NBSIR 80-2122

Development of Guide Specifications for the 1980 Exterior Restoration of the White House

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Prepared for

U.S. Department of the Interior
National Park Service
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ABSTRACT

At the request of the National Park Service, a study was performed to develop guide specifications for use in the 1980 exterior restoration of the White House. The study included 1) an evaluation of historic practices and difficulties from painting of the White House, 2) an evaluation of technical literature on surface cleaning procedures and coating systems, 3) laboratory tests of selected coatings and field tests of selected surface cleaning procedures and coatings and 4) development of guide specifications. Four coating materials were selected for evaluation in laboratory and field tests and four surface cleaning methods were evaluated in a field test at the White House, of which one system was recommended for use in the 1980 restoration.

This report presents the findings of the study and includes the proposed guide specifications.

ACKNOWLEDGMENT

The authors gratefully acknowledge the substantial contributions of staff members of the National Park Service, the Chief Usher of the White House and staff, and the Office of the Architect of the Capitol in carrying out this study. In particular, the authors acknowledge, the generous assistance and guidance of the Chief Usher of the White House and his staff in arranging for the field tests at the White House; the Park Service personnel for their contributions in writing non-technical portions of the guide specifications; and Larry Masters, National Bureau of Standards, for his helpful advice, encouragement and assistance.

1. INTRODUCTION

1.1 BACKGROUND

Since construction of the White House in the 1790's, considerable effort has been put forth to keep the exterior of the building white. Typically, these efforts have consisted of frequently repainting a large portion of the Aquia Creek (Virginia) sandstone of which the building is constructed. Historical records indicate that throughout the 19th century, the building was repainted on an average of about every third or fourth year. Sometimes, repainting was performed only on the South elevation. President Lincoln, for example, began cutting costs in 1861 and decided to repaint only the South elevation rather than the entire building. The White House was generally painted with white lead in oil until the 1950's when the white lead pigment was replaced with titanium dioxide pigments.

The National Park Service records, while incomplete, indicate that poor performance of exterior paints has been a recurring problem and that moisture related problems must have been continuous as evidenced by stone deterioration and frequent repainting. While the records also show that paint removal methods have been mostly restricted to hand scraping, brushing or sanding, other methods such as burning and water blasting have been used.

Because of the historical poor performance of paints on the White House, the National Park Service (NPS) requested that the National Bureau of Standards (NBS) develop guide specifications covering the exterior restoration and painting aspects of the planned 1980 restoration. The results of the study to develop the guide specifications are presented in this report.

1.2 OBJECTIVE

The objective of this study was to develop guide specifications, based upon laboratory and field test results, for use in the 1980 exterior restoration of the White House. The guide specifications include recommendations for surface preparation and paint removal procedures, coating systems and application procedures; further, the specifications address the need for minimum disruption to the activities on the premises.

1.3 APPROACH

The approach used in conducting the study included 1) Evaluating the historic practices and resulting difficulties in painting of the White House, including identification of the surface preparation methods and coating systems used; 2) Examining technical literature to identify possible surface cleaning methods and coating systems which may aid in overcoming past problems; 3) Performing laboratory tests to evaluate various methods of surface preparation, types of appropriate coatings and application procedures; 4) Performing field tests at a selected site at the White House to obtain on-site data on the performance of candidate coatings, methods of surface preparation and application procedures; and 5) Developing guide specifications for the exterior restoration of the building, based upon the laboratory and field test results.

2. IDENTIFICATION AND ASSESSMENT OF PAINT REMOVAL METHODS

2.1 IDENTIFICATION OF METHODS

Early in the study, the technical and scientific literature was searched to identify various paint removal techniques that might be useful in cleaning the

exterior surface of the White House prior to repainting. This chapter summarizes the findings of the search.

Many paint removal techniques have been developed for wood and metal surfaces. Since stone and masonry buildings are not ordinarily painted, methods for paint removal from stone have been far less developed than methods for cleaning wood and metal. It is probable, however, that some paint removal techniques for wood and metal may be adapted for stone. Such an adaptation of paint removal techniques is described in a paper by Weiss [1][1/] where water cleaning, chemical action and abrasive blasting were used to clean masonry.

Six general categories of surface cleaning methods were identified and are listed below with a brief description of each method.

Mechanical Abrasion. In this category, loose and flaking paint is removed by hand tools such as chisels, paint scrapers, putty knives and wire brushes. Use of power tools, including power chisels and power sanders, is included in this category since these tools remove paint by mechanical abrasion.

Water Cleaning. A number of cleaning methods utilizing water have been used for paint removal, including a low pressure wash over an extended period of time, moderate to high pressure wash, hot water and steam cleaning. Variations in these methods include the addition of chemicals, e.g., detergents to the spray, the addition of abrasives

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1/ Numbers in brackets refer to references in Chapter 10 of this report.

to the spray (water sand-blasting or wet aggregate blasting); and chemically treating the painted surface before water spray.

Abrasive Blasting. While abrasive blasting also mechanically removes paint as described under "Mechanical Abrasion", this category is considered separately since specialized equipment is required. Materials such as coconut hulls, sand, aluminum pellets, garnet, shot, and solid carbon dioxide pellets are propelled onto the painted surface by high air pressure, resulting in a gradual wearing away of the paint.

Chemical Stripping. This category utilizes the chemical action of organic solvents, such as methylene chloride and aromatic solvents, or the chemical action of alkaline or acidic ingredients to soften the old paint prior to removal. The softened paint film is usually removed by scraping, although other removal techniques, including water spray, could be used. A variation of the chemical treatment utilizes a plastic film which includes encapsulated solvent paint removers.

The film is left in place overnight and the plastic film and the old paint are removed together [2]. Also, there is a Japanese patent [3] in which the paint stripping agent is covered by a paper (or fabric) and the paint is stripped upon removal of paper.

Heat Application. The application of heat by open flame to remove paint is an old technique, but newer heating sources have made the method safer and more feasible. Typical heat sources include blow torch, propane torch (open flame), propane torch (recessed open flame, "infrared"),

electric heat blower and electric quartz mercury lamp. A study conducted at CERL* utilized a microwave technique as a method for removing paint from wood [4].

Laser Radiation. The application of laser radiation for restoration purposes has been reported by Asmus [5]. The laser output which is highly directional and monochromatic, has been used to clean metal, stone and even leather without damage to the substrate.

2.2 ASSESSMENT OF METHODS

The purpose of this section is to present information on the effectiveness and feasibility of each of the six categories of paint removal methods. Assessments of the methods are primarily based upon 1) reports to the Department of Housing and Urban Development (HUD) relating to the removal of leaded paints [6], 2) results of NBS graffiti removal studies [7] and 3) unpublished paint removal studies conducted at NBS and at the St. Louis Courthouse by NPS personnel. Other sources of information used in assessing effectiveness include the U.S. Army Technical Manual TM 5-801-2, Historic Preservation and Maintenance Procedures, and Weiss' study [1] on the cleaning of building exteriors.

Comments on the effectiveness and feasibility of paint removal by each of the six categories of paint removal methods are as follows:

Mechanical Abrasion. The mechanical abrasion techniques, such as by chisels, paint scrapers or wire brushes, have been used extensively

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* Construction Engineering Research Laboratory, Champaign, Illinois.

in the past at the White House. These techniques have not been highly effective. It has been found that much of the old paint is left intact after chipping. An example of the ineffectiveness of these methods is that peeled paint chips, which included as many as 19 paint layers, have recently been obtained from the White House. When painted over, such underlying areas provide the initiation point for further paint peeling.

Water Cleaning. Water spray, in conjunction with cleaning agents or brushing using bristle brushes, is somewhat effective in cleaning a painted surface and removing peeling paint and fungi. Problems may arise with high pressure [1000-2000 psi (6.9 - 13.8 MPa)] abrasion which can erode the stone surface and lead to excessive water penetration. Water absorbed in the interior of the stone may lead to spalling through several processes including freeze-thaw cycling damage or lead to premature paint failures through blister formation. The problems with high pressure spray can be minimized by the use of skilled operators.

Moderate pressure water spray [80-100 psi (0.55-0.69 MPa)] in conjunction with sand (wet aggregate blasting) has been reported to effectively remove old paint from the St. Louis Courthouse (limestone) and from the San Francisco Mint (sandstone) [8]. The water pressure and size of aggregate were considered critical. It was also stated that the wet aggregate method did not damage the saw marks of the stone. In addition, the use of a chemical treatment was reported to be effective in removing old paint on sandstone at the U.S. Capitol [9]. Steam cleaning has been

found to be effective in its ability to clean highly carved areas. However, steam has generally been supplemented with chemicals or sand when used to remove paint. Steam cleaning of large areas has not been as effective as the use of pressurized water spray. Also, the use of steam may present substantial safety hazards to the operator. Wet aggregate blasting techniques or a chemical treatment followed by pressurized water spray appear to be worthy of evaluation for removing the old paint from the White House.

Abrasive Blasting. Abrasive blasting is a rapid, effective means of removing old paint. The primary disadvantage of abrasive blasting is that it can cause excessive erosion of the stone surface. For this reason, it has not been widely used on the White House in the past. Pictorial examples of the disastrous effects of the abrasive blasting of brick are illustrated by Weiss [1] and U.S. Army Document TM 5-801-2. These same erosion effects were observed in many public housing units after cleaning to remove graffiti. Limited erosion effects from sand-blasting were also observed on brick at the St. Louis Courthouse. Abrasive blasting in which spherical pellets (aluminum or steel) are used may cause less erosion than sand.

Chemical Stripping. Chemical stripping is an effective means of removing old paint. A disadvantage of paint removers is that they soften only a few layers of paint at a time. Thus, the remover-paint mixture must be removed from the outer surface before fresh remover is applied. There is an approximate 1/2 hour time lag between remover application and paint removal and the effectiveness of the remover may be temperature

dependent. In many cases, a high boiling petroleum derivative is added to retard evaporation of the active solvents, but this in turn, has to be removed before repainting. Also, any soluble salts contained in the paint remover or formed during the stripping process must be removed before repainting. When used in conjunction with water spray, chemical stripping appears to be most applicable for removing paint from delicate scrollwork where excessive heat or moisture might affect the substrate.

Heat Application. In general, the use of heat, such as with an open flame, has not been highly effective when used on the White House. Disadvantages include the possibility of starting a fire or vaporizing the leaded paints to cause lead poisoning of the operator. The newer methods of heating have made this technique safer and more feasible, although operator skill is important in achieving effective results. NBS studies [10] for HUD addressing removal of leaded paint from wooden doors included heating techniques and the effectiveness of the methods are summarized briefly: both the propane torch and the quartz mercury lamp charred the wood substrate in the process of paint removal; both the electric heat gun and infrared device (recessed propane open flame) were effective in removing paint without charring the substrate. While the application of heat has been effective in removing paint from wood, it is not known whether these results can be extrapolated to use on sandstone. The fact that the use of a propane torch on the brick test area at the St. Louis Courthouse resulted in some spalling of brick leads to questions regarding the feasibility of open flame heating for

use on White House sandstone. It appears that both the electric heat gun and infrared device may be useful in removing paint from sandstone.

Laser Radiation. Asmus [5] states that 1) laser radiation offers exceptional control and selectivity in restoration operations and 2) lasers used to clean stone are relatively costly and their use would be restricted to objects of limited size and high value.

3. IDENTIFICATION OF COATING MATERIALS

3.1 GENERAL

The functions of an exterior masonry coating are 1) to protect the substrate from aggressive atmospheric constituents, 2) to prevent water from penetrating into porous surfaces, which in turn can help prevent freeze-thaw breakdown of porous structures and 3) to provide a decorative finish which will require a minimum of maintenance [11]. Because of the higher relative humidity indoors at most times of the year, the usual direction of moisture movement through masonry walls above grade is interior to exterior [12]. For this reason, and to prevent accumulation of moisture within the wall, the interior surface should be relatively impermeable, while the exterior surface, including the masonry coating, should be permeable enough to permit transpiration of water vapor to the outside while resisting the inward passage of liquid water. For a coating to perform satisfactorily on a masonry surface, it must not be affected by moisture or alkalinity present on the surface. Information on the surface preparation of concrete and masonry prior to coating is given in the Tri-Services Manual "Paints and Protective Coatings" [13]. Included are directions for the removal of efflorescence and laitance, and for neutralizing the alkalinity. While the Aquia Creek sandstone used in constructing the

White House would not be alkaline, newly repaired mortar joints would be, and care must be exercized in selecting coatings for use over such joints.

The types of coatings suitable for application to masonry have been reported on extensively [11, 13, 14, 15]. Suitable resin types for exterior architectural purposes include acrylic latex, polyvinyl acetate, cementitious, epoxy, oil or oilmodified alkyds, rubber, vinyl and urethane resins. Table 14, Appendix D-4 [13] lists recommended architectural coating systems for exterior concrete and masonry. Textured coatings have also been commonly used on masonry and, in fact, they were used recently on the White House.

3.2 COATING MATERIALS

Advantages and disadvantages of generic types of coatings suitable for use on masonry are discussed in the following sections.

3.2.1 Latex (Acrylic and Polyvinyl Acetate)

Latex paints consist of stable aqueous dispersions of synthetic resin particles prepared by emulsion polymerization. Of the two most commonly used resins for exterior use (acrylic and polyvinyl acetate), acrylics generally have better alkali resistance. Latex paints are considered self-priming and they may be thinned with water [16, 17]. Also, alkali-resistant alkyd surface conditioners may be used as a primer and as a means of consolidating a deteriorating or chalked paint surface.

The advantages of latex paints include excellent durability and relative insensitivity to moisture and alkalinity under normal conditions of environmental exposure. They are fast drying, non-flammable, non-toxic, low in odor,

and easy to clean up. While they may be applied to a damp surface, free water should not be present on the surface. These paints are permeable to water vapor.

One disadvantage of latex paints is that the temperature range for application [50-90°F (10-32°C)] is more limited than that for solvent thinned paints. Also, if the substrate is porous and the humidity is very low, prewetting of the substrate is necessary; this reduces absorption of water into the substrate of the wet paint and permits the paint to coalesce to a more uniform film.

3.2.2 Cementitious

Cementitious paints have long been used to coat concrete and masonry surfaces. They are chiefly mixtures of portland cement and either hydrated lime or siliceous aggregate, or both with water. Surface preparation involves special care to remove such materials as form oil, grease, old organic coatings as well as efflorescence, laitance and loose materials. Detailed procedures for surface preparation and application are described in American Concrete Institute (ACI) Standard 616 [18].

The advantages of cementitious paints are that they are durable and the ingredients are inexpensive. However, the requirements of proper application with a bristle brush and a two-day fog cure or covering with plastic sheet tend to negate cost advantages.

The disadvantages of these paints are: they chalk heavily upon aging, particularly if not properly cured; application and curing is labor intensive; the coating is sensitive to low temperatures while curing; excessive film

thickness is too easily attained; and delamination often occurs if coefficients of thermal expansion of coating and substrate are not similar.

3.2.3 Epoxides

These high performance coatings are based upon epoxide resins or upon ester-modified epoxide resins. Surface preparation to completely remove all loose material before applying the coating is essential.

The advantages of this type of coating are excellent adhesion to masonry and excellent resistance to abrasion, impact, chemicals and solvents.

The disadvantages of epoxide coatings include 1) the great care required in properly proportioning and mixing the two package components, 2) limited pot life, 3) the high gloss, tile-like finish usually obtained, 4) lack of permeability to water and water vapor, and 5) chalk is frequently observed on exterior exposure.

3.2.4 Oil or Oil-Modified Alkyds

Oil and oil-modified alkyd paints have had a long history of use on the White House including the use of alkyd resins in the textured coating formulations. Since these materials are inherently alkali sensitive, i.e., they saponify readily, use of the most alkali-resistant resins is essential. Surfaces must be clean and dry before painting. Recommended ambient temperatures for application are 45-95°F (7-35°C).

The advantages of oil or oil-alkyd paints are that they are durable, penetrate porous surfaces well, and have a long and successful history of good exterior performance.

The disadvantages of these paints are that they are alkali sensitive, they are not highly resistant to chemical attack, and they lose gloss readily with atmospheric exposure.

3.2.5 Rubber-Based

This category of coatings include solvent thinned paints formulated with styrene-butadiene, styrene-acrylate, vinyl toluene acrylate or chlorinated rubber resins. These coatings are self-priming and alkali resistant, but the surface must be thoroughly clean and dry before application since they are somewhat deficient in chalk penetrating power [15, 19]. These coatings have had an extended history of successful use on exterior masonry surfaces.

The advantages of these materials are that they have good water and chemical resistance.

The disadvantages of these coatings include low water vapor transmission and susceptibility to solvent attack.

3.2.6 Vinyl Resins

The resin component in these coatings is a terpolymer of vinyl chloride, vinyl acetate and maleic acid. They are intended for heavy duty and fresh water immersion usage. Proper surface preparation is essential and smooth masonry surfaces must be etched with 20 percent hydrochloric acid, followed by thorough rinsing and drying. The acid etching process may damage the stone surface.

The advantages of these coatings are their excellent durability and water impermeability characteristics.

The disadvantage of these coatings is that a thick film [~6-10 mils (150-250μm)] is required for high performance. This film thickness is obtained by either a three to four coat application or use of a high-build [>10 mils (250μm)] formulation. Surface preparation is critical to ensure adhesion. These coatings contain active solvents and, in turn, are subject to solvent attack.

3.2.7 Urethanes

These high performance coatings are based upon moisture cured urethane resins or upon oil-modified urethane resins. The aliphatic urethane resins are the type recommended for exterior use on masonry. The substrate should be etched with 5-10 percent hydrochloric acid, rinsed and dried before coatings application.

The advantages of this type of coating are that they have excellent adhesion to masonry and excellent resistance to abrasion, impact and chemical and solvent attack.

The disadvantages of these coatings for application to sandstone are that they usually have a high gloss, tile-like finish, they are water and water vapor impermeable and they chalk early on exterior exposure.

3.2.8 Textured Coatings

Textured coatings are high build coatings which are most useful to cover surface irregularities. These materials may be either water or solvent thinned. Typical resins used in the formulation of these coatings include alkyd, vinyl

toluene acrylate, styrene acrylate and acrylic. Banov [20] cites accelerated weathering studies which show that vinyl toluene acrylate textured coatings are more resistant to weathering than alkyd and latex textured coatings.

The advantages of this type of coating are that they have excellent wind driven rain and alkali resistance and they can conceal surface irregularities.

The disadvantages of these coatings include their high build and often excessive film thicknesses and low water vapor transmission.

4. LABORATORY TESTING PROGRAM

4.1 PURPOSE

The purpose of the laboratory testing was to obtain data on the performance characteristics of four selected coatings to supplement that obtained from the literature survey and from the field test at the White House. (The field test is described in Chapter 6 of this report.)

Specifically, laboratory testing was performed:

- To determine the effects of coating on the sandstone substrate and
- To determine the performance characteristics of the coatings when exposed to accelerated and natural weathering.

The accelerated tests used in the laboratory testing program were similar to those used in our earlier studies of waterproofing materials [21] and stone preservatives [22].

4.2 MATERIALS USED

4.2.1 Sandstone

The stone used as the test substrate for the laboratory testing was Aquia Creek Sandstone, the same sandstone used in the White House. This stone was obtained from the National Park Service and had been removed from the East Front of the U.S. Capitol.

The large pieces of stone were cut into test specimens which were 4 in squares, approximately 1 in thick (10 x 10 x 2.5 cm). After cutting, the specimens were washed in running tap water to remove dust and loose particles. Before coating, the specimens were dried overnight in a forced air oven at 221°F (105°C).

4.2.2 Coating Materials

In view of the advantages and disadvantages of the eight generic types of coatings discussed in Section 3.2, four generic types were selected for inclusion in the testing program. These were latex, oil-alkyd, rubber-based and textured coatings. Briefly summarized, the primary reasons for not selecting the other four generic types of coatings are as follows: cementitious coatings require fog cure which would be difficult to implement on the White House; epoxides and urethanes usually result in glossy finishes which would be undesirable on the White House and; vinyl coatings are typically used for water immersion type applications. A single coating was selected to represent each of the four generic types selected for inclusion in the testing program and these are described below.

Coating Material	Resin Type/Generic Classification	Federal Specification
1	Latex (Acrylic)	TT-P-19
2	Styrene-Butadiene (Rubber-Based)	TT-P-97
3	Vinyl Toluene Acrylate (Textured Coating)	TT-C-555
4	Tung Oil-Alkyd	TT-P-24

All four coatings were white and the 60° specular gloss ranged from 1.0 to 1.7 (ASTM D523 Standard Method for Specular Gloss). An application rate of 200 ft^2/gal (4.9 m^2/l) was suggested by each of the paint manufacturers and this spreading rate was used for all tests. Brush application was used and a 24 hour curing time was allowed before application of the second coat. After the second coat was applied, the test specimens were cured for two weeks at 50 $\pm$ 4 percent RH and 73 $\pm$ 2°F (23 $\pm$ 1°C) before performing test exposures.

4.3 THE EFFECT OF COATINGS ON STONE PROPERTIES

Certain natural stones are porous materials, which will absorb and hold a certain amount of water. The higher the porosity of the stone, the greater will be the amount of water held. Because of this porosity, water vapor can also diffuse through the stone. When a surface coating is applied to the stone, both the water absorption and water vapor permeability of the stone may be changed.

Absorbed water in the stone may occur from both the penetration of wind-driven rain or from moisture migration from the interior of the structure. The water ordinarily would diffuse to the surface as water vapor and evaporate.

If diffusion cannot occur, water can remain trapped in the stone and, under the appropriate temperature conditions and stone pore size, freeze-thaw damage to the stone may result if the store is critically saturated. Other deterioation processes of stone relating to moisture include 1) salt damage resulting from soluble salts within the stone crystallizing in the pores and expanding, 2) differences in thermal expansion between stone and mortar types and 3) dissolution of stone by rainwater containing acid anhydrides, e.g., carbon dioxide, sulphur dioxide, nitrous oxides. If a coating has been applied to the stone, and water cannot evaporate at a reasonable rate, the coating may blister and delaminate. A coating should therefore diminish the water absorption of the stone while permitting a measurable water vapor permeation. For this reason, both the water absorption and the water vapor permeation of coated specimens were measured for each coating system and for the stone substrate.

4.3.1 Water Absorption Measurements

4.3.1.1 Procedure

Water absorption measurements were made using stone specimens some of which were uncoated while others were coated on all six sides. To determine the influence of coating thickness on water absorption, specimens for each coating material were studied with both one and two coats of paint.

The specimens were weighed to the nearest 0.01 gram and placed standing, 1 in (2.5 cm) apart in a basin. The specimens were covered with distilled water. After 6 hours immersion, the specimens were removed from the basin, drained, and their surface quickly blotted with a damp towel to remove surface water. The specimens were then reweighed.

The specimens were returned to the water bath for an additional 42 hours immersion, then removed and reweighed after the above blotting treatment.

4.3.1.2 Results

Water absorption of uncoated sandstone as measured by percent water absorbed were 5-7 percent. The measurements of the coated stone specimens are given in Table 1.

All coatings showed little effect on the water absorption when only one coating was applied to the stone, for either 6 hours or 48 hours immersion. Specimens with two coats of coatings 2, 3, and 4 had water absorption values after the 48 hour immersion of 16 percent to 50 percent of the values for specimens with one coat. For coating 1 (the latex coating), there was, no appreciable difference between one and two coat specimens. The overall change in water absorption, from most water absorbed to least, was in the order 0>1>2>4>3 (for coated specimens with two coats, where 0 represents the uncoated stone).

4.3.2 Water Vapor Permeation Measurements

4.3.2.1 Procedure

Water vapor permeation measurements were made using ASTM Test Method C355, Standard Methods of Test for Water Vapor Transmission of Thick Materials. Measurements were made on test specimens which were both uncoated and coated on all six sides. Duplicate uncoated and triplicate coated specimens were used.

Cups to hold the square test specimens were fabricated from 1 mm thick aluminum sheet. The insides of the cups were made airtight by a coating of paraffin wax. To measure water vapor permeability, calcium chloride desiccant

TABLE 1. WATER ABSORPTION MEASUREMENTS

Coating Material Number [1]	Orig. Wt. of Coated Stone (g)	6 Hour Immersion			48 Hour Immersion		
		Wt. After 6 Hours (g)	Wt. Gain (g)	Percent Water Absorbed	Wt. After 48 Hours (g)	Wt. Gain (g)	Percent Water Absorbed
1-1	500.98	530.18	29.20	5.82	532.05	31.07	6.20
1-2	526.76	553.97	27.21	5.16	556.99	30.23	5.74
2-1	520.36	556.88	36.52	7.01	557.58	37.22	7.15
2-2	569.65	573.15	3.50	0.61	589.71	20.06	3.52
3-1	504.98	540.85	35.87	7.10	541.52	36.54	7.23
3-2	523.64	526.49	2.85	0.54	529.66	6.02	1.15
4-1	547.65	583.10	35.45	6.47	584.65	37.00	6.76
4-2	546.01	551.50	5.49	1.00	560.58	14.57	2.66

[1] -1 and -2 designate one and two coats of paint, respectively.

was added to the cups and the test specimens were taped to the cups with adhesive polyester tape, which was then coated with wax. The cups and attached specimens were kept in a constant humidity - temperature room (50 $\pm$ 4 percent RH and 73 $\pm$ 2°F (23 $\pm$ 1°C)), and periodically weighed until the rate of water pickup by the desiccant was constant. The rate of weight increase measured the rate at which water vapor passed through the test specimen.

The Water Vapor Transmission (WVT), Permeance, and Water Vapor Permeability (WVP) of the specimens were calculated from the test data.

WVT = weight change in grams/test area (m^2)

Permeance = $WVT/S(R_1 - R_2)$

S = saturation vapor pressure at test temperature

R_1 = relative humidity in constant temperature room

R_2 = relative humidity inside cup

Water Vapor Permeability = permeance x specimen thickness (cm).

4.3.2.2 Results

Because all specimens were not of the same thickness, water transmission is given in Table 2 as water vapor permeability (WVP). Coatings 3 and 4 diminished the WVP the most; coatings 1 and 2 lowered the WVP to about 50 percent of that of the uncoated stone.

4.4 ACCELERATED WEATHERING TESTS

Weathering factors that are of primary importance in the degradation of coatings are the ultraviolet (UV) radiation of sunlight, atmospheric water and air pollutants (including chemical and salt attack) and thermal factors (heat and freeze-thaw).

TABLE 2. PERMEABILITY MEASUREMENTS

Coating Material Number	Specimen Number	Water Vapor Transmission (g/m^2)	Permeance (metric perms)	Water Vapor Permeability (Metric perm-cm)	Average Permeability (Metric perm-cm)
0[1/]	1	16.07	1.31	3.16	3.02
0	2	14.66	1.20	2.87	
1	1	11.96	0.98	2.15	
1	2	5.47	0.45	1.12	1.51
1	3	6.19	0.51	1.27	
2	1	10.55	0.86	2.27	
2	2	9.27	0.76	1.90	2.12
2	3	10.18	0.83	2.20	
3	1	2.82	0.23	0.61	
3	2	2.64	0.22	0.57	0.64
3	3	3.33	0.27	0.74	
4	1	2.46	0.20	0.54	
4	2	1.15	0.09	0.27	0.40
4	3	1.79	0.15	0.40	

1/ Uncoated sandstone

Accelerated laboratory tests, including 1) exposure to UV radiation, 2) exposure to water condensation and 3) cyclic exposure in a test chamber to simulate a number of degradation factors, were performed using triplicate test specimens. While correlations between accelerated test results and actual in-service performance have not been obtained, the results of such accelerated tests are thought to be useful in identifying potential field problems.

4.4.1 Exposure to Ultraviolet Radiation

4.4.1.1 Procedure

In this test, Method (A) of ASTM G 27-70, Standard Recommended Practice for Operating Xenon-Arc Type Apparatus for Light Exposure of Nonmetallic Materials, was used. A weathering machine with a 6500-watt water cooled, Xenon-arc lamp and borosilicate inner and outer glass filters was used. The machine had an automatic radiation control, with monitoring at 340 nm. Light exposure was continuous, with a water spray on the specimens 9 minutes each hour. Black Panel temperature in the test chamber was 122°F (50°C). Test specimens were painted on five sides with the unpainted side facing away from the lamp.

Specimens were exposed to the Xenon lamp for 1534 hours (64 days). After exposure, the specimens were removed from the test machine, and allowed to equilibrate in a constant temperature room before determining the color difference (Method 4250, Federal Test Method Standard 141).

4.4.1.2 Results

The color difference values of the exposed specimens are given in the first column of Table 3. The change in color of the coated specimens was in the

TABLE 3. COLOR DIFFERENCE MEASUREMENTS OF EXPOSED SPECIMENS

Coating Material Number	Color Difference (E)		
	Ultraviolet Radiation	Water Condensation	Cyclic Exposures
1	0.80	0.53	4.56
2	2.04	0.29	4.00
3	2.64	1.47	8.95
4	1.51	0.51	5.01

order of 3>2>4>1. Visual inspection of the coatings after exposure indicated no loss of adhesion or surface cracking.

4.4.2 Exposure to Water Condensation

4.4.2.1 Procedure

The effects of cyclic water condensation/evaporation on coated stone test specimens were studied using the test chamber and procedure described in ASTM D2247-68, Standard Method of Testing Coated Metal Specimens at 100 Percent Relative Humidity.

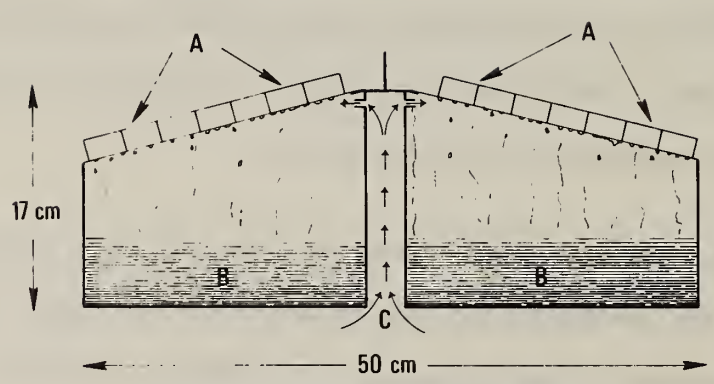
The test chamber is shown in Figure 1. The test specimens were mounted over a water bath (B) at 97°F (38°C). Water evaporating from the bath condensed upon the surface of the specimens and dripped back into the bath. After 90 minutes of water condensation, the water was evaporated from the specimens by warm air blown through (C) over the specimens' surface. After 30 minutes of air-drying, the air flow was stopped and the water condensation on the specimens began again. The 90 minutes of water condensation and 30 minutes of warm air-drying comprised one testing cycle.

The test specimens, coated on five sides, were mounted over the bath at an angle of 45° with the uncoated side facing away from the water bath. Specimens were examined periodically during testing for signs of degradation. After 500 cycles (1000 hours), specimens were removed from the bath, visually inspected, and equilibrated at constant humidity/temperature before determining color difference.

A -- TEST SPECIMENS.

B -- WATER BATH.

C -- DUCT FOR FORCED-AIR DRYING.



WATER EVAPORATION / CONDENSATION TEST

FIGURE 1. WATER CONDENSATION APPARATUS

4.4.2.2 Results

The results of the color difference measurements are given in Column 2 of Table 3. The change in color of the coated specimens was in the order of 3>1>4>2. Visual inspection of the specimens during and after exposure found no physical degradation of the coated surfaces.

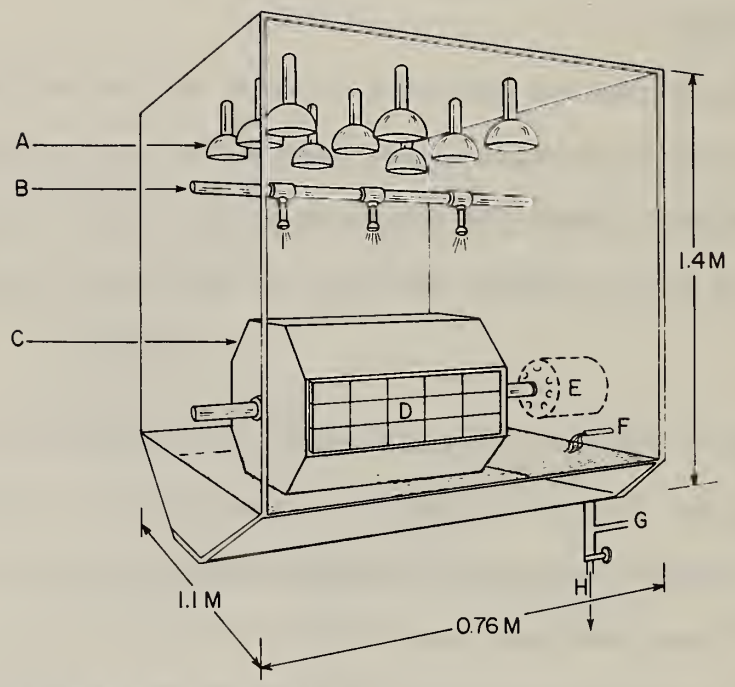
4.4.3 Cyclic Exposure Testing

4.4.3.1 Procedure

A cyclic exposure test was performed in which several factors affecting stone decay and coating deterioration were combined in one test cycle. This test used an apparatus, Chamber for Accelerated Decay (CAD), and test cycle which were developed by the Illinois Institute of Technology Research Institute (IITRI).

The CAD, which is built of stainless steel, is illustrated in figure 2. Its features include: A) three infrared and six ultraviolet (UV) lamps; B) a water spray; C) a revolving eight-sided specimen drum; D) each face of the drum can hold up to 15 test specimens [each 4 x 4 x 1 in (10 x 10 x 2.5 cm)] on removable plates; E) a motor and reduction gearbox for rotation of the specimen drum; F) an inlet for corrosive test solutions; G) an outlet through which the corrosive test solution can be pumped back to storage for reuse; and H) a drain that can be completely closed by a valve when the corrosive test solution is being used, or only partially closed by a stand pipe during water-soaking of the specimens.

The CAD test cycle (Table 4) combines chemical attack, salt and water action, and thermal effects in one test cycle. Freeze/thaw action was simulated by



A - HEAT & ULTRAVIOLET LAMPS
B - WATER SPRAY
C - ROTATING SPECIMEN DRUM
D - FIFTEEN STONE SPECIMENS MOUNTED ON ONE FACE OF SPECIMEN DRUM
E - MOTOR & GEAR TO ROTATE SPECIMEN DRUM AT 1 RPM
F - INLET FOR CORROSIVE TEST SOLUTIONS
G - OUTLET FOR STORAGE OF CORROSIVE TEST SOLUTIONS
H - OUTLET TO DRAIN

FIGURE 2. CHAMBER FOR ACCELERATED DECAY (CAD)

TABLE 4. CHAMBER FOR ACCELERATED DECAY (CAD) TEST CYCLE

Overnight	-- Specimens stored in deep-freeze at -40°F (-40°C). (16 hours)
8:30	-- Specimens removed from deep-freeze, mounted on drum of CAD.
8:30-10:00	-- Specimens rotated with lamps (6-UV, 3-IR) on -- specimens' surface temperature reaching 122°F (50°C). (1 1/2 hours)
10:00-10:30	-- Water spray on, continued rotation of specimens with lamps on. (1/2 hour)
10:30-11:00	-- Water spray off, continued rotation or specimens with lamps on. (1/2 hour)
11:00-16:00	-- Lamps on, CAD drain closed; 3% sodium chloride/0.01 molar sulfurous acid solution pumped into CAD, specimens rotated, passing through solution for 1/8 of rotation. (5 hours)
16:00-16:30	-- Lamps off, continued rotation of specimens. (1/2 hour)
16:30	-- CAD drained, specimens removed and returned to deep-freeze for overnight storage.

removing, from the CAD, the plates holding the specimens after they had been soaked in the sodium chloride/sulfurous acid solution and storing them overnight in a deep freezer at -40°F (-40°C). As the coatings contained organic resins, which might be degraded by UV radiation, UV lamps were used to simulate this radiation in the CAD.

In addition to the weighed coated specimens, two specimens of weighed uncoated sandstone were exposed in the CAD. The test was performed for a total of 20 cycles. After completion of the exposure, the specimens were removed from the plates on which they had been mounted for testing and were washed for 8-16 hours in running tap water. The specimens were then dried at room temperature under vacuum for 8-16 hours. The specimens were weighed and color difference measurements were made.

4.4.3.2 Results

Color difference results are contained in Column 3 of Table 3. The change in color of the coated specimens was in the order of 3>4>1>2.

After 10 test cycles, cracks were observed in the specimens of coatings 1 and 2. After 20 cycles, cracks were observed in specimens of coatings 1, 2 and 3; only coating 4 specimens had no cracks in the coated surface. Photographs of specimens of coatings 1, 2, 3 and 4 are shown in figures 3, 4, 5, and 6, respectively.

The specimens of the uncoated sandstone showed a loosening of the surface granules after 20 cycles. This difference between the unexposed sandstone and the exposed sandstone may be noted in figures 7 and 8.

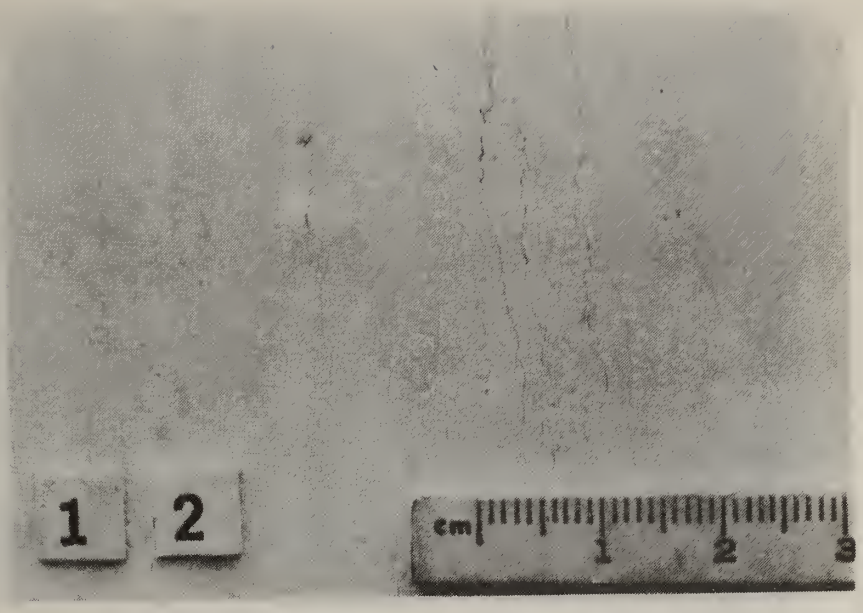


FIGURE 3. COATING 1 AFTER CAD EXPOSURE (20 CYCLES)

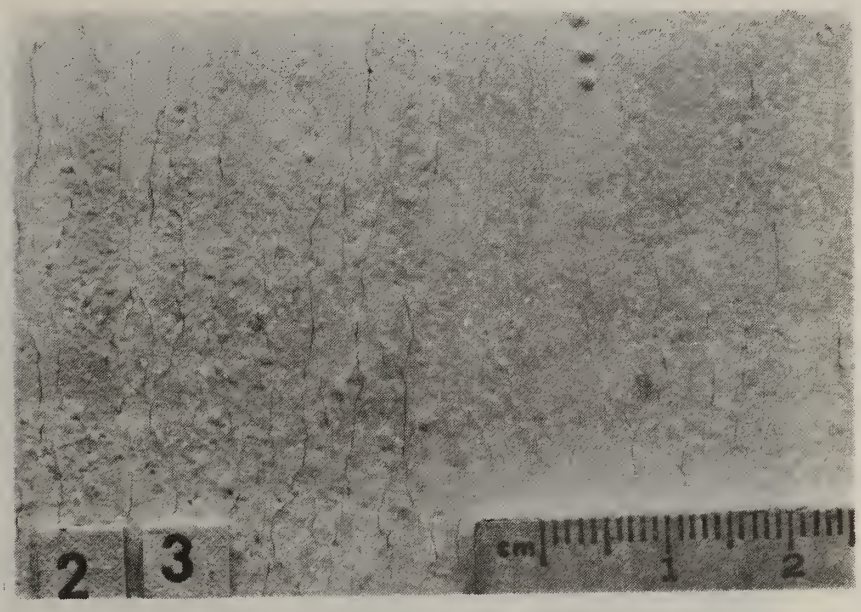


FIGURE 4. COATING 2 AFTER CAD EXPOSURE (20 CYCLES)

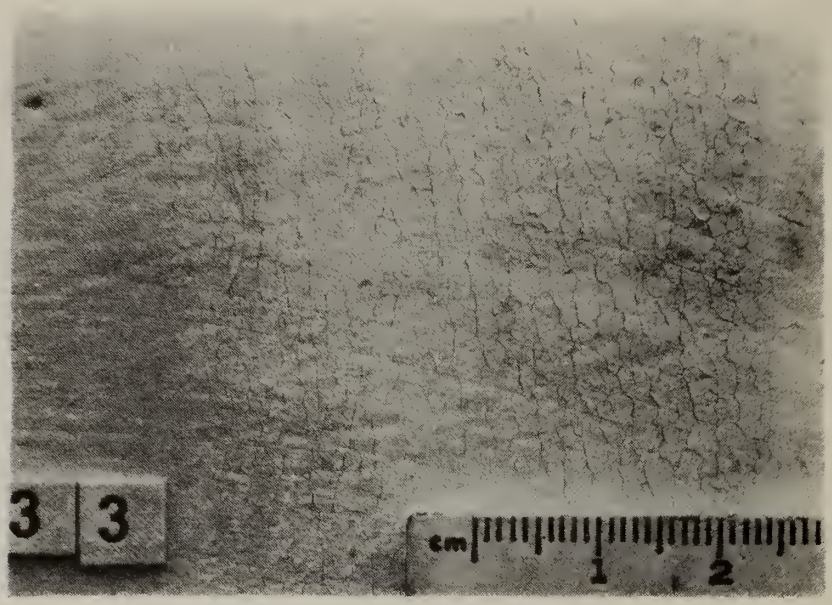


FIGURE 5. COATING 3 AFTER CAD EXPOSURE (20 CYCLES)

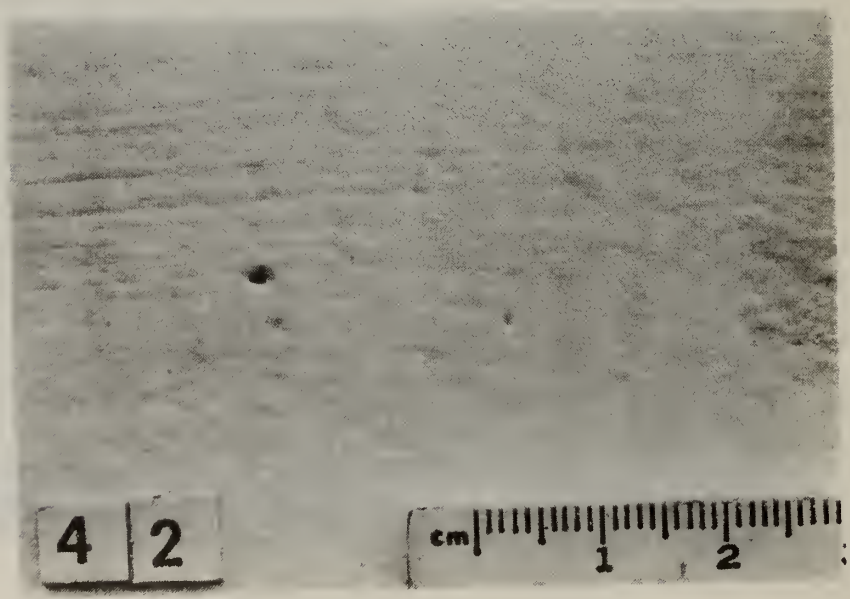


FIGURE 6. COATING 4 AFTER CAD EXPOSURE (20 CYCLES)

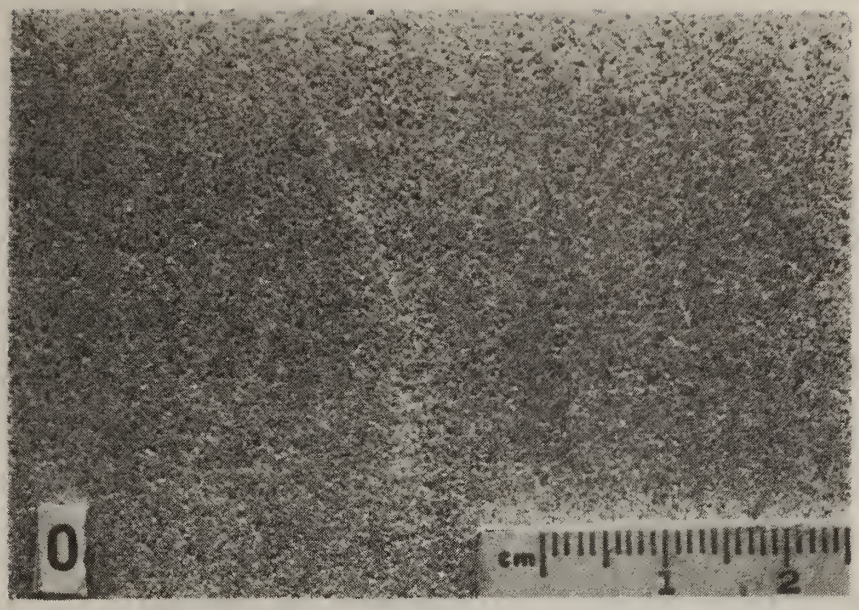


FIGURE 7. UNEXPOSED SANDSTONE

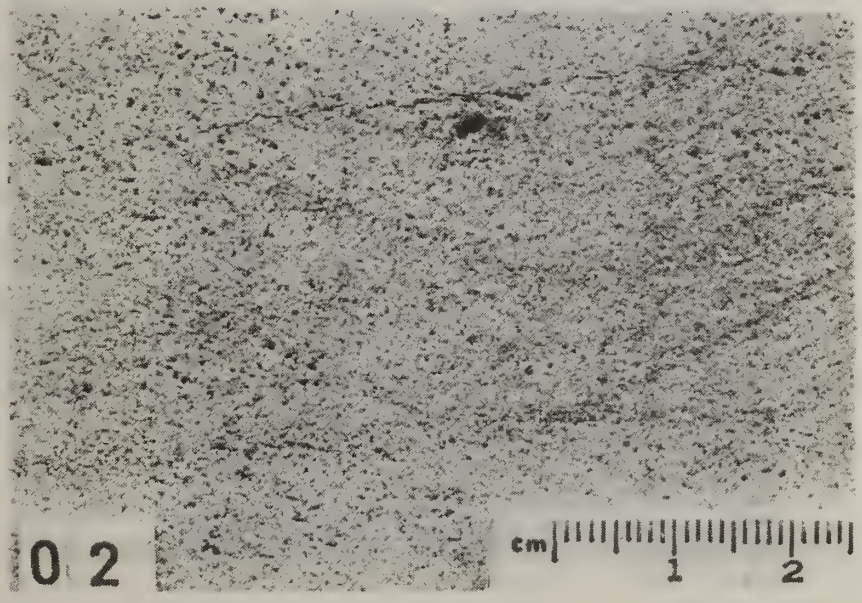


FIGURE 8. SANDSTONE AFTER CAD EXPOSURE (20 CYCLES)

4.5 OUTDOOR EXPOSURE OF COATED SPECIMENS

4.5.1 Procedure

A single test specimen of each of the four coating materials was prepared as described in 4.2.2 and exposed outdoors on the roof of the White House (see Figure 9). The exposures were performed from December 3, 1978 to March 15, 1979. Color difference was determined after the exposure.

4.5.2 Results

The color difference values obtained for specimens of coatings 1, 2, 3 and 4 were 5.05, 4.23, 5.43 and 2.80, respectively. Visual inspection of the exposed specimens showed no signs of loss of adhesion or surface cracking.

4.6 DISCUSSION OF LABORATORY TEST RESULTS

As might be expected, the coatings diminished the water absorption and water vapor permeability of the sandstone. With the exception of coating 1 specimens, water absorption decreased dramatically for the sandstone substrates with the two coat application. For the two coat specimens, coatings are ranked in order of decreasing water absorption as 1>2>4>3; coatings are ranked in order of decreasing permeability as 2>1>3>4. However, none of the two coat systems functioned as a perfect water vapor barrier and none was impervious to water penetration.

The coating materials are ranked in the following order of decreasing color changes for the various exposure conditions:

FIGURE 9. TEST SPECIMENS EXPOSED ON THE ROOF OF THE WHITE HOUSE

Cyclic Exposure (CAD): 3>4>1>2

Ultraviolet Exposure : 3>2>4>1

Water Condensation : 3>1, 4>2

Outdoor Exposure : 3>1>2>4

Specimens exposed to the CAD test and outdoors exhibited the largest color changes. All specimens exposed to UV radiation and water condensation exhibited only minor color changes. Coating material 3 exhibited the largest color change under all exposure conditions.

Visual examination of the coating materials after exposure to UV radiation, water condensation and outdoor exposure revealed no blisters, cracks or other detectable surface defects in any of the coatings. Also, the stone substrates appeared to be unaffected by the exposures. However, the CAD test produced surface cracking in all coatings except coating 4.

5. PRELIMINARY PAINT REMOVAL TESTS

Based upon the information on paint removal methods described in Chapter 2, four paint removal techniques were selected for evaluation in preliminary tests performed by commercial firms.

The painted sandstone specimens used for the tests were sections of roof balustrade removed during the expansion of the east front of the U.S. Capitol. The paint removal tests consisted of sending out balustrades to the selected commercial organizations, having them remove the paint in their laboratories and returning the cleaned specimens to NBS. The effectiveness of the various paint removal methods was evaluated by visually comparing before and after photographs.

The first method of paint removal (Method 1) consisted of paint removers applied to the paint followed by high-pressure water spray to remove the loosened paint. Figures 10 and 11 show the balustrade before and after paint removal.

The second method of paint removal (Method 2) consisted of a combination of scraping, slow speed grinding, application of paint removers and high-pressure, low volume water spray. Figures 12 and 13 show the balustrade before and after paint removal treatment.

The third method evaluated (Method 3) was an abrasive type paint removal system, developed for the Department of Housing and Urban Development (DHUD). The apparatus had been developed to remove leaded paint from interior plaster walls and wood trim and to recover the loosened paint as it was dislodged. The system used an impeller motor to propel aluminum beads, or other soft abrasives, against the paint. Figures 14 and 15 show the balustrade before and after paint removal by Method 3.

The fourth method evaluated (Method 4) was a prototype system using a special pressure-adjustable nozzle to project a mixture of water, sand, and air. Figures 16 and 17 illustrate the balustrade before and after paint removal by Method 4.

Figures 10-17 illustrate that all four paint removal methods evaluated in the preliminary tests were effective in removing paint from the balustrades of the Capitol, although the commercial firms did not all attempt to remove all of the paint. Since the balustrades had been stored in the open in Rock Creek Park since the expansion of the east front of the Capitol, part

FIGURE 10. STONE SPECIMEN 4, BEFORE PAINT REMOVAL

FIGURE 11. STONE SPECIMEN 4, AFTER PAINT REMOVAL BY METHOD 1

FIGURE 12. STONE SPECIMEN 3, BEFORE PAINT REMOVAL

FIGURE 13. STONE SPECIMEN 3, AFTER PAINT REMOVAL BY METHOD 2

FIGURE 14. STONE SPECIMEN 2, BEFORE PAINT REMOVAL

FIGURE 15. STONE SPECIMEN 2, AFTER PAINT REMOVAL BY METHOD 3

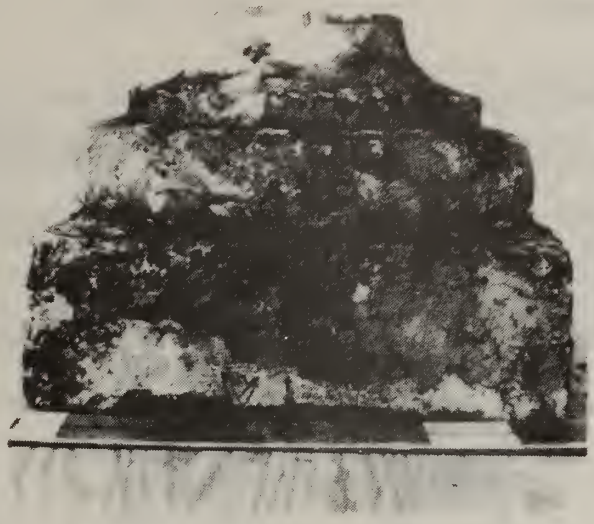


FIGURE 16. STONE SPECIMEN 6, BEFORE PAINT REMOVAL

FIGURE 17. STONE SPECIMEN 6, AFTER PAINT REMOVAL BY METHOD 4

of the visible deterioration of the stone after paint removal may have been due to the stone remaining unpainted for a long period of time.

6. FIELD TEST STUDY

6.1 WHITE HOUSE TEST SITE

In June 1978, a ground-floor test site at the northeast corner of the White House was selected after consultation with the National Park Service and White House staff personnel. The test site was divided into four areas (A, B, C and D) of about 250 ft^2 each (23 m^2). Areas A and B on the east elevation are shown in figure 18; figure 19 shows test areas C and D on the north elevation.

The north wall of the site was 40 ft long by 12 ft high (13 by 3.8 m); the east wall was 35 ft long by 12 ft high (11 by 3.8 m). The stone was ashlar construction, with stone blocks approximately 12 in (30 cm) high and up to 39 in (100 cm) wide. The surface of the blocks was finished with fine vertical fluting. All stone in the test areas was painted. Painting of the stone commenced in 1800 during construction of the building and much of the older paint was still present; some of the paint samples removed were at least 0.1 in (0.3 cm) thick.

6.2 PAINT REMOVAL TECHNIQUES

Based upon the results of preliminary paint removal tests described in Chapter 5, four different paint removal techniques, including Methods 1, 2, and 3 described in Chapter 5, were selected for use in the field test as follows:

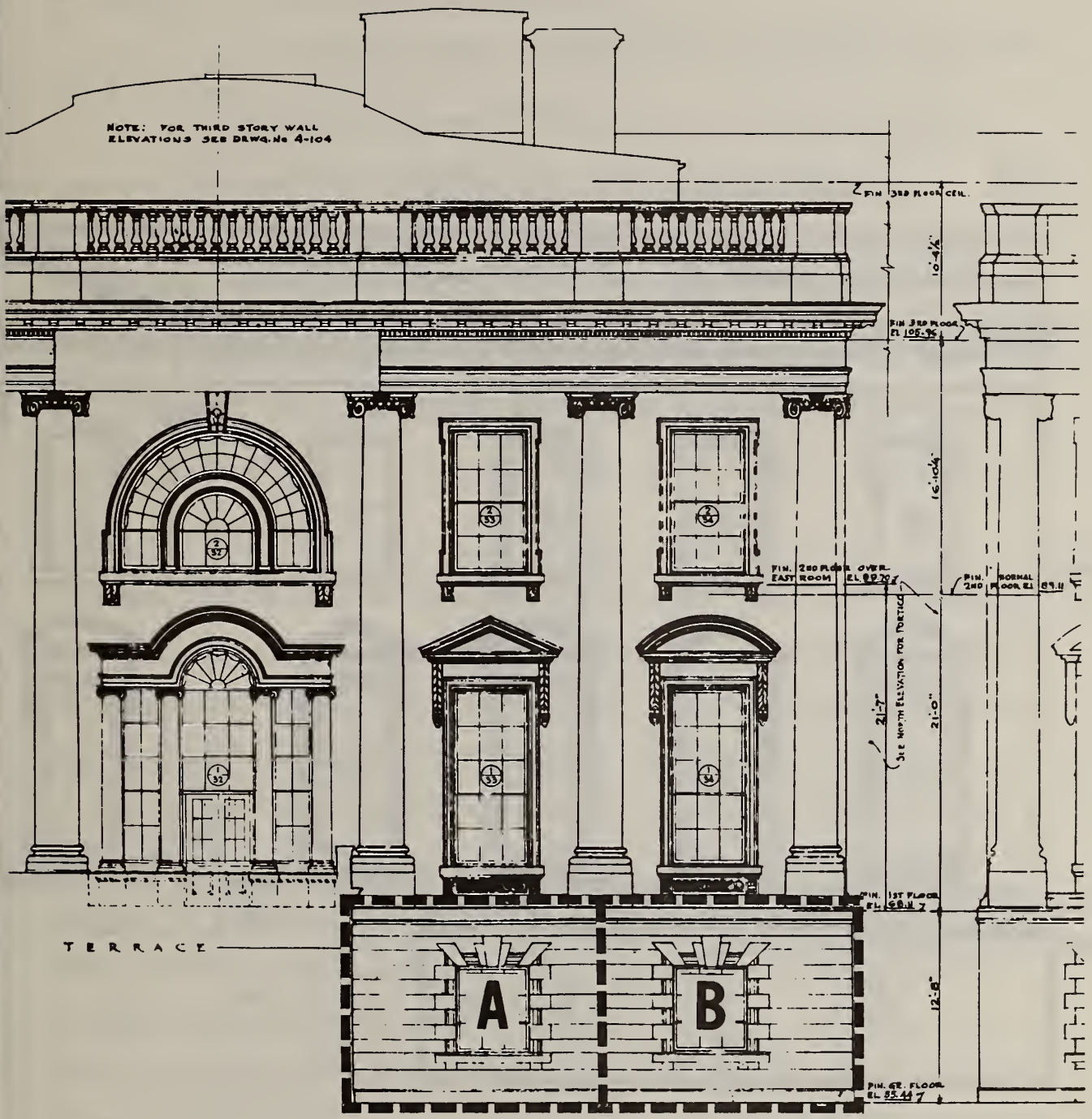


FIGURE 18. WHITE HOUSE - EAST ELEVATION TEST AREA

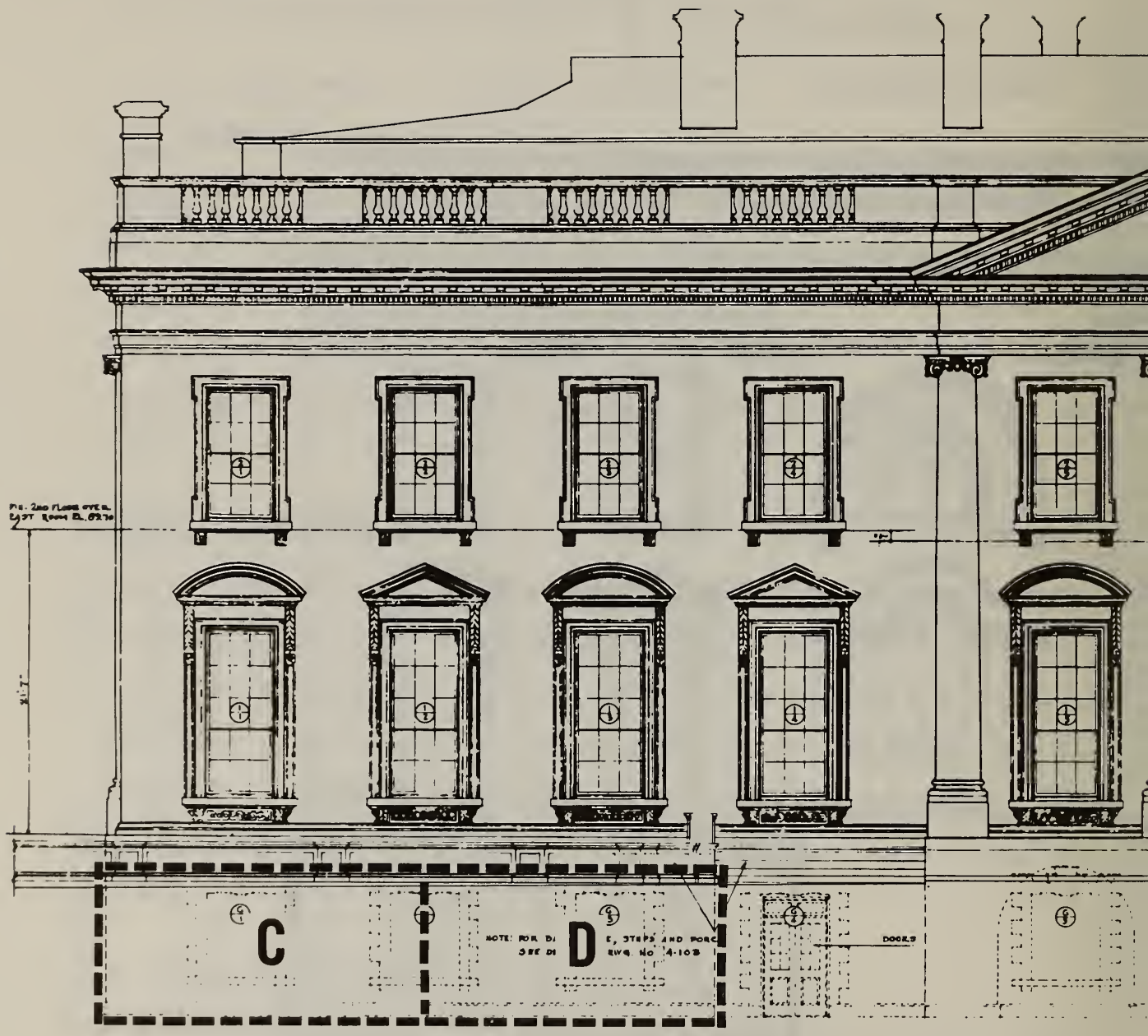


FIGURE 19. WHITE HOUSE - NORTH ELEVATION TEST AREA

Area	Paint Removal Technique
A	Combination hand cleaning, chemical treatment, water spray (Method 2)
B	Chemical treatment/high pressure water spray (Method 1)
C	Abrasive blasting with aluminum beads (Method 3)
D	Hand scraping and chipping

Hand scraping and chipping, a method historically used by White House staff, was used primarily to compare its effectiveness with that of the other This method was carried out by the White House Paint Crew. Paint removal methods 1, 2, and 3 were performed by Companies 1, 2, and 3, respectively.

6.2.1 Test Area A

Test Area A was cleaned on August 30-31 and October 10-11, 1978 by Company 2, using a combination of cleaning techniques. The procedure consisted of 1) scraping the old paint by hand, taking care to avoid damaging the fluting on the stone, (see figure 20), 2) applying an alkaline paint remover, 3) scouring the paint with a wire brush, and 4) rinsing the surface with high-pressure water spray (see figures 21 and 22). In addition, a heat gun was used in a small area to soften the paint, which was then scraped off. This process is shown in figure 23. The equipment used in the operation included hand tools, air compressor and spray apparatus and required 110V electrical and water services. A temporary asphalt-plastic filler dam was constructed to contain water run off (see figure 21). Figure 24 shows test Areas A and B prior to paint removal. Approximately 3/4 of the paint on Area A was removed by the cleaning process.

FIGURE 20. PAINT REMOVAL IN AREA A, SCRAPING OFF PAINT AFTER SOFTENING WITH PAINT REMOVER

FIGURE 21. PAINT REMOVAL IN AREA A, USING HIGH PRESSURE WATER SPRAY

FIGURE 22. PAINT REMOVAL IN AREA A, USING HIGH PRESSURE WATER SPRAY

FIGURE 23. PAINT REMOVAL IN AREA A, USING HEAT GUN TO SOFTEN PAINT BEFORE SCRAPING

6.2.2 Test Area B

Test Area B was cleaned by Company 1 using a combination chemical treatment/high pressure water spray process. The work was performed on August 21-23, 1978. Preliminary tests were made on a test portion of Area B with two types of paint removers. The first paint remover contained methylene chloride and paraffin wax and was slightly alkaline. The second paint remover contained sodium gluconate, sodium hydroxide, and EDTA (ethylene diamine tetraacetic acid) in a strongly alkaline emulsion solution. The first remover was judged more effective in softening the newer paint layers, while the second remover was more effective with the older paint layers. Also, the first remover was observed to evaporate more rapidly than the second. Based upon the preliminary tests, both removers were used in the cleaning process.

The removal technique of Company 1 followed the procedure described below:

- The paint remover was applied by bristle brush to the painted surface and allowed to stand 10 to 15 minutes.
- The paint was then scoured with brushes.
- Additional paint remover was added and allowed to remain undisturbed for 10 to 30 minutes.
- The softened paint was rinsed off with water spray at a low pressure and then with high pressure [1000 to 1700 psi (6.9-11.7MPa)].
- The above steps were repeated until all the paint had been removed.

Figures 25 and 26 illustrate the operation of Company 1. They utilized the White House movable scaffold and required 110V electrical and water services.

FIGURE 24. AREAS A AND B, BEFORE PAINT REMOVAL

FIGURE 25. PAINT REMOVAL IN AREA B, APPLICATION OF PAINT REMOVER

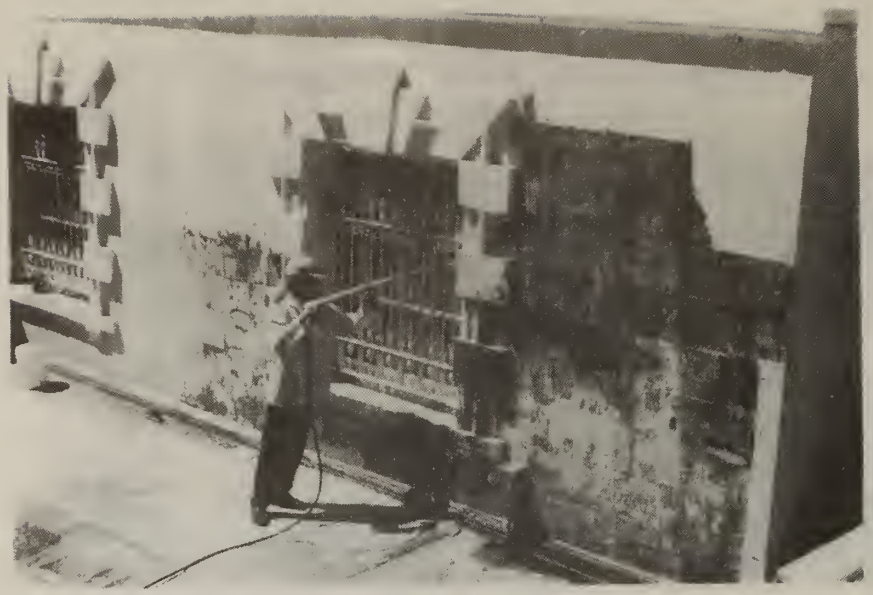


FIGURE 26. PAINT REMOVAL IN AREA B, WASHING AWAY SOFTENED PAINT WITH WATER SPRAY

FIGURE 27. AREA A (BEFORE PAINT REMOVAL) AND AREA B (PAINT REMOVED)

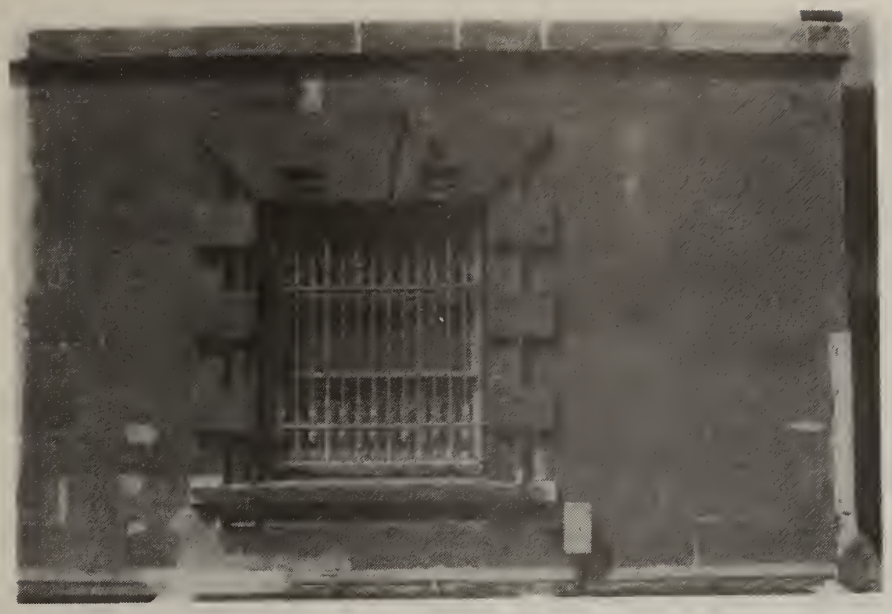


FIGURE 28. AREA B, AFTER PAINT REMOVAL

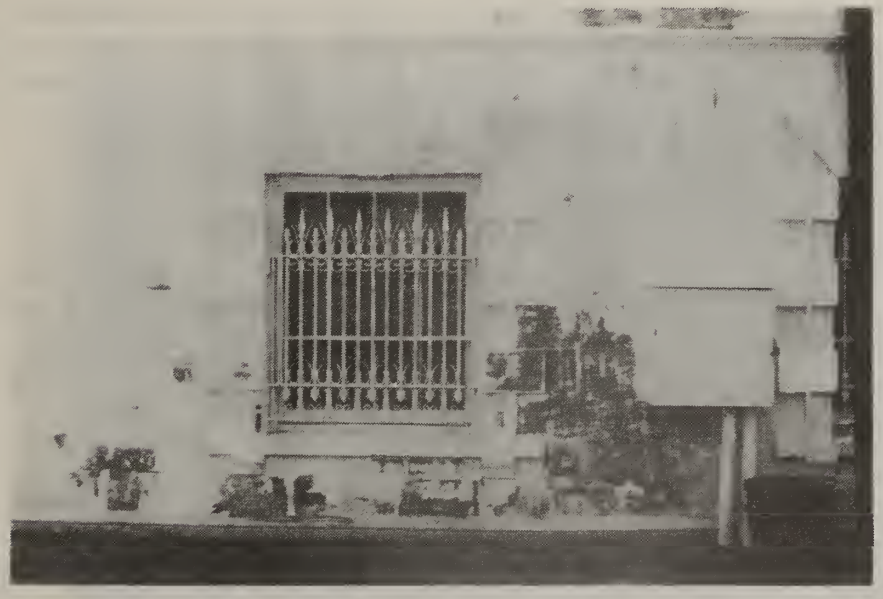


FIGURE 29. AREA C, AFTER PAINT REMOVAL EFFORTS

Their compressor had no sound insulation and may need modification for extended usage around a sound sensitive area. Figures 27 and 28 show that the process was effective at removing paint from the sandstone.

6.2.3 Test Area C

On August 23, 1978, representatives of Company 3 removed paint from Area C using their air driven abrasive system. The abrasive used was 0.004 in (0.01 cm) aluminum beads. The process did not successfully remove the paint. Figure 29 shows Area C after cleaning. Often the beads impacting on the area would not remove or loosen the old paint, but a knife or screwdriver inserted under the paint in the same area would completely remove the paint. There was some evidence of slight damage to the stone if the apparatus was held too long on the exposed sandstone. Based upon the difficulties encountered, Company 3 representatives decided to discontinue the operation. Some of the loose paint still present in Area C was removed, prior to repainting, by the White House paint crew using heat guns and/or scrapers.

6.2.4 Test Area D

The White House painting crew removed paint from Area D using hand scraping and chipping. Paint chips were caught on drop cloths spread next to the wall. Loose paint was removed with scrapers. Adherent paint was removed by lightly tapping with the flat chisel-head blade of a hammer (figure 30). Surface details of the cleaned stone are shown in figure 31-33. Figure 34 shows Area D with most of the paint removed. It is apparent from figure 34 that most of the paint was removed by this process. But the sandstone can be easily damaged by the process as shown in figures 32 and 33.

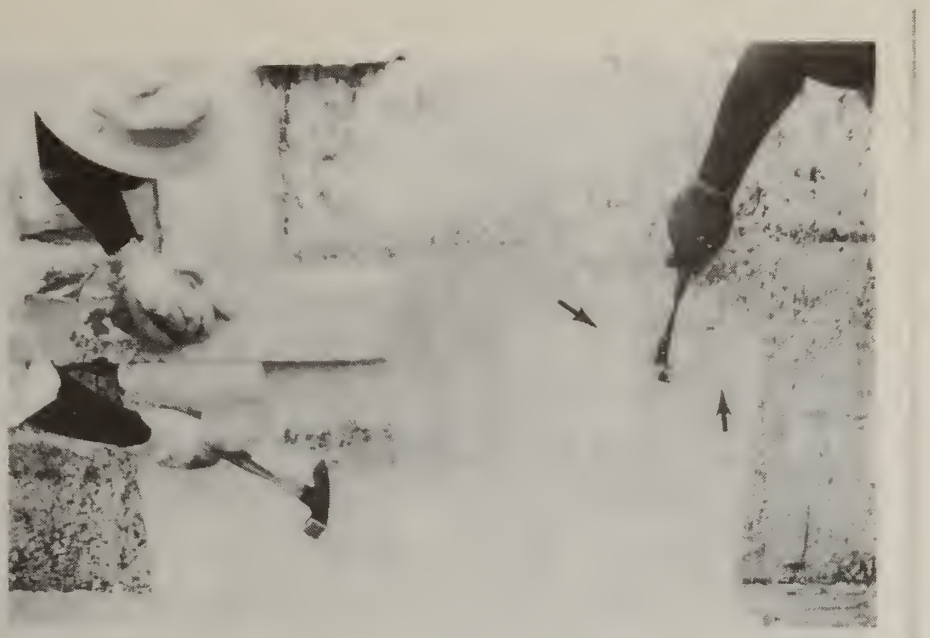


FIGURE 30. PAINT REMOVAL IN AREA D (BY WHITE HOUSE PAINT CREW); ARROWS INDICATE AREAS SHOWN IN FIGURES 31 AND 32

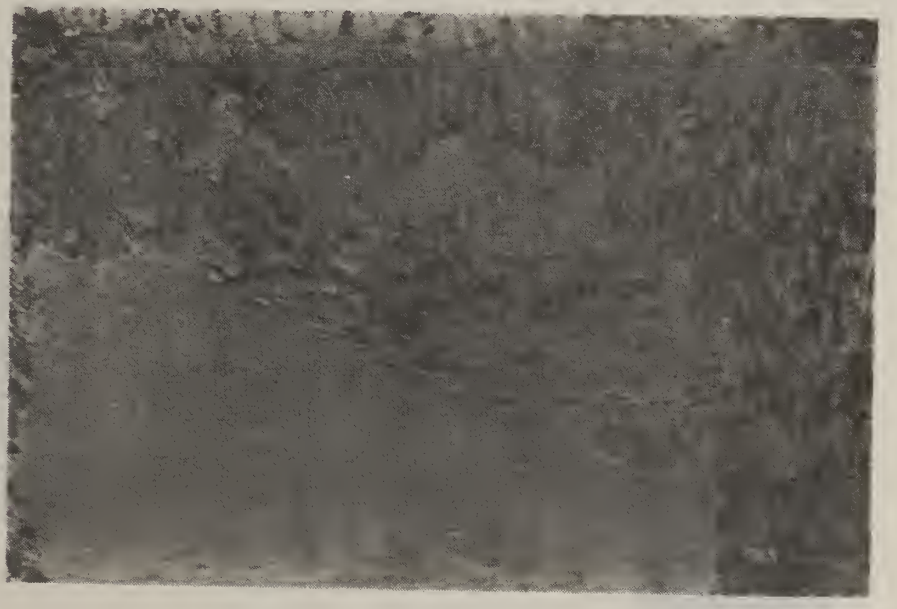


FIGURE 31. AREA D, PAINT REMOVED BY CHIPPING

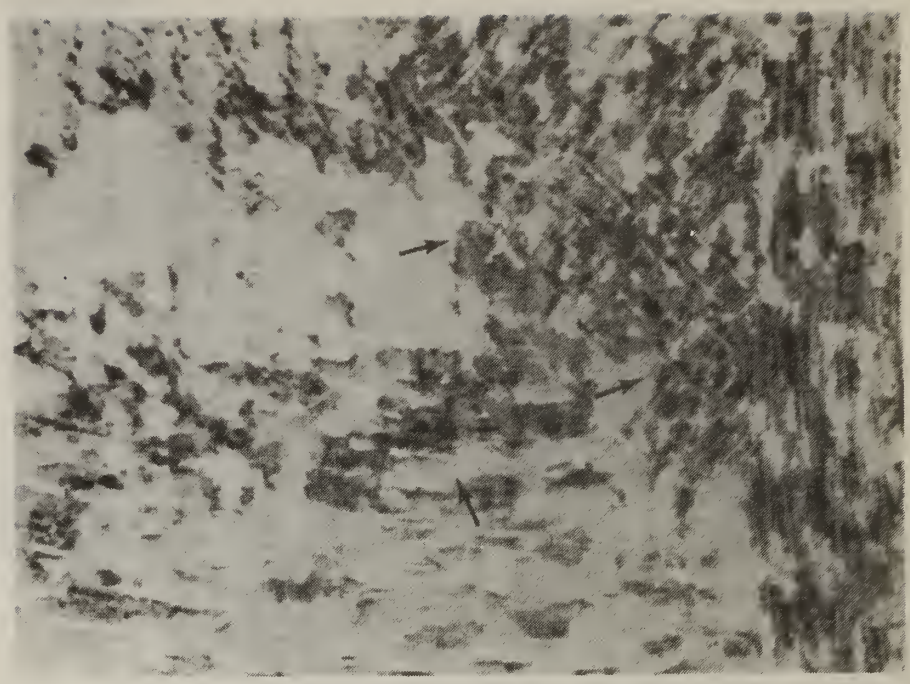


FIGURE 32. AREA D, PAINT REMOVED BY CHIPPING, ARROWS INDICATE IMPACT MARKS OF HAMMER BLADE

FIGURE 33. AREA D, ARROWS INDICATE PLACES WHERE STONE WAS CHIPPED BY PAINT REMOVAL

FIGURE 34. AREA D, WITH MOST OF THE PAINT REMOVED

6.2.5 Discussion of Paint Removal Results

Not all of the four methods of paint removal worked equally well in removing paint. Only the White House painting crew and Company 1 succeeded in removing all or most of the paint within a short time frame. The operation of Company 2 was also effective in paint removal, but the time for removal was twice that of Company 1. The Company 3 operation, using their apparatus and abrasive, did not remove the paint.

The estimated times needed to clean a 250 ft^2 (23.2 m^2) section for the three paint removal tests that were completed are as follows:

Company 2	58 man hours
Company 1	28 man hours
White House Painting Crew	78 man hours

The advantages and disadvantages of each method are briefly summarized:

	Advantages	Disadvantages
Hand scraping and chipping	° Method did not require highly trained people ° Equipment costs are minimal ° Paint was removed as easily collected dry chips ° No water or chemical used, the dry surface could have been painted immediately after old paint and other loose materials were removed.	° Slowest method used ° The chipping demand the stone ° Method worked best on flat surface; is questionable for use on delicately carved stone ° Paint was not removed from pores of stone

	Advantages	Disadvantages
Chemical treatment/ high-pressure water (Company 1)	° Paint was removed effectively from surface and pores of stone ° Fastest method used ° Applicable to various surface configurations ° Damage to stone was minimal	° Water/chemical/old paint runoff a potential problem ° Experienced personnel were needed ° High-pressure water dislodged loose mortar and decayed stone (this may be an advantage) ° After paint removal, the wet surface has to be dried before repainting ° Possible damage to stone by inorganic salts if not completely removed
Combination scraping, chemical treatment high-pressure water (Company 2)	° Was somewhat effective at removing paint ° Damage to stone was minimal ° Faster than hand cleaning	° The operation was complex, better planning a necessity ° Partial hand cleaning slowed the process ° Others same as for Method 1
Abrasive blasting (Company 3)	° Potential for removing paint with minimal damage to stone ° Old paint and abrasive collected in dry form by vacuum attachment ° Abrasive reusable	° Ineffective in removing paint from a large area in present form ° The operating head used was too heavy for convenient operation

6.3 MASONRY REPAIR

Removal of the paint revealed many areas where the stone had been previously repaired or was in need of repair, as well as many areas where the mortar had been removed during paint removal.

Using a mortar formulation recommended by Mr. J. W. Rogers, Architect of the Capitol's Office, repair was performed and cured 28 days before painting. Illustrations of a decayed stone patch exposed by paint removal (Area A) and repair are illustrated in figures 35 and 36. Figure 37 illustrates the repointing work. It may be noted that the excess or loose mortar was not completely removed from the joint area.

6.4 PAINT APPLICATION

The same four paints (coatings) which were evaluated in the laboratory tests (Chapter 4) were applied to the cleaned sandstone. The pattern of application to each of the four test areas is illustrated below:

CLEANED TEST AREA

	A		B		C		D	
Coating Material Used	2	1	3	4	1	3	4	2
	3	4	2	1	4	2	1	3

where coating materials 1-4 were as follows:

1. Latex (Acrylic)
2. Styrene-Butadiene (Rubber-Based)
3. Coating Vinyl Toluene-Acrylate (Textured Coating)
4. Tung Oil - Alkyd

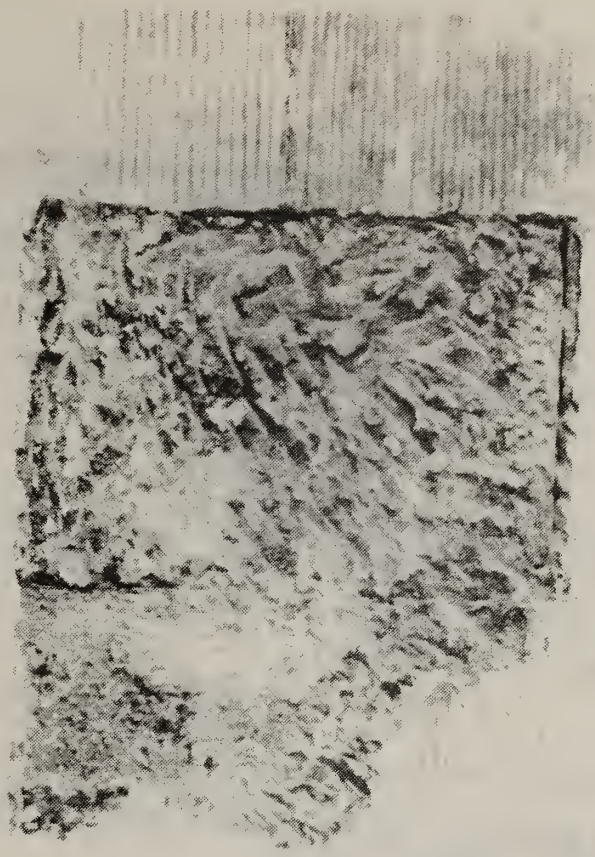


FIGURE 35. AREA A, DECAYED STONE REPAIR, EXPOSED BY PAINT REMOVAL

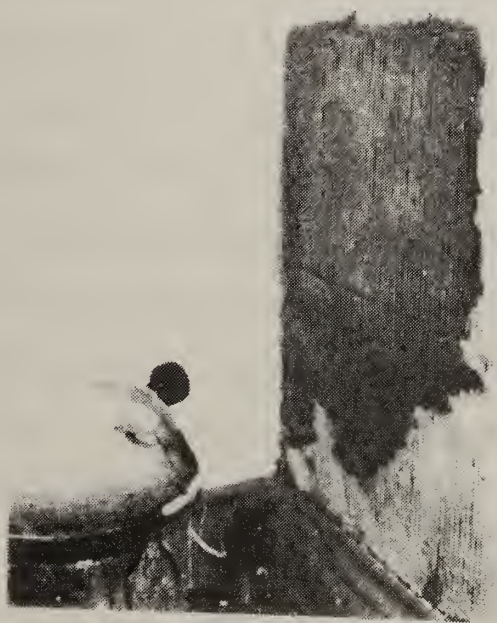


FIGURE 36. AREA A, REPAIRED AREA

FIGURE 37. REPAINTING OF AREA B, ARROWS INDICATE BROAD AREA OF EXCESS MORTAR AFTER REPOINTING

Thus each paint was applied to each of the four differently prepared surfaces. The White House painting crew applied each paint at a spreading rate of 200 ft^2/gal (4.90 m^2/l). The first coats were applied October 11 and 12, 1978 and the second coats on October 26, 1978. The moisture content of the sandstone and mortar joints was less than 5 percent by weight prior to initial paint application.

The paint operation is illustrated by figures 38 and 39. Figures 40-45 show the test areas after painting.

6.5 RESULTS OF FIELD TEST INSPECTIONS

The paint removal procedures and paint application procedures were performed during the summer and fall of 1978. The site was inspected in March, May, October and December 1978 to evaluate coatings performance and the effects of the paint removal procedures on sandstone.

In the March 1979 inspection, surface cracking of the acrylic paint (Coating 1) was observed in all four paint removal areas. The cracks did not appear to penetrate through both layers of paint and appeared to be due to an excessive paint buildup. Figure 46 illustrates the type of surface cracking observed. Painting conditions for both coats of paint were good; temperatures during the application of the second coat on October 26, 1978 ranged from 60 to 82°F (15 to 27°C) and only light precipitation of 0.01 in (0.025 mm) occurred at midnight. Since none of the Coating 1 panels involved in the UV laboratory exposure tests or the exposure test on the roof of the Residence exhibited any cracking, we surmise that an excessive coating thickness of the second coat may have been responsible for the incipient failures (see

FIGURE 38. REPAINTING OF AREAS A AND B

FIGURE 39. REPAINTING OF AREA D

FIGURE 40. AREAS A AND B, AFTER REPAINTING

FIGURE 41. AREAS A AND B, AFTER REPAINTING

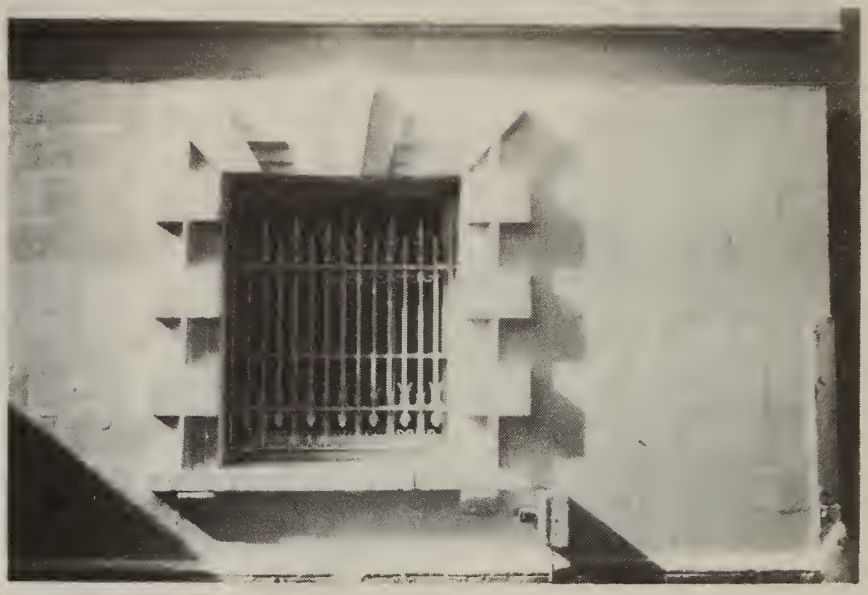


FIGURE 42. AREA B AFTER REPAINTING

FIGURE 43. AREA C AFTER REPAINTING

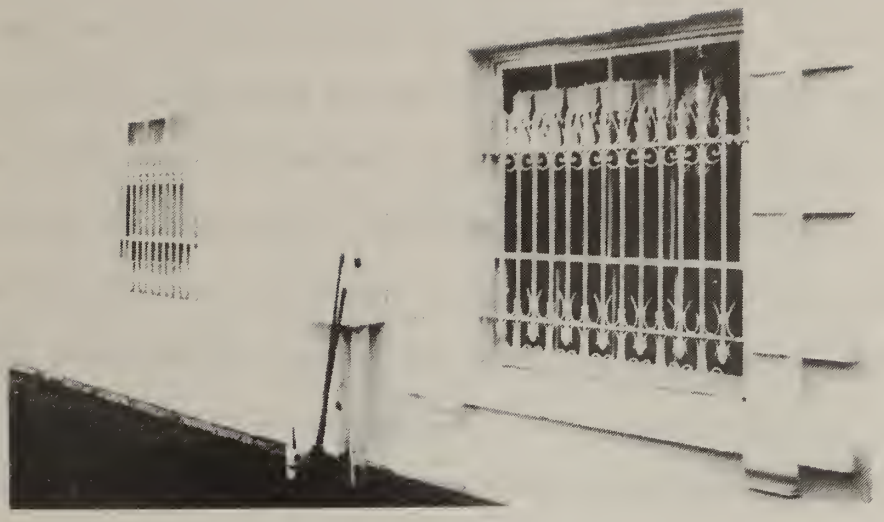


FIGURE 44. AREAS C AND D, AFTER REPAINTING

FIGURE 45. AREA D AFTER REPAINTING; ARROWS INDICATE VERTICAL LINE DIVIDING TEST SECTIONS D4 AND D1 (TO LEFT) FROM SECTIONS D2 AND D3 (TO RIGHT)

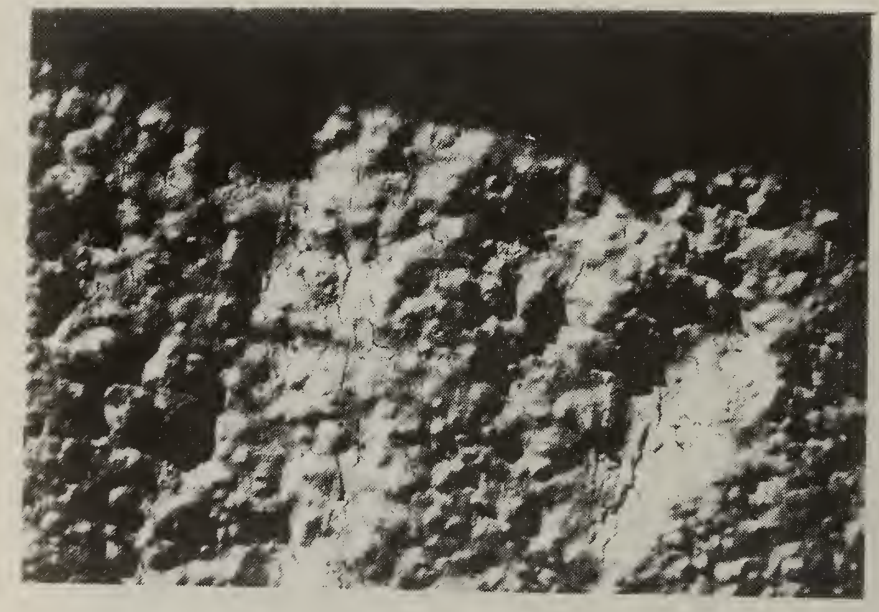


FIGURE 46. SURFACE CRACKS IN COATING 1; 1:1 EXPOSURE, MARCH 1979

Hess [23] for discussions on this type of failure). None of the other coating materials applied exhibited any similar surface cracking. As noted earlier, repointing in Area B resulted in some powdery mortar material remaining on the surface which was not removed prior to painting (see figure 37). However, no delamination was observed in the affected mortar joint area. In the May 1979 inspection, Coating 3 appeared to be darker in comparison to the other coatings but the amount of surface cracking, noted during the March inspection on Coating 1, did not appear to increase. Some delamination of Coating 2 was observed in Test Area A and all four coatings exhibited delaminations in Area C. These paint failures were due to the poor adhesion of the old paint layers that had not been removed by cleaning prior to repainting. Figures 47 and 48 illustrate this type of failure which is typical of the paint failures observed in the past on the Residence.

During the October 1979 inspection, Elcometer[2/] adhesion tests were performed in Area C on all coating systems. In this area, not much of the old paint had been removed prior to painting. The purpose of the adhesion tests was to measure the level of adhesion between the old paint and the new paint. Using a cyanoacrylate adhesive, failures were obtained between 50 and 125 psi (0.35 and 0.96 MPa). However, failures were within the old paint layers rather than at the old paint-new paint interface. These results lend support to the theory that paint failures are likely to be a continuing problem

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2/ Certain commercial equipment, instruments, processes or products are identified in this paper in order to specify the experimental procedure. In no case does such identification imply recommendation or endorsement by the National Bureau of Standards, nor does it imply that the material or equipment identified is necessarily the best available for the purpose.

FIGURE 47. PAINT DELAMINATION IN AREA A, MAY 1979

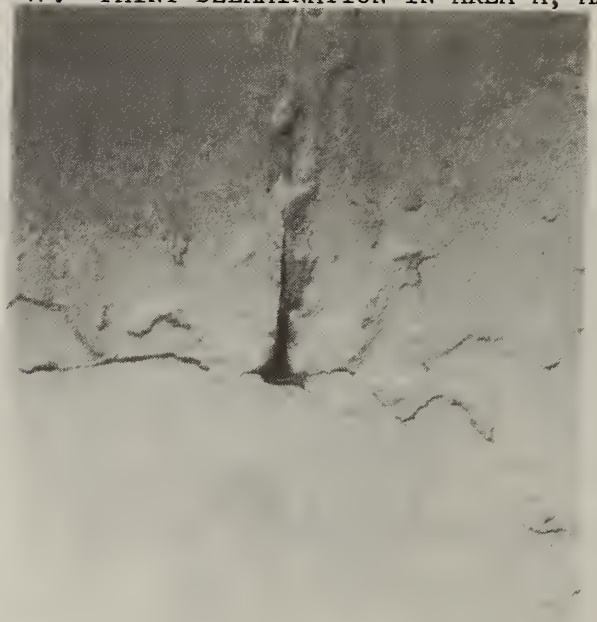

FIGURE 48. PAINT DELAMINATION IN AREA C, MAY 1979

until the old paint has been removed from the Residence. The coatings appeared to be performing well (except as noted in prior inspections), although Coating 3 was chalking slightly on the east elevation exposures. Figures 49-55 illustrate the appearance of the coating systems on the four paint removal areas.

The test site was inspected in December 1979, fourteen months after painting. Chalk resistance measurements (ASTM D 659) and lightness index difference measurements (Method 6122, F.T.M.S. 141) were made in Test Area B. The following results were obtained:

Coating Number	Chalk Resistance	Lightness Index Differences
1	8, 8	0.7
2	6, 6	5.3
3	6, 6	1.4
4	6, 6	1.4

The performance of all coatings appeared to be good, with the exceptions noted previously in which peeling of old paint was observed and Coating 1 had surface cracks.

Conclusions, based upon the field test inpections are as follows:

1. Surface preparation prior to repainting was a key factor affecting coatings performance. Where all or most of the old paint had been removed prior to repainting (Test Areas B and D), none of the four paints exhibited peeling or other loss of adhesion. In contrast, peeling was observed in Test Areas A and C where portions of old paint were not removed.

FIGURE 49. AREAS A AND B, OCTOBER 1979

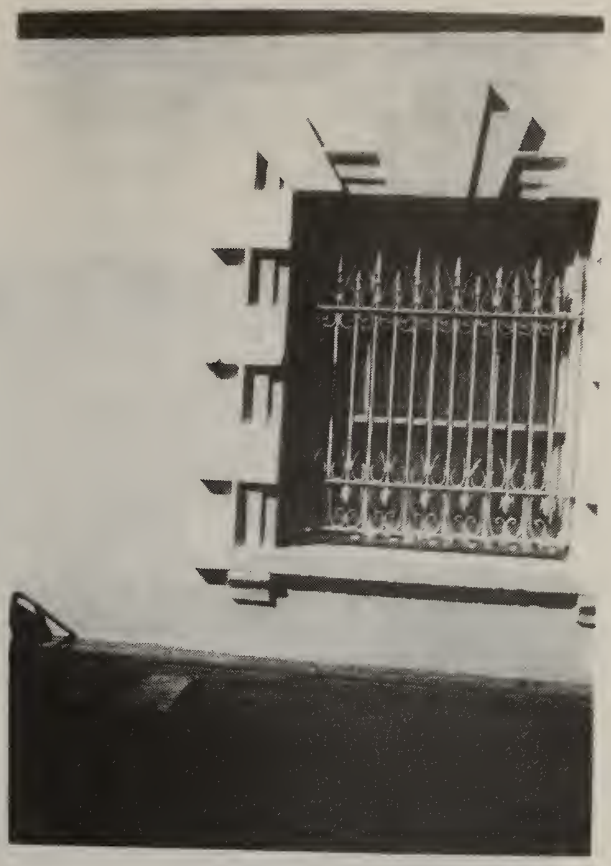

FIGURE 50. AREA B, OCTOBER 1979

FIGURE 51. AREA B, OCTOBER 1979

FIGURE 52. AREA C, OCTOBER 1979

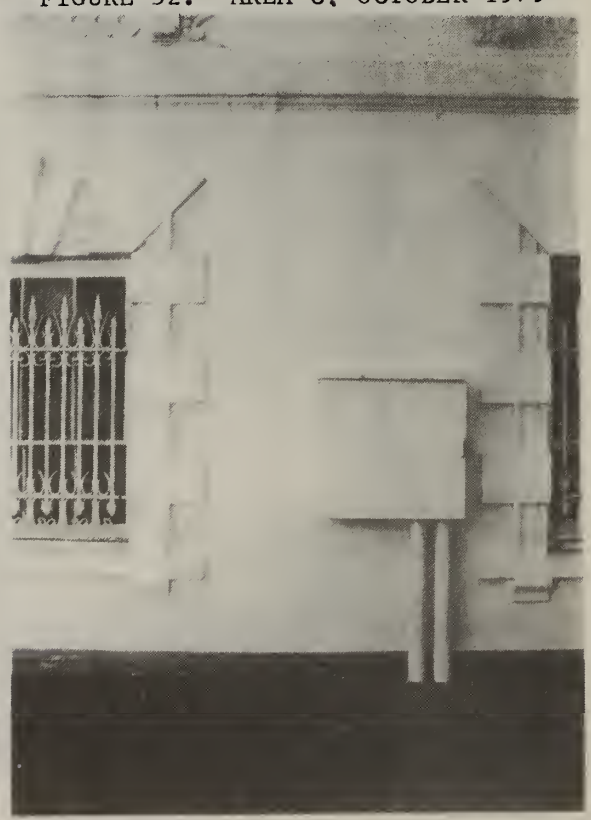

FIGURE 53. AREAS C AND D, OCTOBER 1979

FIGURE 54. AREA D, OCTOBER 1979

FIGURE 55. AREA D, OCTOBER 1979

2. Coating 1 exhibited surface cracking in all four Test Areas and these would be likely sources of premature failure.
3. Coatings 2, 3 and 4 exhibited good performance, particularly in Test Areas B and D.

7. CONCLUSIONS

The following conclusions, based upon the laboratory and field test results, are drawn:

1. The field test data indicate that poor performance, particularly peeling or other loss of adhesion, is likely to result if the stone surface is not properly prepared before repainting. Specifically, it is essential to remove all loose, peeling and blistering paint and accumulated surface contaminants prior to repainting.
2. The field test data indicate that a chemical treatment combined with high pressure water spray (Method 1) is highly effective at removing old paint. While handscraping and chipping is also effective at removing old paint, the chemical treatment/high pressure water spray procedure is preferred because it is less likely to damage the stone surface.
3. The laboratory and field tests indicate that, of the four specific coatings evaluated, Coating 4 is likely to provide the best overall performance on White House sandstone. Coating 4 is the only one that did not exhibit surface cracking in the laboratory tests using the CAD cyclic test. Coating 1 exhibited surface cracking in the field tests and Coating 3 exhibited the greatest amount of color change in the three laboratory exposure tests and in the outdoor exposure test on the roof of the White House. Coating 4 is rated slightly higher than Coating 2

on the basis of the smaller color changes during the outdoor exposure test on the roof of the White House and the results of the CAD cyclic laboratory test.

4. While the Method 1 surface preparation procedure was effective in removing old paint during the field test, the limited size of the test area and the limited period of time (14 months) in which actual performance of of applied coatings was evaluated indicates that additional data should be obtained prior to cleaning all White House sandstone with the method.

8. GUIDE SPECIFICATIONS

8.1 GENERAL

Utilizing the laboratory and field test exposures results, guide specifications were developed for the 1980 exterior restoration of the White House. The specifications are presented in Appendix 1. The guide specifications follow the format of AE Specifications Guidelines, Denver Service Center, National Park Service, U.S. Department of the Interior. The principal features of the specifications address complete removal of all old paint from the east elevation of the Residence, but removal only of loose paint and other loose foreign material from the north, west, and south elevations of the Residence; repair, repointing and replacement of deteriorated masonry; and repainting the exterior of the Residence. The major divisions of the document are General Requirements; Masonry; Thermal and Moisture Protection; and Finishes.

8.2 GENERAL REQUIREMENTS

The contents of the General Requirements Division are Summary of Work, Submittals, Inspection Procedures, Temporary Facilities, Scaffolding and Conveying Systems, Special Controls and Contract Closeout. A key item in this Division is the outline of inspection procedures. The following inspection procedures are critical to the success of the exterior restoration: use of weather forecasts to determine anticipated restoration conditions; determination of moisture conditions of both substrate and surrounding atmosphere; approval of substrate, e.g., stone and mortar, prior to painting; and control of paint application rates. Also, photographic records will be used to record stone replacement and repair and to record progress during the cleaning and painting operation. The photographic records will be important for both historic record purposes and for follow-up evaluations. Another key item in this Division is quality assurance and control. Highly skilled personnel are required for the restoration operation which includes paint removal, masonry repair and replacement and painting. Therefore, specialist qualifications are defined to include proof of experience in similar projects completed in the last five years. A final important item of this Division is the post-construction inspection, which states that the Contracting Officer will inspect the project to determine whether corrective work is required. This inspection will be prior to the expiration of one year from the date of final acceptance.

8.3 MASONRY

The Stone Masonry Restoration Section 04520 of Division 4, Masonry, includes masonry restoration of the east elevation of the Residence only. The following operations are included: paint removal and cleaning; repointing and repair, removal and replacement of deteriorated stone.

8.3.1 Paint Removal

The specifications require that paint removal on the east elevation be performed by using a chemical treatment combined with high pressure water spray (Method 1 of Chapter 6). Selection is based upon the successful demonstration, in the field test, of the effectiveness of the method.

During paint removal operations at the White House test site, some deteriorated sandstone and deteriorated concrete repair work was uncovered. As a consequence, provisions in the guide specifications call for immediate work stoppage and notification of the Contracting Officer if such observations are made in order to prevent further damage to the substrate and to avoid excessive water penetration. Also, the waste paint residue and water may contain traces of lead and requirements are made for collecting the waste water for safe waste disposal.

8.3.2 Mortar Replacement and Repair

During the paint removal operation at the White House test site, an appreciable amount of deteriorated mortar was uncovered. J.W. Rogers, Architect of the Capitol's Office, recommended that, since an appreciable amount of mortar seemed unsound, the mortar joints on the east elevation of the Residence be completely replaced. Therefore, provision in the guide specifications is

made for the repointing of all joints on the east elevation. Replacement sandstone and limestone are designated to comply with ASTM C616 and ASTM C568, respectively, and repair procedures are included in the guide specifications. However, the replacement stone should be of similar strength and porosity to the original stone in order to minimize deterioration of the adjacent stone.

8.4 THERMAL AND MOISTURE PROTECTION

The Thermal and Moisture Protection Division (Section 07951 on Caulking) of the guide specifications addresses caulking work of the wood windows and doors. The material used, TT-C-00598, a linseed oil caulking, is the same as is on the wood surfaces, at present and it can readily be painted to match the adjacent substrates.

8.5 FINISHES

The Painting Section 09902 of Division 9 on Finishes addresses exterior painting, including stone masonry, wood, and metal window grilles. Included are provisions for job conditions, surface preparation of the different substrates involved, paint materials and application. To achieve successful coatings performance, it is essential that the surfaces be clean, that surface moisture be minimized and that paint application be restricted to ambient and surface temperatures between 45°F (7.2°C) and 95°F (35°C), relative humidities equal to or less than 80 percent, wind velocities equal to or less than 15 mph (24 km/h), and to surface temperature, greater than 5°F (2°C) above the dew point.

8.5.1 Surface Preparation

Surface preparation for areas other than the east elevation of the Residence is described in Section 09902. Surface preparation of masonry on the north, south and west elevations includes high pressure water spray to remove all loose, peeling and blistering paint and accumulated surface contaminants before painting. Detailed guidance is given for the surface preparation of stone and other substrates in par. 3.2. It is essential that all loose paint be completely removed. Otherwise, premature failures are likely to occur due to poor adhesion of the old paint.

8.5.2 Paint Materials

Based upon the laboratory and test site exposure results, a linseed oil, tung oil, soya alkyd paint (Coating 4), is required for use on all masonry of the White House.

The paint system required for ferrous surfaces to be painted is a zinc chromate alkyd primer, TT-P-645, and a top coat of a lusterless alkyd enamel, TT-E-527. Similar paint systems are recommended in the Tri-Service "Paints and Protective Coatings" Manual [13]. The alkyd primer and alkyd top coat system has been used successfully for the metal railings at the Residence in the past. For wood substrates, which include doors and window trim, the alkyd primer and topcoat system, TT-P-25, TT-P-102, has been used successfully at the Residence in the past and is required in the guide specifications.

8.5.3 Paint Application

Brush application of all primer coats is required to ensure proper covering of uneven, porous masonry surfaces. Use of spray or roller on primer coats

could allow the paint to bridge any defects in the porous masonry surface, leaving voids which would lead to premature failure. Spray application of finish coats is permitted since it would be economically attractive and it would provide a uniform finish. Control of paint thickness is important.

In the laboratory study, application at 200 ft^2/gal (23.2 m^2/l) to sandstone provided excellent coverage and produced no surface cracking for any of the four coatings. In the guide specifications, paint control is established by maintaining records of the surface area painted and the volume of paint used. Also, provision is made to restrict the rate of film application to conform to specification and manufacturer's recommendations and to restrict dry film application to not more than 1 mil (25μm) greater than manufacturer's recommendations.

9. RECOMMENDATIONS

9.1 GUIDE SPECIFICATIONS

It is recommended that the Guide Specifications included in Appendix 1 of this report be used in the 1980 White House exterior restoration activities. While the guide specifications address all elements of the restoration activities, the emphasis of this study has been directed to restoration of the sandstone. For this reason, key recommendations for the 1980 sandstone restoration are highlighted as follows:

Surface Preparation of the Sandstone Prior to Repainting

It is recommended that:

1. All paint on the east elevation of the Residence be removed using the same combined chemical treatment/high pressure water spray procedure (Method 1) that was used in the field test.

2. All loose, peeling, and blistering paint and all accumulated surface contaminants be removed on the north, west and south elevations of the Residence using high pressure water spray.
3. Deteriorated sandstone be repaired, repointed or replaced as needed on all elevations. All mortar joints on the east elevation be repointed.
4. All sandstone surfaces be thoroughly inspected prior to commencing repainting operations.

Coating Materials for Repainting the Sandstone

It is recommended that:

1. Sandstone on all elevations be repainted using a linseed oil, tung oil, soya alkyd paint (Coating 4). Where the stone is exposed after cleaning, two coats are recommended; where the stone is not exposed after cleaning, one coat is recommended.
2. The quality of the paint procured be evaluated prior to application by performing compliance and performance tests.

9.2 COMPILATION OF DATA ON EFFECTIVENESS OF 1980 SANDSTONE RESTORATION ACTIVITIES

It is recommended that:

1. After the 1980 sandstone restoration activities are completed, the exterior surfaces be visually inspected quarterly and observations recorded in order to evaluate the effectiveness of the restoration procedures.
2. Information obtained on the effectiveness be compiled and used to aid in the development of recommendations for subsequent restoration activities.

9.3 MAINTENANCE

To aid reduction of future maintenance costs, it is recommended that:

1. Periodic inspection be performed to identify paint problems and, where possible, maintenance touch up painting be performed as needed. Maintenance touch up painting could prolong the time between complete repainting operations
2. Paint inspection equipment be made available to the Contracting Officer and to the White House maintenance staff. A recommended list of inspection equipment includes Polaroid camera; sling psychrometer; wet film thickness gage; optical thickness gage, dry film, Tooke; magnifying lens (20X) and micrometer.
3. Periodic inspection and repair of the roof drainage system be performed to help minimize potential moisture problems.
4. A barrier be provided between the refuse collection area and the White House, i.e., east elevation of the Residence at ground level, to prevent damage to the stone.

10. REFERENCES

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19. Parker, H. E., Myers, Raymond R. and Long, J.S., Ed., "Chlorinated Rubber" Chapter 5, "Treastise on Coatings", Vol. I, Pt I, Marcel Dekker, New York, 1967.

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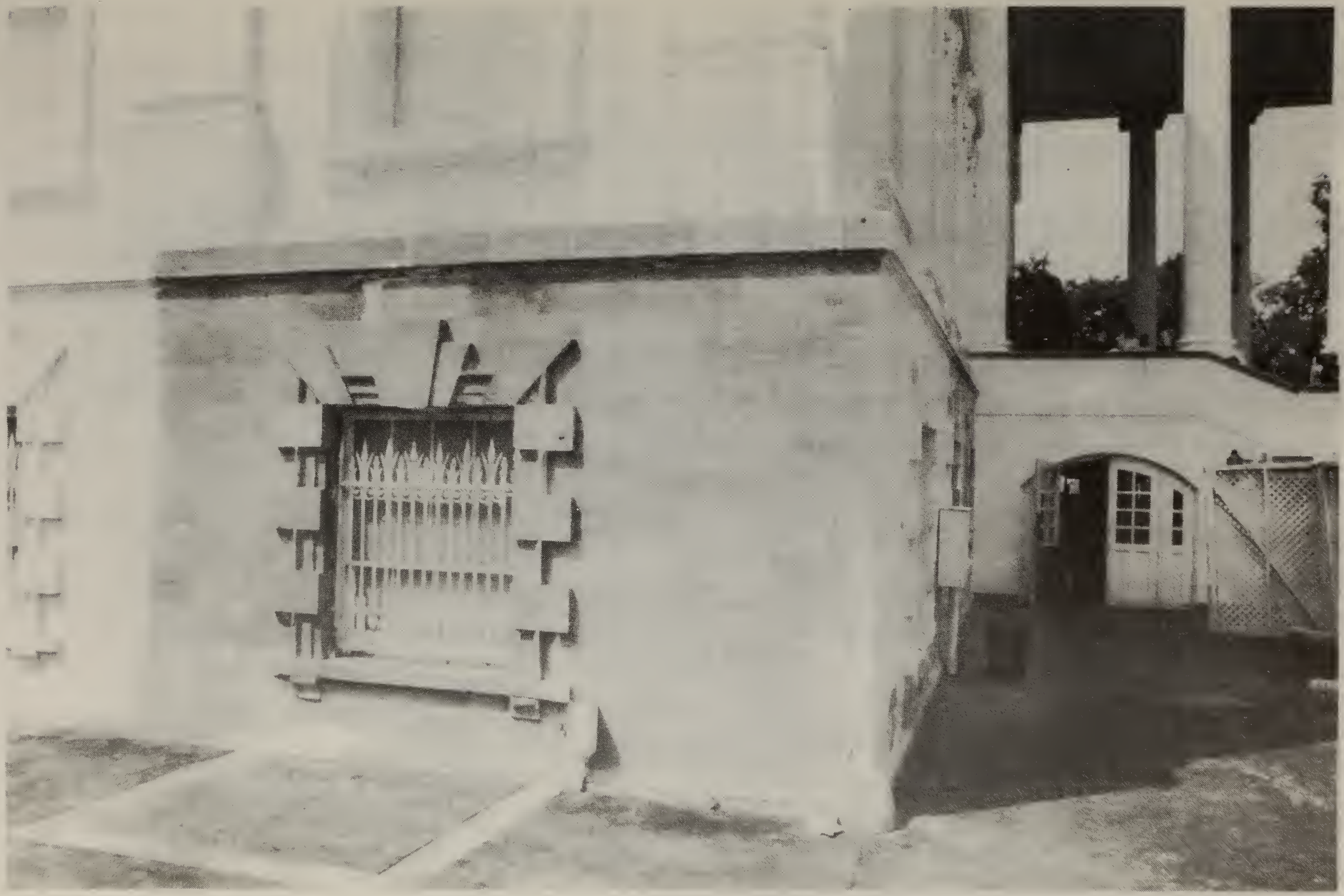
22. Sleater, Gerald A., "Stone Preservatives: Methods of Laboratory Testing and Preliminary Performance Criteria", NBS Technical Note 941, May 1977.

23. Hess, Manfred, "Paint Film Defects; Their Causes and Cures", p. 54, Reinhold Publishing Corp., New York, 1951.

APPENDIX 1

EXTERIOR RESTORATION CONSTRUCTION SPECIFICATIONS



WHITE HOUSE, 1600 Pennsylvania Avenue, N.W., Washington, D.C.

EXTERIOR RESTORATION - 1980
CONSTRUCTION SPECIFICATIONS

Division I - General Requirements

Index to Sections

Division 2 - Not Used for this Project

Division 3 - Not Used for this Project

Division 4 - Masonry

Division 5 - Not Used for this Project

Division 6 - Not Used for this Project

Division 7 - Thermal and Moisture Protection

Division 8 - Not Used for this Project

Division 9 - Finishes

Division 10-16 - Not Used for this Project

INDEX TO ARTICLES OF THE SECTIONS OF DIVISION 1 - GENERAL REQUIREMENTS

3. Disposal of Waste Materials
4. Air and Water Pollution Control
5. Protection of Executive Residence
6. Safety
7. Quality Assurance and Control
8. Construction Signs
9. Photographs

SECTION 01700 - CONTRACT CLOSEOUT

1. Site Restoration
2. Project Record Drawings
3. Substantial Completion and Final Inspection
4. Acceptance of the Work
5. Closeout Submittals
6. Post-construction Inspection

1. DESCRIPTION: The work covered by these specifications consists of furnishing all labor, equipment, materials and supplies for performing all exterior restoration work. All paint specified hereinafter will be furnished by the Government. The work under this contract shall include, but not be limited to the following:

   A. Complete removal of all paint from the east elevation of the Residence.
   B. Removal of loose paint and other loose foreign material on the north, west, and south elevations of the Residence.
   C. Repair, replacement and repointing of deteriorated masonry on all elevations of the Residence.
   D. Repair and restoration of wood windows and trim, including caulking.
   E. Exterior painting of the Residence.
   F. Clean up

2. LOCATION: Executive Residence, 1600 Pennsylvania Avenue, N.W., Washington, D.C.

3. TIME FOR COMPLETION: All work shall be completed within 90 calendar days from the date of the notice to proceed.

4. LIQUIDATED DAMAGES: In case of failure on the part of the Contractor to complete the work within the time fixed for completion of the contract, or any extension thereof, the contractor shall pay to the Government as fixed, agreed and liquidated damages, pursuant to the clause of this contract entitled "Termination for Default-damages for Delay-Time Extension" the sum of $500 for each calendar day of delay.

5. CONTRACT DRAWINGS: The White House Drawing No. 77-9, titled Exterior Coatings Study, dated March 1980, forms a part of and a supplement to these specifications.

6. SEQUENCE OF WORK: The sequence of work shall be as follows:

   A. East elevation of the Residence shall be completely stripped of paint.

   B. All masonry on the east elevation of the Residence shall be repaired and/or replaced, and repointing completed. Allow a 28 day curing period.

   C. During the curing period, clean the north, west and south elevations of the Residence to remove all loose paint and/or other loose foreign material.

   D. Make any necessary masonry repairs and/or replacements, or repointing on the north, west and south elevations of the Residence.

E. After the 28 day curing period, apply the primer coat to the east elevation of the Residence and spot prime other surfaces where the stone has been exposed.

F. Apply finish coat of paint to all surfaces.

7. ACCESS: Access to the site for all persons taking part in the work of the contract, including the delivery of all material and equipment, shall be by way of the North service drive from East Executive Avenue, unless otherwise notified.

A. Parking: Only one service vehicle at a time will be allowed on the grounds. Parking will not be provided on-site. Should the Contractor require the use of the streets for parking, he shall make arrangements through the appropriate municipal authorities for all required permits.

B. Public Access: The Executive Residence will remain open to the visiting public throughout the project, and the Contractor's operations shall not impede access. Where the public must cross construction areas to reach the building, acceptable barriers and protective enclosures shall be provided for public safety. Tours exit from the north portico, Tuesday through Saturday between 8 am and 1 pm. Work, materials and equipment will not be permitted near the north portico during these hours.

8. SECURITY: All persons engaged by the Contractor to work under this contract must obtain the required security clearance. Each person will be subject to a personal investigation prior to issuance of a clearance. This clearance must be issued before any person is admitted to the Executive Residence Grounds.

A. Required clearance cards must be completed and submitted to the Contracting Officer six (6) weeks prior to commencement of work.

B. All persons and equipment and material entering the Executive Residence Grounds are subject to a security search.

C. No person or persons taking part in any way in the execution of the work of this contract will be permitted within the Executive Residence, the East and West Terraces or the East and West Wings at any time.

D. Access to the Executive Residence Grounds and to the Executive Residence will be limited to normal working hours and the point of entry.

E. The Executive Residence and Offices will remain occupied during the life of this contract. All operations shall therefore be conducted as quietly as possible, and in such a manner not to interfere with the occupants of the building or with the progress of their work.

F. The Contracting Officer reserves the right to require the Contractor to temporarily delay operations in any area at any point. In the case of such temporary delays, an adjustment to the contract price as provided in Paragraph 17 of the General Provisions will not be made provided contract work in other areas is permitted to continue. An adjustment will be considered only if all work in all areas is interrupted for an unreasonable (more than one hour) period of time. Adjustments will not be made if work would have otherwise been stopped due to weather, undelivered materials, approval of submittal or Contractor's negligence.

9. ARCHEOLOGICAL FINDINGS AND SURVEY MARKERS: There may be archeological remains and survey markers in the work area. Artifacts, structural features, and unexpected objects of any nature, found within the construction area, are the property of and will be removed by the Government. Should Contractor's operations uncover or his employees find any remains, Contractor shall suspend operations at the site of discovery, notify the Contracting Officer immediately of the findings, and continue operations in other areas. Included with the notification shall be a brief statement of the location and details of the findings. Should the temporary suspension of work at the site result in delays, or the discovery site require additional studies resulting in delays or additional work for the Contractor, he will be compensated by an equitable adjustment under the General Provisions of the Contract. Survey markers shall not be moved or covered over under any conditions. Should Contractor's operations disturb any survey marker, notify the Contracting Officer immediately.

10. PRECONSTRUCTION CONFERENCE: As soon as possible after issuance of Notice of Award and prior to start of operation, Contracting Officer will arrange a meeting with Contractor. The meeting agenda will include the following:

Correspondence procedures
Designation of authorized representatives
Labor standards provisions
Payroll reports
Changes
Payments to Contractor
Subcontractors
National Park Service regulations
Security clearances
Work schedule
Accident prevention
Submittal of schedules, shop drawings, project data, and samples

11. COOPERATION WITH OTHER CONTRACTORS: Cooperation with other Contractors working in the Executive Residence during this contract will be required.

END

1. SUBMISSION PROCEDURE: At least 30 days before Contractor's need for approval, submit 5 copies or 5 specimens (unless a different number is specified in the individual section) of all submittals required under this section to the Contracting Officer. Identify all submittals on National Park Service form DSC-1 (CS). When approved, one copy will be returned to Contractor. The listing of submittals given below is intended to be as complete as possible. However, the Contracting Officer reserves the right to request additional submittals. No materials requiring the Contracting Officer's approval shall be delivered to the site until approval has been given.

2. CONTRACTING OFFICER'S APPROVAL: The Contracting Officer will indicate his approval or disapproval of the submittals. Any work done prior to such approval shall be at the Contractor's risk.

3. SHOP DRAWINGS:

   A. Definition: The term "shop drawings" includes drawings, diagrams, layouts, schematics, descriptive literature, illustrations, schedules, performance and test data, and similar materials furnished by the Contractor to explain in detail specific portions of the work required by the Contract.

   B. Contractor's Review and Approval: The Contractor shall coordinate all such drawings, and review them for legibility, accuracy, and completeness and shall indicate his approval thereon as evidence of such coordination and review. Shop drawings submitted to the Contracting Officer without evidence of Contractor's approval may be returned for resubmission.

   C. Approval by Contracting Officer: Such approval shall not relieve the Contractor from responsibility for any errors or omissions in such drawings, nor from responsibility for complying with the requirements of this Contract, except with respect to variations described and approved in accordance with Paragraph D below.

   D. If shop drawings show variations from the contract requirements, the Contractor shall describe such variations in writing, separate from the drawings, at the time of submission. All such variation must be approved by the Contracting Officer.

   E. Shop drawings, reports and manufacturers' literature required:

Section	Description
01521	Scaffolding and conveying system
04520	Stone masonry restoration
07951	Caulking

4. SAMPLES REQUIRED:

SECTION	DESCRIPTION
04520	Stone and mortar
07951	Caulking

5. CERTIFICATES: For items listed below, furnish certificates from manufacturer, suppliers or others certifying that materials or equipment to be furnished under the contract comply with the requirements of these specifications

SECTION	DESCRIPTION
04520	Mortar and polyethylene joint filler
07951	Caulking

6. PROGRESS SCHEDULE: As soon as possible after receiving Notice of Award and before any work is begun, submit a Progress Schedule (normally in bar chart form) showing estimated starting and completion dates for each part of the work.

7. SCHEDULE OF VALUES: In conjunction with the Progress Schedule, submit a schedule of dollar values of the various portions of the work whose aggregate equals the contract sum. Each item shall include its proper share of overhead and profit. When approved, the Schedule of Values shall form the basis of progress payments as provided in Paragraph 7 of the General Provisions.

8. REVIEW OF SCHEDULES: Both the Progress Schedule and the Schedule of Values shall be subject to review and modification by the Contracting Officer both for format and content.

END

1. INSPECTION PROCEDURES: The Contractor shall provide labor and scaffolding required to accomplish the inspection procedures. Also, assistance to permit historic investigations will be a part of this contract. The Contractor shall supply specialists for the purpose of opening and closing areas of the structure for this work. The following inspection procedures will be performed during the course of the Contract:

   A. Weather forecasts. The U.S. Weather Bureau projected 12 hour forecast obtained from the National Airport (WE 6-1234) will be used to determine anticipated restoration conditions.

   B. Moisture readings. A Delmhorst moisture meter and a sling psychrometer will be used to measure moisture conditions of the substrate and surrounding atmosphere, respectively. Dew point will be determined from standard psychrometric tables.

   C. Temperature readings. A surface thermometer will be used to measure substrate temperatures prior to painting.

   D. Stone and Mortar examination. All stone and mortar conditions must be approved prior to painting.

   E. Paint application rates. The Contractor shall maintain a daily record of paint application, i.e., surface area painted per gallons of paint used. The paint application rate will also be determined by inspection of the substrate with a wet film thickness gage.

   F. Photographic records. Photographic records will be used to record stone replacement and repair, and also used daily during the cleaning and painting operation to record progress.

   G. Photographic documentation of historical and architectural features of the East elevation will be performed. Contractor may be required to remove or relocate scaffolding and other equipment to accommodate this work.

END

1. SIGNS, SIGNALS AND BARRICADES: The Contractor shall provide, erect and maintain barricades, lights, danger signals, and warning signs as appropriate. Take all necessary precautions for the protection of the work and safety of the public. All barricades and signs shall be in accordance with Part VI, American National Standards Institute (ANSI) Standard D6.1, Manual of Uniform Traffic Control for Streets and Highways.

2. UTILITIES:

   A. The Contractor will be permitted to use existing water outlets for paint removal or other cleaning operations and for his employees for drinking and washing, provided that no disruptions occur to the occupants.

   B. The Contractor will be permitted to use existing electrical outlets for the duration of the Contract, provided that no disruptions occur to the occupants.

3. STORAGE FACILITIES: The Contractor will be assigned space for the storage of materials and equipment. The amount and type of materials to be stored will be determined by the Contracting Officer. No other material will be allowed in the storage space. Storage of materials and supplies shall meet all safety requirements. Amounts of materials to be delivered at any time will be limited. Surplus stored materials will be removed by the Contractor at the completion of work.

4. SANITARY FACILITIES: Existing sanitary facilities located beneath the South Portico staircase will be made available to the Contractor's employees by the Contracting Officer.

END

1. GENERAL: Erect and dismantle a complete scaffolding system: erect, operate, maintain and dismantle a complete conveying system for movement of personnel, equipment and materials and for removal of wastes.

2. LEGAL REQUIREMENTS: Comply with Occupational Safety and Health Administration requirements and with all other applicable federal, state, and local laws, codes, regulations and controls.

3. QUALIFICATIONS: Perform all work, including design, only with highly qualified and thoroughly trained specialists. Furnish a certified statement giving length of experience, training, degrees, licenses and other relevant data. See Section 01560, paragraph 7.

4. SYSTEMS ANALYSIS: It is recognized that various methods of design and installation of the systems are possible. Accordingly, prior to final design present to the Contracting Officer alternative conceptual design for analysis and selection of the most feasible system.

5. FINAL DESIGN: Furnish for approval shop drawings, specifications and related documents as necessary to fully explain and describe the proposed systems, including procedures for erection and dismantling. Identify methods of roof and building protection, procedures and anchorage, enclosure devices, etc. Include engineering data indicating loads transferred to the building structure. Design independent components allowing for staged erection and dismantling as described below. All scaffolding is subject to inspection by National Park Service safety inspectors.

6. SPECIAL RESTRICTIONS:

   A. The type of scaffolding may be that of the Contractor's own choosing, except that swinging scaffolds will not be permitted for cleaning or painting any portion of the North Portico. All scaffolding and conveyances must be removed from the North Portico at the completion of each day's work. It may be noted that past experience has shown that a cherry picker with a telescoping boom serves this purpose effectively. If such equipment is used, the maximum allowable wheel load is 7000 pounds (3178 kg).

   B. Access to the roof of the Executive Residence shall be only by ladder or scaffold. The Contractor will be permitted to erect sectional demountable tubular scaffolds approximately 5 ft x 7 ft horizontal dimension (approximately 1.5 m by 2 m), with walk up stairs, one at each end of the Residence on the roof of the terrace. These scaffolds may remain in place until all work on the roof is completed. However, all ladders and scaffolding will be placed in such a position and secured at the end of the day so as to deny access to any building from ground level.

END

1. PRESERVATION OF NATURAL AND MAN-MADE FEATURES: Special attention shall be given to the historic nature of the Residence and grounds. All flowers, shrubs, trees and other plantings around the building shall be protected during the work. All plant materials covering areas to be cleaned and painted will be removed by the Chief Horticulturist of the Executive Residence who will then inform the Contracting Officer that the Contractor may proceed. The Contractor shall furnish drop cloths or tarpaulins to protect the floors, stairways, pillars and other areas. Damage to Government property or structures shall be restored to their original condition at no additional cost to the Government.

2. HOUSEKEEPING:

   A. The project shall be neat, orderly and in a safe condition at all times. Hazardous rubbish shall be removed immediately. Rubbish shall not be allowed to accumulate. The Contractor shall provide on-site containers for collection of rubbish and dispose of it at daily intervals during the progress of work. Daily rubbish removal is especially important in the roof area to avoid its entry into the roof drainage systems. At the conclusion of the daily work, the premises shall be left in a clean, neat condition, subject to the approval of the Contracting Officer.

   B. Wet down dry materials and rubbish to prevent blowing dust, as necessary.

   C. Volatile wastes shall be kept in covered containers prior to disposal.

3. DISPOSAL OF WASTE MATERIALS: The Contractor shall dispose of waste materials off the premises. Disposal of waste materials shall be in compliance with all applicable EPA regulations.

4. AIR AND WATER POLLUTION CONTROL:

   A. The Contractor shall take all necessary reasonable measures to reduce air and water pollution by any material or equipment used during his operations.

   B. Volatile wastes, oils or water immiscible materials shall not be disposed of in storm or sanitary drains.

5. PROTECTION OF EXECUTIVE RESIDENCE: The Contractor shall submit to the Contracting Officer suggested methods and procedures to protect the existing skylights, areaway and roof drains, chimneys, windows and other appurtenances from water damage, breakage or unwanted exposure from the work activity. Specifically:

   A. Windows shall be protected from exposure to water cleaning and breakage during erection and dismantling of scaffolding and during cleaning and painting activity. The glazing is both historic

and irreplaceable. Solid 1/4 in (6.4 mm) plywood panels or sheet metal panels shall be used to cover the window openings where high pressure spray is being used.

B. Skylights within the work activity shall be covered to prevent any damage.

C. Roof drains will not be used during any water cleaning. All drainage from this activity will be confined to the immediate cleaning area, conveyed from the roof by separate conduit to the ground level. The roof drain shall be closed off during water cleaning operations. It is the Contractor's responsibilty to leave the drain operational at the end of the daily work period.

D. Scaffolding: Special controls for this activity are covered in Section 01521.

E. Water Cleaning: This activity shall be confined to the work area by controlling the drift of water and spray. Necessary screens, deflectors, tarpaulins, etc. shall be used to confine the work and drain the water.

6. SAFETY: All OSHA regulations shall be adhered to.

7. QUALITY ASSURANCE AND CONTROL: Specialist Qualification Requirements: Bidders shall be prepared to provide the following information on specialist qualifications immediately following bid submittal and prior to award. Specialist work is required in Sections 01521, 04520, 07951 and 09902:

A. Firm or individual's names, addresses, telephone numbers and date organized.

B. Each firm's construction experience in projects completed in the last five (5) years, considered to be of a similar nature, listing: project name, owner's representative to contact, architect to contact, date completed, total cost, and percentage of alteration or restoration work included in each project. Proof of experience may include photographs, work description, etc.

C. Individual's experience in the past five years of the specialized nature required of this building repair and assembly reconstructions, listing: project name, owner's representative to contact, architect to contact, date completed, total cost, and percentage of comparable restoration work included in each project.

Specialist: The term "specialist" as used in this specification shall mean an individual or firm of established reputation (or, if newly organized, whose personnel have previously established a reputation in the same field), which is regularly engaged in, and which maintains a regular force of workmen skilled in (as applicable): manufacturing or fabricating items required by the contract; installing items required

by the contract; or otherwise performing work required by the contract. Where the specifications require installation by a specialist, that term shall also be deemed to mean the manufacturer of the item, and individual or firm who will perform the work under the manufacturer's direct supervision.

The Government may at its discretion require the manufacturer or his specialists to demonstrate their abilities on sample areas prior to performing contract work.

8. CONSTRUCTION SIGNS: No construction or Contractor signs will be erected or identified with this project.

9. PHOTOGRAPHS: The Contractor will not be permitted to bring photographic equipment on the job site.

END

1. SITE RESTORATION;

   A. Final Cleaning: Remove all tools, equipment, surplus materials, and rubbish. Repair marred surfaces and remove grease, dirt, stains, foreign materials, fingerprints, etc., from finished surfaces.

2. PROJECT RECORD DRAWINGS:

   A. Project record drawings shall be made using colored ink on reproducibles furnished by the Contracting Officer. Indicate all changes and revisions to the original contract.

   B. Keep record drawings current. Inspection will be made weekly. Certification of accuracy and completeness will be required on monthly submitted payment requisitions.

3. SUBSTANTIAL COMPLETION AND FINAL INSPECTION: Submit written certification that project, or designated portion of project, is substantially complete, and request, in writing, a final inspection. Contracting Officer will make an inspection within 10 days of receipt of request.

   Should the Contracting Officer determine that the work is substantially complete, he will prepare a punch list of deficiencies that need to be corrected before final acceptance, and issue a notice of substantial completion with the deficiencies noted.

   Should the Contracting Officer determine that the work is not substantially complete, he will immediately notify the Contractor, in writing, stating reasons. After the Contractor completes the work, he shall resubmit certification and request for final inspection.

4. ACCEPTANCE OF THE WORK: After all deficiencies have been corrected, a Letter of Final Acceptance will be issued. If only designated portions of the project have been inspected, a Letter of Partial Acceptance will be issued for that portion of the work.

   Acceptance may be given prior to correction of deficiencies which do not preclude operation and use of the facility; however final payment will be withheld until all deficiencies are corrected.

   Until receipt of Letter of Final Acceptance, Contractor shall be responsible for the work of this Contract.

5. CLOSEOUT SUBMITTALS: Submit before final payment request.

   A. Project Record Drawings: As specified above.

   B. Materials: Paint, 10 gallons (38 l), in sealed, labeled containers.

6. POST-CONSTRUCTION INSPECTION: Prior to expiration of one year from date of final acceptance, the Contracting Officer will inspect the project to determine whether corrective work is required. The Contractor will be notified in writing of all deficiencies. In accordance with terms of the General Provisions, corrective work must start on noted deficiencies within 10 days of receipt of notification to the Contractor.

END

1. GENERAL

1.1 DESCRIPTION: The work in this section consists of sandstone and limestone masonry restoration of the east elevation of the Residence only. The following operations are included:

A. Paint removal and cleaning.
B. Repointing.
C. Repair, removal and replacement of deteriorated stone.

1.2 RELATED WORK SPECIFIED ELSEWHERE: Caulking - Section 07951, Painting - Section 09902.

1.3 QUALITY ASSURANCE:

A. Standards, American Society for Testing and Materials (ASTM).
B. All work shall be done by a specialist. See Section 01560.

1.4 SUBMITTALS: In accordance with Section 01300.

A. Submit samples and product literature of stone, mortar materials, chemical paint removers.

B. Furnish affidavits from manufacturers certifying materials and products delivered meet specified requirements.

C. Submit literature on proposed water spray equipment.

D. Submit shop drawings on replacement stone.

1.5 PRODUCT HANDLING: Deliver materials in manufacturer's original, unopened, protective packaging. Store materials in a dry place off the ground, under cover which permits air circulation, to prevent damage and intrusion of water or foreign matter. Handle and store stone on pallets.

1.6 JOB CONDITIONS: Do not conduct cleaning operations in freezing weather. Do not replace, repair, or repoint stone when the temperature of the outside air is below 40 °F (4.4 °C).

1.7 SITE TESTING: Periodic tests of materials will be required throughout the course of the work. Tests will include, but are not necessarily limited to, those identified throughout the specification. Tests shall be at the expense of the Government, and shall be made at testing laboratories designated by the Contracting Officer.

2. MATERIALS

2.1 SANDSTONE: The sandstone used for replacement of deteriorated sandstone or limestone shall comply with ASTM C616-68. The sandstone shall be without depressions or projections which would prevent proper bedding and setting. All finished surfaces shall resemble the condition of adjacent existing stone when placed. (It may be noted that Aquia Creek sandstone passes the physical requirements of the standard specification and may be used if available.)

2.2 LIMESTONE: The limestone used for replacement of deteriorated sandstone or limestone shall comply with ASTM C568, Category I (Low-Density). The limestone shall be without depressions or projections which would prevent proper bedding and setting. Tooled exposed surfaces shall resemble the conditions of adjacent existing stone when placed.

2.3 MORTAR: The mortar composition shall comply with the following formulation by volume:

1 part white portland cement (ASTM C150, Type 1, non-air-entrained)
12 to 15 parts sand (ASTM C144)
4 parts hydrated lime (ASTM C207, Type S)
potable water

2.4 CLEANING MATERIALS: The materials used for cleaning shall not affect any surrounding vegetation, limestone, sandstone, marble, asphalt, wood or metal.

A. Water: Clean, potable, free of materials injurious to stone or mortar.

B. Proprietary Chemical Cleaners:

1. Biodegradable, non-flammable, alkaline gel (semi-paste), water soluble.

2. Biodegradable, non-flammable, alkaline (semi-paste), solvent/surfactant system.

3. Liquid type for use in water spray equipment.

C. TT-R-243 Remover, Paint (Alkali-Organic Solvent Type) for use on wood, windows and trim and iron window grills.
D. Proprietary stain remover.
E. Detergent: mild, non-ionic.
F. Soap: powder, liquid.
G. Fiber and bristle brushes (wire brushes are not to be used).
H. Plastic and metal scrapers.

3. EXECUTION

3.1 PAINT REMOVAL AND CLEANING:

A. General: The work of this section consists of the removal of all paint from the east elevation of the Residence only. The level of paint removal shall meet or exceed the level of paint removal depicted in a photograph of a previously cleaned area at the Northeast corner of the Residence. Dirt and pollutants shall be cleaned from stone surfaces where the paint has peeled or weathered away. Paint removal and cleaning shall 1) reveal all masonry areas requiring replacement, repair and repointing, 2) not cause physical or chemical damage to the historic stone and to sound mortar joints, and 3) leave the surface physically and chemically compatible for the application of new paint. Protection against damage from cleaning operations for windows is described in Section 01560.5.

B. Paint Removal Method:

Chemical treatment combined with high-pressure water spray shall be performed by "Company 1". The paint removal method is as follows:

1. Application of semi-paste paint remover by bristle brush. The type of paint remover best suited to remove the paint is dependent upon the type and age of the paint layers and temperature conditions.

2. After standing on the surface for 10 to 15 minutes, scarify the paint-paint remover layer with bristle brushes.

3. Add additional paint remover and allow to stand undisturbed for 10 to 30 minutes.

4. Rinse off the softened paint layers with water spray at a low pressure and then increase the pressure [not to exceed 1800 psi (12.4 MPa)] for final rinsing and paint removal. Pressure nozzle to be held a distance and angle from stone sufficient to prevent damaging stone.

5. Repeat the procedure until the above specified level of paint removal is attained.

C. The high-pressure water spray methods shall be capable of variations in volume and pressure of water, and in size, angle and configuration of nozzles to facilitate adjustment to different conditions of the masonry surfaces. The volume of water used shall be 4 to 6 gallons (15 to 23 1) per minute and the maximum pressure not over 1800 psi (12.4 MPa).

D. Paint removal shall commence at the bottom and shall continually progress up the face of the wall. Special care shall be taken during the paint removal operation in areas where the sandstone details may have deteriorated underneath the paint. Should any paint removal operation cause the slightest injury to the masonry or reveal extensive areas of deteriorated stone, stop work immediately and notify the Contracting Officer. Avoid water spray into large open cracks or open joints.

E. Rinse surfaces with clean water after cleaning to remove all residue. Rinse until the rinse water is neutral, i.e., pH 7. Contractor shall demonstrate as requested.

F. Wet-dry high pressure vacuum and tarpaulins shall be used to pick up excess rinse water and paint residues resulting from the paint removal and rinsing operation. The waste paint residue is likely to contain traces of lead and shall be disposed of in a safe manner as described in Section 01560.

3.2 WALL PREPARATION:

A. The work intent is to preserve as much of the original stone and mortar as possible. Do not disturb sound, tight mortar. Remove loose, deteriorated, unsound mortar by raking to a depth of not less than 1/2 in (12.7 mm) or to sound mortar. Where deteriorated joints are too deep to rake out, remove debris with water jet or compressed air. Obtain approval from the Contracting Officer. Use care to avoid damage to adjacent sound stone and mortar joints when removing deteriorated mortar.

B. Remove deteriorated or spalled stone as directed by the Contracting Officer. Scour interior surfaces of adjacent stone to remove debris, to roughen and to insure good mortar bond with new replacement stone. Flush interior faces with water to remove residue.

3.3 REPLACEMENT AND REPAIR OF STONE:

A. Mixing Mortar. Mortars shall be mixed thoroughly to obtain uniformity of both visual and physical characteristics. Dry ingredients shall be mixed before adding water. The mixture shall be prehydrated to help prevent shrinkage on drying. To prehydrate the mortar, sufficient water shall be added to the dry mix to make a damp, stiff mortar. After one to two hours, the mortar shall be remixed with additional water to give the desired consistency. Retempering mortar shall not be permitted. In setting large blocks of replacement stone or grouting deep joints, an approved admixture may be introduced to maintain mortar in a plastic condition to insure complete filling of joints.

B. Large replacement stones shall be placed with natural bedding planes horizontal. Stones shall be clean and as damp as the interior cavity surfaces. Inject mortar until all joints are filled to approximately 1 in (25.4 mm) of the exterior surface; remove skids before mortar sets up, fill voids.

C. Install new stones at deteriorated or spalled areas described in 3.2B. Stones to be cut to fit neatly into voids; stone and void walls to be clean and dampened. Drill new stones and backup to receive for each 12 in (30.4 cm) of length, one stainless steel metal anchoring dowel 1/2 in (12.7 mm) in diameter. Slush void between stone with mortar, set accurately into position in full bed of mortar with vertical joints full. Note: If approved, the Contractor may elect to use epoxy with dowels instead of mortar.

3.4 REPOINTING:

A. All mortar joints in stone work shall be repointed. The stone and old mortar shall be wetted at the time of repointing, but no excess water shall be present. The work shall consist of removing loose material to a depth of not less than 1/2 in (12.7 mm). All joints shall be raked and cleaned to a depth of at least 1/2 in (12.7 mm). Joints and spaces which are deeper than 1/2 in (12.7 mm) shall be solidly filled with a closed cell polyethylene joint filler to 1 in (25.4 mm) at the surface of the stone, after which the remainder of the joint shall be filled with an approved white portland cement mix. The joints shall be thoroughly compacted and tooled to match the existing joints.

3.5 PRECAUTIONS:

A. Remove mortar splashings and droppings immediately from stone surfaces and make sure there are no mortar stains or smears. The mortar joints shall be finished neatly by hand to match existing undisturbed joints. Keep walls clean as work progresses.

B. Provide tarpaulins or other suitable means to keep mortar materials off previously treated masonry or adjacent surroundings.

3.6 FINAL CLEANING: Rinse freshly prepared mortar with 5 percent acetic acid solution and rinse with water until the washings are neutral (pH 7). After the mortar has cured, clean the surface with clean water and stiff fiber brushes.

4. METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.1 GENERAL: The exact conditions of the east elevation's stone masonry are not fully known, therefore exact quantities for the replacement of stone masonry cannot be accurately determined in advance. The

final scope of the stone masonry replacement will be made by the Contracting Officer after all the paint has been removed from the stone.

4.2 MEASUREMENT AND PAYMENT: No measurement of quantities will be made for paint removal and cleaning or repointing. The costs shall be included in the lump sum price for "Paint Removal and Cleaning" or

"Repointing". No measurement of quantities will be made for the repair of deteriorated mortar and masonry. The costs shall be included in the lump sum price for "Painting". No measurement of quantities will be made for the replacement of masonry. Payment for this work will be at the negotiated price obtained during the course of the Contract.

END

1. GENERAL:

1.1 DESCRIPTION: The work of this section consists of all necessary caulking work.

1.2 RELATED WORK SPECIFIED ELSEWHERE: Section 04520 - Stone Masonry Restoration; Section 09902 - Painting.

1.3 QUALITY ASSURANCE:

A. Federal Specification, manufacturers recommendations.

1.4 SUBMITTALS: In accordance with Section 01300.

A. Submit samples and product literature of caulking.
B. Furnish affidavits from manufacturers certifying materials meet specified requirements.
C. All work shall be done by a specialist. See Section 01560.

2. MATERIALS:

2.1 CAULKING: The caulking used for the replacement of deteriorated caulking shall comply with F.S. TT-C-00598 unless otherwise specified by the Contracting Officer. Color shall match finished surfaces.

3. EXECUTION

3.1 REPAIRS AND REPLACEMENT: Replace all deteriorated and/or missing caulking.

4. MEASUREMENT AND PAYMENT

4.1 MEASUREMENT: This item of work will not be measured for payment.

4.2 PAYMENT: This item of work shall be included in the lump sum price Bid on the "Painting" item in the Contract Bid Schedule.

END

1. GENERAL

1.1 DESCRIPTION: The work of this section consists of all exterior painting, including stone masonry, wood, and metal window grilles, as indicated on the contract drawings.

1.2 SURFACES NOT TO BE PAINTED: Items which are specifically excluded from painting are perimeter fences, gates, South Portico hand railings, North Portico chandelier, South Portico lanterns, East and West wings and terraces guard houses, masonry gate posts, and the sun room on the roof of the Residence. Some walls on the third floor of the Residence have not been painted previously and are not to be painted as indicated on the contract drawings.

1.3 SURFACES TO RECEIVE PAINT REMOVER: In addition to paint removal from the east elevation of the Residence specified in Section 4520 - Stone Masonry Restoration, remove paint from wood, window grates and other ornamental metal work on the east elevation of the Residence.

1.4 OTHER SURFACES TO BE CLEANED: Clean all other exterior surfaces to be painted, as shown on the contract drawings.

1.5 SURFACES TO BE PAINTED: All exterior surfaces of the Residence shall be painted.

1.6 QUALITY ASSURANCE:

A. Standards; American Society for Testing and Materials (ASTM); Federal and Military Specifications in Army, Navy, Air Force - Paints and Protective Coatings Manual, Federal Standard No. 595A - Colors, and manufacturer's printed recommendations.

B. All work shall be done by a specialist. See Section 01560.

1.7 SUBMITTALS: In accordance with Section 01300.

A. Furnish affidavits from manufacturers certifying that materials and products delivered meet specified requirements except for government-furnished materials.

B. Apply paint to a sample test area [approximately 2 ft by 2 ft (60.8 cm by 60.8 cm)] on the building and on a 2 ft x 2 ft (60.8 cm by 60.8 cm) piece of hardboard for approval of color and texture.

1.8 PRODUCT HANDLING: Deliver no material without prior approval of the Contracting Officer. Deliver materials in manufacturer's original, unopened, protective packaging. Store materials in a dry place off the ground on pallets, under cover which permits air circulation. Each

container shall be labeled showing designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's instructions and name, and compliance with applicable specifications. The storage area shall be maintained between 65 and 85°F (18.3 and 29.4°C).

1.9 JOB CONDITIONS:

A. Protect wall surfaces from mechanical damage. Take necessary precautions to keep fire hazards to a minimum; remove daily from the area all oily rags, waste and other combustibles stored in metal containers.

B. Determine surfaces to which paints and other finishes are to be applied are even, smooth, sound, thoroughly clean and dry, and free from defects that might affect proper application. Cleanliness, e.g., chalk, mortar dust, will be determined by method ASTM D659 using a Jacobsen chalk tester. An acceptable chalk resistance rating is 8 or above. Dryness of the surface will be determined using a Delmhorst moisture meter or equivalent. An acceptable moisture content reading on wood is not over 12 and on stone not over 15. Correct or report defective surfaces to the Contracting Officer.

C. Apply finish materials when both ambient and surface temperatures are 45°(7.2°C) or above but below 95°F (35°C). No paint shall be applied when the relative humidity exceeds 80 percent, when the wind velocity is greater than 15 mph (24 km/h), or when the surface temperature is less than 5°F (2°C) above the dew point. Apply no material where dust is being generated or during damp or rainy weather.

D. Projected weather forecasts. Painting will not be permitted when the C/P Telephone Company projected 12 hour forecast obtained from National Airport (WE 6-1234) anticipates any one of the following weather conditions:
Precipitation greater than 30 percent probability
Temperatures below 45°F (7.2°C)
Temperatures above 95°F (35°C)
Relative humidity above 80 percent
Wind velocity greater than 15 mph (24 km/h)

E. All masonry repairs and repointing shall cure for 28 days prior to any paint application on these surfaces.

1.10 SITE TESTING: Periodic testing of materials will be performed by the Government throughout the course of the work in addition to the certifications called for in Article 1-7 above. Tests will include, but are

not necessarily limited to, those identified in this specification section. Tests will be at the expense of the Government and shall be made at recognized independent testing laboratories designated by the Contracting Officer.

1.11 SAMPLING: Sampling on the job site will be by the Contracting Officer. The Contractor shall be present to certify in writing that the sample was properly taken. Samples will be two quarts (1.9 1) per 50 gallons of (189 1) paint in sealed containers. The contents of the sampled containers shall be thoroughly mixed as to render the sample truly representative. Samples shall be clearly identified by designated name, specification number, intended use, batch number, project contract number, and quantity involved. Samples shall be tested before approval at the testing laboratories designated by the Contracting Officer. Samples will be retained by the Government for possible future testing should the material appear to be defective during or after application. If a sample is tested and it fails to meet specification requirements, the material represented by the sample shall be replaced at the Contractor's expense and the cost of retesting will be deducted from the payments due to the Contractor at the rate of $250 per sample retested.

2. MATERIALS

2.1 CLEANING MATERIALS: The materials used for cleaning shall not adversely affect surrounding vegetation, limestone, sandstone, marble, asphalt, wood or metal. The cleaning materials used are described in Section 04520 - 2.4, except that wire brushes shall be used on the ferrous surfaces to remove paint.

2.2 PAINT AND FINISH PRODUCTS - GOVERNMENT FURNISHED

A. Materials shall conform to the requirements of the specification shown in the paint schedule. Paints shall be in sealed, containers that plainly show the designated name, formula or specification number, batch number, Fed. Std. No. 595A color, date of manufacture, manufacturer's instructions and name. Paints shall be furnished in containers not larger than five-gallon (18.9 1) capacity. Materials shall be homogeneous and show no separation that cannot be overcome by stirring, and when mixed shall permit application by brush or spray methods. Paints older than 12 months shall not be used. Other painting materials not specifically described, such as thinners, etc., shall be subject to the approval of the Contracting Officer and must be formally submitted prior to requested use.

B. Exterior:

1. For ferrous surfaces:

TT-P-645 Primer, Paint, Zinc Chromate, Alkyd Type.
TT-E-527 Enamel, Alkyd, Lusterless
Color and texture to match existing painted surfaces

2. For wood surfaces where stone restoration operations have been performed and for all other wood surfaces:

   TT-P-25 Primer, Coating, Exterior (undercoat for Wood, Ready-Mixed, White and Tints).

   TT-P-102 Paint, Oil, Alkyd (Modified), Exterior, Fume Resistant, Ready Mixed, White and Tints.

3. For stone masonry where stone restoration operations have been performed and for all other stone masonry surfaces:

   Coating Material 4 containing tung, linseed oil and soya alkyd resins.

3. EXECUTION

3.1 GENERAL REQUIREMENTS: Clean all surfaces to be painted of foreign matter before applying finish materials. Surfaces shall be dry. Remove and protect hardware, lighting fixtures and similar items; or provide complete protection during painting. Upon completion of each area, carefully replace all removed items. Use drop cloths of adequate size to protect work being finished. All primer paint coats shall be applied by brush, except that spraying will be permitted for applying paint to the column captals and other decorative work where brush application is not possible. The use of spraying will be permitted for application of the finish coat of paint. Use of rollers will not be permitted.

3.2 SURFACE PREPARATION

A. General, Areas for Stone Restoration (east elevation of Residence): Remove all paint, accumulated pollutant and other elements from the masonry (see Section 04520 for paint removal method used), metal grilles and wood trim from the east elevation of the Residence. This preparatory work shall 1) completely expose the original surfaces of the various historic materials so that necessary repairs and replacement can be accomplished, and 2) leave all surfaces physically and chemically compatible to application of new coatings.

B. General, All other Areas: Remove all loose, peeling, blistering paint and accumulated surface contaminants by the use of high pressure water spray. Make any necessary masonry repairs and/or replacements, or repointing (see Section 04520 for the methods used) to any deteriorated masonry or mortar joints exposed during cleaning.

C. Dispose of water materials in a safe manner, insuring against damage to other portions of the building and grounds (see Section 01560). The Contractor shall provide adequate methods to dispose of excess rinse water containing paint and other contaminants. Disposal system shall be submitted for approval before use.

D. Any compound, solution, fluid or abrasive used as a removal or cleaning agent shall be free of ingredients that will physically or chemically injure existing masonry wood or metal substrates. Protection against damage from cleaning operations for windows is described in Section 1560.5.

E. Masonry Surface Preparation:

1. The procedure for surface preparation of the east elevation of the Residence is described in Section 04520 and involves complete removal of all paint, accumulated pollutants and other elements from the surface. Allow sufficient drying time prior to paint application so that the Delmhorst moisture meter reading is not over 15 as measured by the Contracting Officer.

2. Surface preparation of masonry in all other areas shall be with high pressure water spray [not to exceed 1800 psi (12.4 MPa)] with plain water or with approved cleaner. Allow sufficient drying time prior to paint application so that the Delmhorst moisture meter reading is not over 15 as measured by the Contracting Officer. All cleaned surfaces shall have an ASTM D659 chalk resistance rating of 8 or greater and no visible areas of loose paint prior to approval for paint application as measured by the Contracting Officer.

F. Wood Surface Preparation:

1. For surface preparation of wood windows and trim on the east elevation of the Residence, use paint remover, on a test window where directed, clean off with a plastic or metal scraper. Repeat the process as necessary to remove all old paint. Use extreme caution when cleaning adjacent to glass. See Section 01560. Rinse with clean water. When approved, the sample window shall represent the quality standards to which all subsequent work on this elevation shall conform. After paint removal and cleaning, allow sufficient drying time prior to paint application, so that the Delmhorst moisture meter reading is not over 12 as measured by the Contracting Officer.

2. Surface preparation of wood windows and trim in all other areas shall be with high pressure water spray [not to exceed 1800 psi (12.4 MPa)] with plain water or with approved cleaner. Allow sufficient drying time prior to paint application so that the Delmhorst moisture meter reading is not over 12 as measured by

the Contracting Officer. All cleaned surfaces shall have an ASTM D659 chalk resistance rating of 8 or greater and no visible areas of loose paint prior to approval for paint application as measured by the Contracting Officer.

3. For all wood window and trim areas, all damaged, loose, broken or otherwise defective glazing shall be removed. All removed and missing glazing shall be replaced with new glazing in a workmanlike manner. Glazier's points that have been removed or that are missing shall be replaced with heavy duty galvanized glaziers points. The caulking around the wood frames shall be applied after the frames have been primed. All loose and deteriorated caulking material shall be removed from around wood frames to a depth of no less than 1/2 in (12.7 mm) and shall then be caulked. Any deteriorated wood shall be brought to the attention of Contracting Officer.

G. Ferrous Metal Surface Preparation:

1. For surface preparation of iron window grilles and other ferrous surfaces on the east elevation of the Residence, use paint remover, on a test grille where directed, clean off with a plastic or metal scraper or wire brush. Repeat the process as necessary to remove all old paint. Rinse with clean water. When approved, the sample grille shall represent the quality standards to which all subsequent work on this elevation shall conform. Allow sufficient drying time prior to paint application so that surface moisture is removed, but before the time when rust appears on the ferrous surface.

2. Surface preparation of iron window grilles and other ferrous surfaces in all other areas shall be with high pressure water spray [not over 1800 psi (12.4 MPa)] with plain water or with approved cleaner. All cleaned surfaces shall have an ASTM D659 chalk resistance rating of 8 or greater and no visible areas of loose paint prior to approval for paint application as measured by the Contracting Officer.

3.3 APPLICATION: Secure approval from the Contracting Officer of each coat prior to proceeding with application of the next coat.

A. Priming requirements. All previously painted wood and metal surfaces where the base material is exposed, either before or after cleaning, shall be thoroughly primed.

B. Finish coat requirements. After the surfaces have been properly prepared for painting by cleaning, primer coat application, etc., one of two finish coats shall be applied as applicable.

C. Paint Workmanship: Apply priming material evenly by brush and finish coat material by brush or spray without drops, skins, lumps, runs or sagging of the paint. Apply only at the approved spreading rate. Paint shall be kept well stirred while being applied.

D. Paint Control: The Contractor shall submit a daily record of paint application, i.e., surface area painted per gallons of paint used. The paint application rate shall conform to guidance given by the appropriate specification and manufacturer's recommendations.

3.4 CLEANUP: Remove all paint or other finish material where it has spilled, splashed or scattered.

3.5 SCHEDULE OF MATERIALS:

A. Exterior Wood, within limits of stone preservation or in other areas where the wood substrate is exposed;

One primer coat; Two finish coats

B. Exterior Wood, in all other areas where the wood substrate is <u>not</u> exposed:

One finish coat

C. Exterior Masonry, within limits of stone preservation or in other areas where the masonry substrate is exposed:

Two finish coats

D. Exterior Masonry, in all other areas where the masonry substrate is <u>not</u> exposed:

One finish coat

E. Exterior Ferrous Surfaces, within limits of stone preservation or in other areas where the ferrous substrate is exposed:

One primer coat; Two finish coats

F. Exterior Ferrous Surfaces, in all other areas where the ferrous substrate is <u>not</u> exposed:

One finish coat

4. METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.1 MEASUREMENT AND PAYMENT: No measurement will be made for painting. The costs shall be included in the lump sum price for "Painting".

END

EXTERIOR RESTORATION - 1980
EXECUTIVE RESIDENCE
WASHINGTON, D.C.
SUBMIT BID FOR ALL ITEMS. IN CASE OF ERROR IN THE EXTENSION OF UNIT PRICES, UNIT PRICE GOVERNS. IN CASE OF ERROR IN SUMMATION, THE TOTAL OF THE CORRECTED BID AMOUNT GOVERNS.

ITEM NO. / SECTION	ITEM	ESTIMATED QUANTITY	UNIT OF MEASURE	UNIT PRICE	AMOUNT OF BID
1 / N/A	MOBILIZATION AND DEMOBILIZATION			Lump sum	$ _____
2 / 04520	PAINT REMOVAL AND CLEANING			Lump sum	$ _____
3 / 04520	REPOINTING			Lump sum	$ _____
4 / 04520	REPLACEMENT OF MASONRY			TO BE NEGOTIATED	
5 / 09902	PAINTING			Lump sum	$ _____
				TOTAL BID	$ _____

ABOVE QUANTITIES, EXCEPT LUMP SUM, ARE ESTIMATED AND WILL BE USED TO SOLICIT BIDS, BUT PAYMENT WILL BE MADE ONLY FOR ACTUAL QUANTITIES OF WORK COMPLETED.

ARRANGEMENT OF THE ABOVE ITEMS IS FOR CONVENIENCE IN COMPARING BIDS. AWARD WILL BE MADE TO ONE BIDDER IN ACCORDANCE WITH CLAUSE 10 OF THE INSTRUCTIONS TO BIDDERS.

END

NBS-114A (REV. 9-78)

U.S. DEPT. OF COMM. BIBLIOGRAPHIC DATA SHEET	1. PUBLICATION OR REPORT NO. NBSIR 80-2122	2. Gov't. Accession No.	3. Recipient's Accession No.

4. TITLE AND SUBTITLE

Development of Guide Specifications for the 1980 Exterior Restoration of the White House

5. Publication Date

October 1980

6. Performing Organization Code

7. AUTHOR(S)

P.G. Campbell, G.A. Sleater and M.A. Post

8. Performing Organ. Report No.

9. PERFORMING ORGANIZATION NAME AND ADDRESS

NATIONAL BUREAU OF STANDARDS
DEPARTMENT OF COMMERCE
WASHINGTON, DC 20234

10. Project/Task/Work Unit No.

11. Contract/Grant No.

12. SPONSORING ORGANIZATION NAME AND COMPLETE ADDRESS *(Street, City, State, ZIP)*

U.S. Department of the Interior
National Park Service, National Capital Region
1100 Ohio Drive, S.W.
Washington, D.C. 20242

13. Type of Report & Period Covered

Final

14. Sponsoring Agency Code

15. SUPPLEMENTARY NOTES

☐ Document describes a computer program; SF-185, FIPS Software Summary, is attached.

16. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

At the request of the National Park Service, a study was performed to develop guide specifications for use in the 1980 exterior restoration of the White House. The study included 1) an evaluation of historic practices and difficulties from painting of the White House, 2) an evaluation of technical literature on surface cleaning procedures and coating systems, 3) laboratory tests of selected coatings and field tests of selected surface cleaning procedures and coatings and 4) development of guide specificiations. Four coating materials were selected for evaluation in laboratory and field tests and four surface cleaning methods were evaluated in a field test at the White House, of which one system was recommended for use in the 1980 restoration.

This report presents the findings of the study and includes the proposed guide specifications.

17. KEY WORDS *(six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)*

Coatings; exterior restoration; field tests; guide specifications; laboratory tests; paint removal methods; White House

18. AVAILABILITY

☒ Unlimited

☐ For Official Distribution. Do Not Release to NTIS

☐ Order From Sup. of Doc., U.S. Government Printing Office, Washington, DC 20402, SD Stock No. SN003-003-

☒ Order From National Technical Information Service (NTIS), Springfield, VA. 22161

19. SECURITY CLASS (THIS REPORT)	21. NO. OF PRINTED PAGES
UNCLASSIFIED	127
20. SECURITY CLASS (THIS PAGE)	**22. Price**
UNCLASSIFIED	$10.00

USCOMM-DC