color on some of the flakes. The red plaster is 7.5YR 7/4. The bright red is 5YR 6/6. It weighs 8.18g.</td>
<td>Cross section</td>
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<tr>
<td>Cliff Palace 5MV0625</td>
<td>F. Matero R. Fourie Aug. 2001</td>
<td><strong>Kiva Q</strong></td>
<td>20</td>
<td>Sector 16: Lancaster Repair</td>
<td>This is a large sample 5cm x 4 cm x 2cm. Weigh about 50gm. It is a yellow mortar 2.5Y 7/4. It coarse textures and white particles are visible possibly caliches. It weighs 68.31g.</td>
<td>Thin section Cross section</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>F. Matero R. Fourie Aug. 2001</td>
<td><strong>Kiva Q</strong></td>
<td>21</td>
<td>Sector 16: Fewkes Repair</td>
<td>This sample consists of two pieces. This is a large sample 5cm x 5 cm x 2cm. Weigh about 80gm. It is a yellow mortar 2.5Y 7/4. The final finish is very smooth almost tool like. The broken side of the mortar is very coarse. It is coarser than the previous sample 20. There is an abundance of white particles visible possibly caliches. It weighs 142.62g.</td>
<td>Thin section</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>M. Slater June 1998</td>
<td><strong>Kiva Q</strong></td>
<td>22</td>
<td>Sector 10: Fell Plaster</td>
<td>This is a large sample that consists of a variety type plaster finish flakes. In total these weigh about 30gm. There is some white campaign, red and soot like campaigns visible on mostly the typical red plaster. It weighs 28.20g.</td>
<td>Cross section</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>M. Slater June 1998</td>
<td><strong>Kiva Q</strong></td>
<td>23</td>
<td>Sector 10: Fell Plaster</td>
<td>This is a small sample that consists of a variety type plaster finish flakes. In total these weigh about 10gm. There is some white campaign, red and soot like campaigns visible on mostly the typical red plaster. It weighs 6.56g.</td>
<td>Cross section</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>M. Slater June 1998</td>
<td><strong>Kiva Q</strong></td>
<td>24</td>
<td>Sector 10: Fell Plaster</td>
<td>This is a large sample that consists of a variety type plaster finish flakes. In total these weigh about 80gm. There is some white campaign, red and soot like campaigns visible on mostly the typical red plaster. It weighs 29.70g.</td>
<td>Cross section</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>M. Slater June 1998</td>
<td><strong>Kiva Q</strong></td>
<td>25</td>
<td>Sector 10: Fell Plaster</td>
<td>This is a large sample that consists of one-piece 5cm x 3cm x 1.5cm. It the red plaster with gray mortar. With mortar embossing of the stone joint. In total these weigh about 10gm. It weighs 16.04g.</td>
<td>Cross section</td>
</tr>
<tr>
<td>Location</td>
<td>Author</td>
<td>Date</td>
<td>Sample Description</td>
<td>Type</td>
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<tr>
<td>Kiva Q 26</td>
<td>M. Slater</td>
<td>June 1998</td>
<td>This is a large sample that consists of one-piece 4cm x 3cm x 0.5cm. It is the red plaster with some gray mortar. Mortar embossing of the stone joint. It weighs 8.54g.</td>
<td>Cross section</td>
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<tr>
<td>Kiva Q 27</td>
<td>M. Slater</td>
<td>June 1998</td>
<td>This is a large sample that consists of one-piece 4cm x 3cm x 0.5cm. It is the red plaster with white, gray and bright red finishes visible. It weighs 6.15g.</td>
<td>Cross section</td>
<td></td>
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</tr>
<tr>
<td>Kiva Q 28</td>
<td>M. Slater</td>
<td>June 1998</td>
<td>This is a large sample that consists of one-piece 4cm x 3cm x 0.5cm. The red plaster is thick with some gray mortar. Mortar embossing of the stone joint. It weighs 12.00g.</td>
<td>Cross section</td>
<td></td>
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</tr>
<tr>
<td>Kiva Q 29</td>
<td>M. Slater</td>
<td>June 1998</td>
<td>This sample consists of loose soil couple small chunks of mortar. It seems to be a mortar that has been pulverized. It is about 15gm. Organic matter is visible, white particles possible caliches is also found. It weighs 25.15g.</td>
<td>Cross section</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kiva Q 30</td>
<td>M. Slater</td>
<td>June 1998</td>
<td>This is a large sample. Pity the exact location is not known because it will be harder to determine whether this is first or second campaign. It consists of three pieces. 3cm x 2cm x 0.5cm each. It is the typical gray mortar with red plaster finish covered with soot. However white particles are visible on the top surface indicating that it is possibly part of the first campaign. It weighs 15.23g.</td>
<td>Thin section</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kiva Q 31</td>
<td>M. Slater</td>
<td>June 1998</td>
<td>This sample consists of two pieces. They do not look the same in color and thickness. It possible that the thin one was on layer and the gray thick one was the next campaign. The small one is about 3cm x 2 cm x 0.5cm and yellow 2.5Y7/4. Indications of tool marks are found confirming that this might me modern repair. The gray mortar is possibly prehistoric. It is about 3cm x 2 cm x 1cm. It has organic matter visible and coarse particles. The color is 5Y 7/2. It weighs 20.85g.</td>
<td>Thin section</td>
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<tr>
<td>Kiva Q 32</td>
<td>M. Slater</td>
<td>June 1998</td>
<td>This is a large sample It is 3cm x 4cm x 2 cm. It is coarse grained with an abundance of white caliches particles. Embossing marks are found visible or maybe tool marks. It weighs 3.75g.</td>
<td>Thin section Cross section</td>
<td></td>
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</tr>
<tr>
<td>Kiva Q 33</td>
<td>M. Slater</td>
<td>June 1998</td>
<td>This is a large sample. It is mainly gray but on the one side it gradually changes to yellow. Charcoal and large metamorphic aggregates are visible. Some organic matter is</td>
<td>Thin section</td>
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</tbody>
</table>

**Note:** The table entries are based on the provided text without attempting to interpret or summarize the content further. The table format is designed to clearly capture the details as extracted from the text.
also found. Very few caliches are seen. It is about 3cm x 3cm 5cm. The gray is 2.5Y 6/2. It weighs 89.21g.

Cliff Palace 5MV0625  M. Slater June 1998 Kiva Q  34  On top of pilaster repair after Lancaster. Exact location unknown This is a large sample. It consists of 10 pieces. It is yellow 2.5 Y 7/3. Some tool marks and joint embossing are visible. There are some remnants of historic mortar on one of the pieces. The historic mortar is gray. The sample weighs 112.20g.

Cliff Palace 5MV0625  M. Slater June 1998 Kiva Q  35  Fell plaster with mortar Exact location unknown This sample is small. It consists of three pieces. 2cm x 2cm x 0.5cm. Two pieces look like the red plaster with washes found on the wall in Kiva Q. The third is a gray piece. Probably removed under the plaster and is part of the floor stratigraphy. The two red plasters are slightly curved indicating that they were removed were the floor and wall meet. The red plaster is 7.5YR 7/3. The gray is 5Y 7/2. It weighs 19.04g. Thin section Cross section

Cliff Palace 5MV0625  M. Slater June 1998 Kiva Q  36  Section 10: Pre-historic Mortar Exact location unknown This sample is average size for a mortar it has been pulverized. Some organic matter is visible. 2.5Y 6/3. It weighs 23.73g.

<table>
<thead>
<tr>
<th>Site Name Number</th>
<th>Sampler Date</th>
<th>Unit#</th>
<th>Sample #</th>
<th>Location</th>
<th>Description</th>
<th>Tests</th>
<th>Slater #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>M. Slater June 1998</td>
<td>Kiva Q</td>
<td>37</td>
<td>Pilaster 1: Extruded smooth, red layers and black layers</td>
<td>There is very little left of this sample.</td>
<td>XRD Thin section, Cross section</td>
<td>1*</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>M. Slater June 1998</td>
<td>Kiva Q</td>
<td>38</td>
<td>Pilaster 2: From Stone, not mortar joint</td>
<td>There is very little left of this sample.</td>
<td>Thin section Cross section</td>
<td>2</td>
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<tr>
<td>Cliff Palace 5MV0625</td>
<td>M. Slater June 1998</td>
<td>Kiva Q</td>
<td>39</td>
<td>Pilaster 1: 1E Extruded smooth from joint: gray</td>
<td>There is very little left of this sample.</td>
<td>Thin section Cross section</td>
<td>3</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>M. Slater June 1998</td>
<td>Kiva Q</td>
<td>40</td>
<td>Pilaster 3: 3E Feather edge of extruded</td>
<td>There is very little left of this sample.</td>
<td>XRD Thin section Cross</td>
<td>4</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>M. Slater June 1998</td>
<td>Kiva Q</td>
<td>Section</td>
<td>Notes</td>
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<tr>
<td>41 Pilaster 2 From Stone</td>
<td>There is very little left of this sample.</td>
<td>Thin section</td>
<td>5</td>
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<tr>
<td>42 Pilaster 3 Near joint possibly extruded</td>
<td>There is very little left of this sample.</td>
<td>Thin section Cross section</td>
<td>6</td>
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<td>43 Pilaster 3: 3E</td>
<td>There is very little left of this sample.</td>
<td>XRD Thin section Cross section</td>
<td>7</td>
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<tr>
<td>44 Section 2</td>
<td>There is very little left of this sample.</td>
<td>XRD Thin section</td>
<td>9</td>
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<tr>
<td>45 Section 2 Mortar</td>
<td>There is very little left of this sample.</td>
<td>Thin section</td>
<td>10</td>
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<tr>
<td>46 Section 5 Wall between Pilaster 4 and 5.</td>
<td>There is very little left of this sample.</td>
<td>XRD Cross section Thin section</td>
<td>11</td>
<td></td>
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<tr>
<td>47 Pilaster 3 Juncure of banquette tip and pilaster bottom</td>
<td>There is very little left of this sample.</td>
<td>XRD Cross section Thin section</td>
<td></td>
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<tr>
<td>48 Section 11 Not a complete c-section, but includes white</td>
<td>There is very little left of this sample.</td>
<td>Thin section</td>
<td></td>
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<tr>
<td>49 Section 11 Mortar joint</td>
<td>There is very little left of this sample.</td>
<td>XRD Cross section Thin section</td>
<td></td>
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<tr>
<td>50 Section 11 Decorative band (lower)</td>
<td>There is very little left of this sample.</td>
<td>XRD Thin section</td>
<td></td>
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<tr>
<td>51 Section 11 Below decorative band – broken (crush for</td>
<td>There is very little left of this sample. It weighs 3.01g</td>
<td>FTIR</td>
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<tr>
<td>Cliff Palace</td>
<td>M. Slater</td>
<td>Kiva Q</td>
<td>Section</td>
<td>Analysis</td>
<td>Techniques</td>
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<tr>
<td>5MV0625</td>
<td>June 1998</td>
<td>52</td>
<td>11</td>
<td>Below decorative band – (Red dado)</td>
<td>Cross Thin</td>
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<td></td>
<td>There is very little left of this sample. Just a few granules</td>
<td>section section</td>
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<td></td>
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<td>53</td>
<td>11</td>
<td>Junction of Kiva wall and floor</td>
<td>XRD Thin</td>
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<td>There is very little left of this sample.</td>
<td>section Thin</td>
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<td></td>
<td></td>
<td>54</td>
<td>12</td>
<td>Two samples 18a/18b</td>
<td>XRD Cross Thin section</td>
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<td>There is very little left of this sample. section Thin</td>
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<td></td>
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<td>55</td>
<td>13</td>
<td>Right wall, 4” in, &amp; mortar from stone vertical joint</td>
<td>Cross Thin</td>
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<td>There is very little left of this sample.</td>
<td>section Thin</td>
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<td>56</td>
<td>13</td>
<td>Right wall inner lip before stone inset (1”)</td>
<td>Cross Thin</td>
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<td>There is very little left of this sample.</td>
<td>section Thin</td>
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<td></td>
<td></td>
<td>57</td>
<td>12</td>
<td>Rear bottom mortar joint</td>
<td>Thin</td>
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<td>There is very little left of this sample.</td>
<td>section</td>
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<tr>
<td></td>
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<td>58</td>
<td>10</td>
<td>Left side wall from stone</td>
<td>XRD Thin section</td>
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<td>There is very little left of this sample.</td>
<td>section</td>
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<td></td>
<td></td>
<td>59</td>
<td>9</td>
<td>1934 repair</td>
<td>Thin</td>
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<td></td>
<td>There is very little left of this sample. It weighs 1.41g.</td>
<td>section</td>
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</tr>
</tbody>
</table>

* Mary Slater’s Thesis.
Uncut reflected light photographs
Sample 1 and 2 are on top of sample 3.
- Stain Buff

Magnification 5x

Sample 1: Sector 14 - Wall under pilaster
- Tan
- Soot
- Brown
- Soot

Magnification 12.5x

Sample 2: Sector 10 - Wall
- Tan
- Buff
- Soot
- Brown
- Soot

Magnification 12.5x

Sample 3: Sector 14 - Wall
- Grey white
- Stain Buff 2

Magnification 12.5x

Kiva Q: Stratigraphy of Wall - Samples 1-3
Kiva Q: Stratigraphy of wall - Sample 53 and Sample 54

Sample 54a: Dado right side of division

Sample 54b: Dado right side of division

Sample 54: Cross section that combines Sample 54a and 54b.

Sample 53: Juncure of floor and wall
Kiva Q: Stratigraphy of Wall - Samples 48-50 and 52

Sample 48 Sector 11: Wall below banquette

Sample 49 Sector 11: Wall mortar-joint

Sample 50 Sector 11: Wall Decorative Band (lower)

Sample 52 Sector 11: Below Decorative Band
Kiva Q: Niches 1 - 4; Samples 55-58

Sample 57: Niche 2

Sample 56: Niche 4

Sample 58: Niche 1 (like sample 53)

Sample 55: Niche 3

Magnification 12.5x
Kiva Q: Pilasters 1 and 2 - Samples 37, 38, 39 and 41

Sample 39: Pilaster 1 - Extruded smooth

Sample 39: Pilaster 1
- Red
- Brown 1
- Buff 2
- Beige

Sample 37: Pilaster 1
- Red
- Brown 1
- Buff 1
- Beige

Sample 41: Pilaster 2

Sample 38: Pilaster 2 Extruded smooth layers
- Red/white
- Brown 1
- Stained
- Buff 2

Magnification 12.5x
Kiva Q: Pilaster 3 - Samples 40, 42, 43 and 47

**Sample 42: pilaster 3 - Near joint possibly extruded**
- Red/white
- Buff 2
- Beige plaster

**Sample 40: Pilaster 3:3E - High Side**
- White
- Brown 1
- Stained Buff 2

**Sample 43: Pilaster 3 - Low Side**
- Tan
- Red
- Brown 1
- Stained Buff 2

**Sample 47b & 47f: Pilaster 3 - Juncture of banquette tip and pilaster bottom**
- Red/orange
- White
- Buff 2
- Beige plaster

Magnification 12.5x
Sample 4: Wall between pilaster 5 and 6

Sample 5: Wall between pilaster 4 and 5

Sample 46: Wall between pilaster 4 and 5

Kiva Q: Wall between pilasters 4 and 5; wall between pilasters 5 and 6

Unmounted RFL Magnification 5x

Magnification 12.5x
Kiva Q: Wall between pilaster 1 and 2, and wall between pilaster 2 and 3

Sample 6: Wall between pilaster 1 and 2

Sample 44: Wall between pilaster 1 and 2

Sample 45f: Wall between pilaster 2 and 3

Brown + White - Red
Buff 2 -
Beige -

Buff 2 -
Beige -

Soot - Brown
Buff
Brown Buff possibly

Magnification 12.5x
The shape factor and perimeter of the aggregate from the different layers are quantified. The aggregate of each layer is traced and marked. See the corresponding table for relevant data to each number and layer.
The shape factor and perimeter of the aggregate from the different layers are quantified. The aggregate of each layer is traced and marked. See the corresponding table for relevant data to each number and layer.
<table>
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<th>Layer</th>
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*Note: The table represents the shapes and factors for a specific aggregate, with each layer having different shape factors.*
6.4.2 Kiva K
Samples 2-10, 18, and 35-37 is fallen plaster. The locations of samples 21, 38, and 39 are uncertain. Sample 25 and 26 are from sides of pilaster 2.
<table>
<thead>
<tr>
<th>Site Name Number</th>
<th>Sampler Date</th>
<th>Unit#</th>
<th>Sample #</th>
<th>Location</th>
<th>Description</th>
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<tbody>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>F Matero Aug 2000</td>
<td>Kiva K</td>
<td>01</td>
<td>East Front Corner edge of shelf Sector 11</td>
<td>This is a large sample. It is one piece of mortar with red plaster finish. It is 8cm x 5cm x 2.5cm. It weighs 202.78g. The red plaster color is 10YR 7/3. The mortar is grey 2.5Y6/2. Sand stones, caliche and organic material visible. It also seems to have recycled plaster finish. The sample has an oval shape on the side of the plaster finish. Indicating that the edge was rounded. The sample is not as porous and hard as some samples seem to be.</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>F Matero Aug 2000</td>
<td>Kiva K</td>
<td>02</td>
<td>On floor of ventilator Sector 9</td>
<td>Sample 2 is large. It is a piece of mortar that was found in the ventilator. It is 8cm x 5cm x 2.5cm. The mortar is grey 2.5Y6/2. It seems to have some remnants of a finish. The finish seems to look the same as the mortar it was just compacted. The sample weighs 185.59g.</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>F Matero Aug 2000</td>
<td>Kiva K</td>
<td>03</td>
<td>On floor of ventilator Sector 9</td>
<td>Sample 3 is large. It is 8cm x 4cm x 2.5cm. It is a piece of mortar that was found in the ventilator. It looks like it is from the deflector. The deflector is made out of pieces of wood standing up right with mortar packed around it. This sample has a large distribution of aggregate size caliche. It also seems porous and shrinkage cracks are visible. The mortar is yellow 2.5Y7/3. It is possible to be a modern repair. The sample weighs 172.88g.</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>F Matero Aug 2000</td>
<td>Kiva K</td>
<td>04</td>
<td>Fallen Sector 10</td>
<td>This sample consists of 8 pieces of mortar some with finishes. Some are grey and seem to be definite prehistoric, others are yellowish and have tool marks indicating that they are modern repairs. This sample weighs 184.47g.</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>F Matero Aug 2000</td>
<td>Kiva K</td>
<td>05</td>
<td>Fallen Sector 10</td>
<td>Sample is large. It is 6cm x 3cm x 2.5cm. It consists of mostly yellow mortar and some grey mortar. The yellow mortar is 2.5Y7/3. The grey mortar color is 2.5Y6/2. It was shaped by hand, finger prints are visible. One might ascertain that this sample is a modern repair encompassing prehistoric mortar. The sample weighs 129.81.</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>F Matero Aug 2000</td>
<td>Kiva K</td>
<td>06</td>
<td>Fallen Sector 12</td>
<td>This is medium size sample. It is 5cm x 4cm x 1.5cm. It is a mortar with red plaster finish. There is a thick red plaster substrate followed by the grey mortar. This sample is probably from the wall in the burnt area. The red plaster finish is 7.5YR 6/4. The grey mortar is 2.5Y6/2. It weighs 54.35g.</td>
</tr>
<tr>
<td>Cliff Palace</td>
<td>F Matero</td>
<td>Kiva</td>
<td>07</td>
<td>Fallen</td>
<td>Sector 12</td>
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<tr>
<td>Cliff Palace</td>
<td>F Matero</td>
<td>Kiva</td>
<td>-08</td>
<td>Test fill mortar H2O only</td>
<td>This is a small sample. It is 3cm x 1.5cm x 2cm It is oval shaped. It is grey mortar. The color is 2.5Y6/3. It was made by JMT. It is recycled soil from the ventilator. Sieved and mixed with water. This was used to do edging and compensation in the Kiva. Note no shrinkage cracks. It weighs 7.7g.</td>
</tr>
<tr>
<td>Cliff Palace</td>
<td>F Matero</td>
<td>Kiva</td>
<td>09</td>
<td>Fallen probably from the banquette wall Sector 13</td>
<td>This is a small sample. It consists of many small plaster flakes. It is red plaster that burnt. It weighs 8.11g. The back of the plaster finish is 7.5YR 413. There is some of the red plaster visible it is 7.5YR 6.4. There is soot like layer on top of the finish 2.5Y 411.</td>
</tr>
<tr>
<td>Cliff Palace</td>
<td>F Matero</td>
<td>Kiva</td>
<td>10</td>
<td>Fallen probably from P3 face Sector 13</td>
<td>This is a small sample. It consists of many small plaster flakes. It weighs 2.89g. The back of the plaster finish is 2.5YR 311. There is light red plaster as final finish. It is 10YR 7.3. There is soot like layer on top of the finish 2.5Y 411. It seems to be from the areas were plaster is intact but were it has the staining problem. The soot like layer at the back is the problem.</td>
</tr>
<tr>
<td>Cliff Palace</td>
<td>F Matero</td>
<td>Kiva</td>
<td>11</td>
<td>Mortar Sector 12 Wall between pilaster 1-2</td>
<td>This is a very small sample after thinsection sample was removed. It is the grey prehistoric mortar. It weighs 0.54g. The grey mortar is 2.5Y 612. Upper wall mortar appears to be applied after sooting</td>
</tr>
<tr>
<td>Cliff Palace</td>
<td>F Matero</td>
<td>Kiva</td>
<td>12</td>
<td>Ventilator, mortar Sector 9</td>
<td>This is a very small sample after thinsection sample was removed. It is the grey prehistoric mortar. It weighs 0.87g. The grey mortar is 2.5Y 612. It has white particles. It is very soft. To banquette mortar, original- not like upper wall</td>
</tr>
<tr>
<td>Cliff Palace</td>
<td>F Matero</td>
<td>Kiva</td>
<td>13</td>
<td>Boulder Sector 7</td>
<td>Burnt wash on boulder adj. to pilaster 4</td>
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<td>Cliff Palace</td>
<td>F Matero</td>
<td>Kiva</td>
<td>14</td>
<td>Shelf Sector 9</td>
<td>This is a large sample. It consists of several pieces of very soft mortar. It is the grey color 2.5Y 612. lots of charcoal and organic matter such as grass and roots are visible. It weighs 62.2g. It is possibly Fewkes repair.</td>
</tr>
<tr>
<td>Cliff Palace</td>
<td>F Matero</td>
<td>Kiva</td>
<td>15</td>
<td>Juncture of original repair Sector 6</td>
<td>This is a small sample. It consists of four pieces. It is more a red plaster 10YR 7/3. tool marks are visible. The back has traces of grey prehistoric mortar. It seems to be a Fewkes repair smeared over original mortar. It weighs 10.8g.</td>
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<td>Cliff Palace 5MV0625</td>
<td>F Matero Aug 2000</td>
<td>Kiva K</td>
<td>16</td>
<td>Masonry Sector 11 Banquette shelf</td>
<td>This is a small sample. It consists of several irregular shaped mortar pieces. The mortar is light yellow 2.5YR/6. It is very brittle. Large amount of white aggregate particles are visible. It is a modern repair done by Decker. It weighs 12.83g.</td>
</tr>
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<td>Cliff Palace 5MV0625</td>
<td>F Matero Aug 2000</td>
<td>Kiva K</td>
<td>17</td>
<td>Middle of Wall Sector 11</td>
<td>This is a small sample. It is 1.7cm x 1.5cm x 0.5cm. It consists of red plaster with red finishes 7.5YR 614. It weighs 2.4g.</td>
</tr>
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<td>Cliff Palace 5MV0625</td>
<td>F Matero Aug 2000</td>
<td>Kiva K</td>
<td>18</td>
<td>Fallen Sector 14</td>
<td>This is a medium size sample. It consists of many pieces of mainly red plaster with red finishes. The overall color is 7.5YR 614. It weighs 20.59g.</td>
</tr>
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<td>Cliff Palace 5MV0625</td>
<td>M. Slater 1998</td>
<td>Kiva K</td>
<td>19</td>
<td>Wall Sector 14</td>
<td>This is a very small sample. It consists of plaster and some finishes. It is red plaster finish with grey and soot like layers over it. The light grey is 10YR 611. It weighs 1.07g.</td>
</tr>
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<td>Kiva K</td>
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<td>Kiva K</td>
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<td>M. Slater 1998</td>
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<td>M. Slater 1998</td>
<td>Kiva K</td>
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<td>Kiva K</td>
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<td>Left corner of pilaster Sector 2 Pilaster 2</td>
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<td>Kiva K</td>
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<td>Below wash line Sector 5 Pilaster 3</td>
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<td>Kiva</td>
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</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>M. Slater 1998</td>
<td>Kiva</td>
<td>30</td>
<td>Reconstructed stratigraphy Sector 5 Pilaster 3</td>
<td>Cross-section</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>M. Slater 1998</td>
<td>Kiva</td>
<td>31</td>
<td>Transitional area below P2 Sector 4 Pilaster 2</td>
<td>Thin-section</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>M. Slater 1998</td>
<td>Kiva</td>
<td>32</td>
<td>Face at juncture with rock Sector 4 Pilaster 2</td>
<td>Cross-section</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>M. Slater 1998</td>
<td>Kiva</td>
<td>33</td>
<td>Sector 15 Rock) Wall</td>
<td>Cross-section</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>M. Slater 1998</td>
<td>Kiva</td>
<td>34</td>
<td>Single layer from rock Sector 15 Wall</td>
<td>Cross-section</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>M. Slater 1998</td>
<td>Kiva</td>
<td>35</td>
<td>Plaster Sector Uncertain</td>
<td>Cross-section</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>M. Slater 1998</td>
<td>Kiva</td>
<td>36</td>
<td>Plaster with mortar fell to floor. Big sample. Uncertain</td>
<td>Cross-section</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>M. Slater 1998</td>
<td>Kiva</td>
<td>37</td>
<td>Plaster fell. Uncertain</td>
<td>Cross-section</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>M. Slater 1998</td>
<td>Kiva</td>
<td>38</td>
<td>Side of pilaster Uncertain</td>
<td>Repair mortar c. 1985?</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>M. Slater 1998</td>
<td>Kiva</td>
<td>39</td>
<td>Same as S. Wall Uncertain</td>
<td>Repair mortar. Fewkes?</td>
</tr>
</tbody>
</table>
Kiva K: Stratigraphy of Wall - Samples 17, 19, 20, and 33

Sample 20: Sector 11 - Middle wall

Sample 17: Sector 12 - Middle wall

Sample 19: Sector 14 - Aura of niche

Sample 33: Sector 15 - Wall area on boulder

Reflected Light; 12.5x Magnification
Kiva K: Stratigraphy of Pilasters 2-4: Samples 24, 26-29

Sample 24: Left side high
Sample 29: Front high
Sample 26: Left side low
Sample 27: Left side low
Sample 28: Front high
Sample 25: Front low

Reflected Light; 12.5x Magnification
## Mineralogy of Clay-size Fraction

<table>
<thead>
<tr>
<th>LAB'S SAMPLE #</th>
<th>OWNER'S #</th>
<th>KAO</th>
<th>ILL</th>
<th>CHL</th>
<th>SME</th>
<th>I/S</th>
<th>OTHERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>GA99001</td>
<td>Kiva K plaster</td>
<td>7</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>CAL</td>
</tr>
<tr>
<td>GA99002</td>
<td>Kiva Q plaster</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>4</td>
<td>CAL, (?)</td>
</tr>
<tr>
<td>GA99003</td>
<td>Kiva Q mortar (small)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>- Nitritine (NaNO3), Rosickyte (S), (?)</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** KAO = kaolinite, ILL = illite, CHL = chlorite, SME = smectite, and I/S = mixed-layer illite and smectite. Clay minerals reported as parts in ten. TR = trace or less than 0.5 parts in 10. Non-clay minerals: CAL = calcite, DOL = dolomite, FEL = feldspar, GYP = gypsum, QTZ = quartz, ORT = orthoclase, PLA = plagioclase, UNK = small amount of unknown, (?) = mineral may be present, _ = major component, and ( ) = minor component.

**Date:** April 7, 1999

**By:** [Signature]
### NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES

**Bulk Mineralogy**

<table>
<thead>
<tr>
<th>LAB'S SAMPLE #</th>
<th>OWNER'S SAMPLE #</th>
<th>MINERALS IN ORDER OF ABUNDANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>GA99001</td>
<td>Kiva K plaster</td>
<td>QTZ, CLA, CAL, DOL, ORT</td>
</tr>
<tr>
<td>GA99002</td>
<td>Kiva Q plaster</td>
<td>QTZ, CAL, PLA, CLA (?)</td>
</tr>
<tr>
<td>GA99003</td>
<td>Kiva Q mortar</td>
<td>QTZ, CAL, PLA, KAO, I/S, (?)</td>
</tr>
</tbody>
</table>

**NOTE:** Clay and feldspar subdivided where possible. AMP = amphiboles (dark-colored, Fe-Mg silicates), CAL = calcite (CaCO₃), CLA = clay minerals: very finely divided hydrous aluminosilicates, DOL = dolomite (CaMg(CO₃)₂), FEL = feldspar, ORT = orthoclase feldspar, PLA = plagioclase feldspar, QTZ = quartz (SiO₂), UNK = trace amount of unknown, and (?) = may be present.

**Date**  April 7, 1997

**By** [Signature]
6.4.3 Room 64
### Room 64: Sample List

Mesa Verde National Park, Mesa Verde, CO.

<table>
<thead>
<tr>
<th>Site Name #</th>
<th>Samplers</th>
<th>Unit#</th>
<th>GIN/Seg#</th>
<th>Sample #</th>
<th>Description</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>F. Matero R. Fourie Aug 2001</td>
<td>Rm. 64</td>
<td>Sector 4</td>
<td>01</td>
<td>Aura with grey plaster, thick red wash and two grey washes</td>
<td>Cross-section</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>F. Matero R. Fourie Aug 2001</td>
<td>Rm. 64</td>
<td>Sector 3</td>
<td>02</td>
<td>Scrapings of the tan mud balls</td>
<td>Cross-section</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>F. Matero R. Fourie Aug 2001</td>
<td>Rm. 64</td>
<td>Sector 3</td>
<td>03</td>
<td>Grey mud balls and some red finish.</td>
<td>Cross-section</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>F. Matero R. Fourie Aug 2001</td>
<td>Rm. 64</td>
<td>Sector 5</td>
<td>04</td>
<td>Fewkes repair: Repointing mortar under door opening.</td>
<td>Cross-section</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>F. Matero R. Fourie Aug 2001</td>
<td>Rm. 64</td>
<td>Sector 8</td>
<td>05</td>
<td>Dark grey mud balls</td>
<td>Cross-section</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>F. Matero R. Fourie Aug 2001</td>
<td>Rm. 64</td>
<td>Sector 1</td>
<td>06</td>
<td>Chunk of stone with mortar and red finish. Above doorway</td>
<td>Cross-section</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>F. Matero R. Fourie Aug 2001</td>
<td>Rm. 64</td>
<td>Sector 4</td>
<td>07</td>
<td>Big chunk of mortar from above doorway.</td>
<td>Cross-section</td>
</tr>
</tbody>
</table>
6.4.4 Room 121
**Kiva 121: Sample List**

C.A.S.P.A.R: Conservation of Architectural Surfaces Program for Archaeological Resources
Mesa Verde National Park, Mesa Verde, CO.

<table>
<thead>
<tr>
<th>Site Name Number</th>
<th>Sampler Date</th>
<th>Unit#</th>
<th>Sample#</th>
<th>Location</th>
<th>Description</th>
<th>Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>F Matero Aug.2000</td>
<td>Rm 121</td>
<td>1</td>
<td>North-Wall; Red Dado</td>
<td>Red Dado Repair</td>
<td>Thin-section Cross-section</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>F Matero Aug.2000</td>
<td>Rm 121</td>
<td>2</td>
<td>West-Wall; White Dado</td>
<td></td>
<td>Thin-section Cross-section</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>F Matero Aug.2000</td>
<td>Rm 121</td>
<td>3</td>
<td>North-Wall; Red Dado</td>
<td></td>
<td>Thin-section Cross-section</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>F Matero Aug.2000</td>
<td>Rm 121</td>
<td>4</td>
<td>Red Dado Repair</td>
<td></td>
<td>Thin-section Cross-section</td>
</tr>
<tr>
<td>Cliff Palace 5MV0625</td>
<td>F Matero Aug.2000</td>
<td>Rm 121</td>
<td></td>
<td>West-Wall Field</td>
<td></td>
<td>Thin-section Cross-section</td>
</tr>
</tbody>
</table>
6.5 Schedule of mortar coupons
### Mesa Verde / Cliff Palace, 5Mv0625
### Mortar Coupons - Edging & Filling Soil Mixtures

All the mortar coupons were placed on pre-cast concrete slabs. The control mortar coupons were marked with a "C" and placed in Room 51. The rest were placed in Kiva I to weather. August 2001

<table>
<thead>
<tr>
<th>Soil Mixture</th>
<th>Binder: 5% Acrylic</th>
<th>Binder: Water</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coupon Number*</td>
<td>Weight (g)</td>
</tr>
<tr>
<td>1:4:1:3</td>
<td>X1</td>
<td>172.3</td>
</tr>
<tr>
<td></td>
<td>X2</td>
<td>176.9</td>
</tr>
<tr>
<td></td>
<td>X3</td>
<td>177.8</td>
</tr>
<tr>
<td></td>
<td>CX4</td>
<td>190.0</td>
</tr>
<tr>
<td>3:1:0</td>
<td>X5</td>
<td>192.2</td>
</tr>
<tr>
<td></td>
<td>X6</td>
<td>214.4</td>
</tr>
<tr>
<td></td>
<td>X7</td>
<td>182.8</td>
</tr>
<tr>
<td></td>
<td>CX8</td>
<td>191.1</td>
</tr>
<tr>
<td>1:0:1</td>
<td>X9</td>
<td>207.7</td>
</tr>
<tr>
<td></td>
<td>X10</td>
<td>210.6</td>
</tr>
<tr>
<td></td>
<td>X11</td>
<td>198.8</td>
</tr>
<tr>
<td></td>
<td>CX12</td>
<td>202.6</td>
</tr>
<tr>
<td>2:5:1</td>
<td>X13</td>
<td>187.3</td>
</tr>
<tr>
<td></td>
<td>X14</td>
<td>189.9</td>
</tr>
<tr>
<td></td>
<td>X15</td>
<td>180.0</td>
</tr>
<tr>
<td></td>
<td>CX16</td>
<td>219.6</td>
</tr>
<tr>
<td>1:5:1</td>
<td>X17</td>
<td>187.9</td>
</tr>
<tr>
<td></td>
<td>X18</td>
<td>185.9</td>
</tr>
<tr>
<td></td>
<td>X19</td>
<td>172.4</td>
</tr>
<tr>
<td></td>
<td>CX20</td>
<td>177.2</td>
</tr>
<tr>
<td>1:6:2</td>
<td>X21</td>
<td>185.0</td>
</tr>
<tr>
<td></td>
<td>X22</td>
<td>187.2</td>
</tr>
<tr>
<td></td>
<td>X23</td>
<td>179.4</td>
</tr>
<tr>
<td></td>
<td>CX24</td>
<td>178.1</td>
</tr>
<tr>
<td>Banquette Mortar</td>
<td>X25</td>
<td>170.4</td>
</tr>
<tr>
<td></td>
<td>X26</td>
<td>182.1</td>
</tr>
<tr>
<td></td>
<td>X27</td>
<td>182.6</td>
</tr>
<tr>
<td></td>
<td>CX28</td>
<td>179.8</td>
</tr>
<tr>
<td>0:1:3</td>
<td>X29</td>
<td>184.2</td>
</tr>
<tr>
<td></td>
<td>X30</td>
<td>208.2</td>
</tr>
<tr>
<td></td>
<td>X31</td>
<td>171.4</td>
</tr>
<tr>
<td></td>
<td>CX32</td>
<td>182.1</td>
</tr>
<tr>
<td>0:1:1</td>
<td>X33</td>
<td>184.4</td>
</tr>
<tr>
<td></td>
<td>X34</td>
<td>191.2</td>
</tr>
<tr>
<td></td>
<td>X35</td>
<td>202.6</td>
</tr>
<tr>
<td></td>
<td>CX36</td>
<td>207.0</td>
</tr>
</tbody>
</table>

*Numbers are engraved on the back of each coupon.
6.6 Project team
Project Director: Frank G. Matero, University of Pennsylvania
Project Manager: Kathleen Fiero, National Park Service
Project Consultants: Jeanne Marie Teutonico, Getty Conservation Institute
John Fidler, English Heritage
Barry Knight, English Heritage
Katherine Dowdy
Field Supervisors: Claudia Cancino
Kecia Fong
Rynta Fourie
David Flyers
Documentation & Treatment Team: Brynn Bender
Linda Berger
Elsa Bourginon
Rebecca Carr
Chris Carson
Enrico DiNicola
M. Scott Doyle
Ana Maria Duran
Julie Eklund
Marie Farneth
Caroline Finch
Kathleen Forest
Joshua Freedland
Mary Hardy
Monica Hatter
Pietro Mangarella
Melissa McCormack
Lauren Meyer
Christine Miller
Judi Moon
Ayzegul Ozer
Al Parker
Judy Peters
Mary Slater
Nicholas Stapp
Erin Tobin
Sybilla Tringham
Pushkar Sohoni
Nuanlak Watsantachad
Recording Team: Elsa Bourginon
Amanda Didden
Rosanne Dube
Elisabeth Dubin
David Facenda
Sara Gray
Guy Munch
Brad Roeder
Nicholas Stapp
6.7 List of materials and suppliers
List of Materials and Suppliers

Hydraulic lime grouting
Acrylic emulsion Rhoplex E-330: Rohm & Haas
Banding sand
Bulk cotton
Cosmetic sponges
Crepeline: Talas
Disposable syringes w/ her-lock tip-30-60cc: Fisher Scientific
Dust masks
Extension cords
Facing brushes
High speed blender

Needles-16-18 gauge: Fisher Scientific
Plastic mixing bottles
Polyvinyl alcohol: Talas
Portable generator
Potable water
Riverton hydrated hydraulic lime: Riverton Corporation

2 Bird deterrent system

4" coil: Bird Barrier

Suppliers

Fisher Scientific
2761 Walnut Ave.
Tustin, CA 92780
800-766-7000

Rohm & Haas
Philadelphia, PA 19108
215-592-3000