

Conservation Handbook for Rodia Towers in Watts

CONSERVATION HANDBOOK

RODIA TOWERS IN WATTS

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i. BACKGROUND and PREFACE

4/91 BACKGROUND

The conservation philosophy of this Handbook aims at safety, durability and historical/artistic integrity, in that order. However, maximizing safety would result in loss of the ornamented mortar coverings of structural load-carrying rings and columns in areas where reinforcements are weakened by loss of materials. In those areas, it was decided to accept a loss in strength (and possibly in the long-life of the sculptures) to preserve the ornamented covers. Starting in 1990, this long-life loss has been minimized by reducing the thickness of the ornamented covers before reinstalling them over the newly strengthened reinforcements, steel mesh and replacement mortar.

As a result of developments since 1983 when the original philosophy was documented, the current policy is:

1. Structurally critical members with badly corroded metal armatures are to receive new structural steel armatures. Original mortar coverings which are able to be salvaged will be ground to a thin shell for reinstallation over the new armature, new wire mesh and new repair/restoration mortar. Exposed mortar may be colored to match the original.
2. Structurally non-critical members will be treated the same as structurally critical members.
3. The method of replacing metal armature must provide a structural tie between the original and new armatures and with intersecting bands and columns, and adjacent, touching spokes, outer arched bands, and the like. Engineering advice shall be sought to decide methods and details for attachments.
4. Only approved and tested materials may be used for mortar, additives, consolidants, pigments, adhesives, crack-fillers and the like. A professional Conservator's advice shall be sought in selecting materials.
5. Upon completion of conservation treatments to each of the 17 sculptures, a comprehensive report shall be prepared, detailing all treatments applied, with dates, materials used, unsatisfactory results experienced, anomalies and the like.
6. The condition of each conservation treatment in each area shall be documented and photographed prior to, during and after removals and/or replacements of members and information shall be entered in the computer database and placed on file.

7/90 PREFACE

This Handbook was prepared under contract to the City of Los Angeles to be used for the conservation of the Towers of Simon Rodia State Historic

Park sculptures in Watts, which are located at 1765 East 107th Street, Los Angeles, California.

The document is an outgrowth of reports prepared by the Ehrenkrantz Group/Building Conservation Technology of San Francisco, from 1981 to 1984. This Conservation Handbook replaces the Ehrenkrantz Maintenance and Restoration Guide released on June 8, 1984 by the State of California, Department of Parks and Recreation. The Handbook has been modified by review of the findings during the \$1,200,000 emergency structural repairs on the sculptures which were done by the Office of the State Architect personnel from May 1979 to July 1985 and by subsequent advances in the state of the art of conservation technology and by test results and studies noted below.

The Ehrenkrantz Preservation Plan, dated November 1983, pages 3 through 79, remains the primary source for information concerning historical data through 1981. Sections in the Preservation Plan and the Guide containing test results and analyses and other technical information necessary for the actual conservation of the sculptures have been reproduced in this Handbook. The City acknowledges the following individuals and their organizations for their valuable contributions to this Conservation Handbook for the Rodia Towers in Watts:

- Dr. Neville Agnew, Getty Conservation Institute
- Mr. Zdravko Barov, Conservator
- Mr. Earl Carlson, (Retired), California Department of Parks and Recreation
- Mr. Steve Cristin-Poucher, Los Angeles County Museum of Art
- Dr. William Ginell, Getty Conservation Institute
- Mr. Jay Oren, A.I.A., Architect, Los Angeles Cultural Affairs Department
- Mr. William Meuser, California Department of Parks and Recreation
- Mr. Frank D. Preusser, the Getty Conservation Institute
- Mr. Rodney Punt, Assistant General Manager, Los Angeles Cultural Affairs Department
- Mr. John Twilley, Los Angeles County Museum of Art

Under contract to the Cultural Affairs Department, the baseline photography system was developed by Mr. Marvin Rand, who also provided all photographs; materials for conservation were tested and selected by Ms. Rosa Lowinger, The Sculpture Conservation Studio who also provided training in applications of the materials; conservation applications, conservation staff supervision and training were performed by Ms. Zuleyma Whitehurst, Conservator; inspection and emergency conservation techniques and training were developed by Ms. Myrna Saxe, Conservator; engineering studies and analyses were performed by ANCO Engineering, C.W. Cook Company, Quelin/Degaine, Cathedral Stone Company, Davis Quality Engineering and Mr. N.J. Bud Goldstone who also provided technical management for the conservation program.

N.J. Goldstone
Watts Towers Consultant
Beverly Hills, California
April 1991

1.1.2.2 The articles selected for embedment into the mortar coverings placed over the metal framework, provide an irreplaceable store of objects of Americana from the 1920's and 1930's.

1.1.2.3 The system used for joining the load-bearing materials of the framework of the structures to support the 99 1/2 foot tall West Tower, and other smaller structures

1.2 Priorities for Conservation

1.2.1 The conservation work shall generally follow this order of priorities:

1.2.1.01 photographic documentation of each of the sculptures for an historic record and baseline of conditions of the work;

1.2.1.02 performance of any necessary additional testing required for determination of a) adhesives to secure loose and detached embedments, b) fill materials for cracks and missing areas, c) techniques allowing replacement of damaged/corroded reinforcements with minimal effects on surfaces, d) materials for restoration of broken or damaged embedments, e) the optimum method for consolidation of the Rodia mortar, and f) the determination of the advisability for use of water repellent- see pages 26 and 27, section 8. References and 9. Appendix for previous test results;

1.2.1.03 accomplishment of the consolidation (reattachment) or temporary securing of loose decorations;

1.2.1.03.1 resecuring of loose decorations on the 3 tallest towers;

1.2.1.03.2 resecuring of loose decorations on the overhead arches, gazebo, walls, small towers, pinnacles, ship, house entrance and ceiling, and house ruins;

1.2.1.04 treatment of armature deterioration and structural cracks 1/2" wide or wider in the West, Center and East Towers;

1.2.1.05 treatment of armature deterioration and structural cracks 1/2" wide and wider in the overhead arches, gazebo, walls, small towers, pinnacles and ship;

1.2.1.06 filling of cracks smaller than 1/2" in the 3 tallest towers;

1.2.1.07 filling of cracks smaller than 1/2" in the sculptures noted in 1.2.1.05;

2/10/98

WATER REPELLENT

ABOLITE

NOT USE

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1.2.1.08 should results of tests and analyses show that water repellent is beneficial, waterproof all exposed surface after completion of each significant portion of the conservation work;

1.2.1.09 stabilize ruins of Rodia house;

1.2.1.10 replace gates to original locations; provide suitable "mats" to protect flooring and steps exposed to visitor traffic;

1.2.1.11 label all ornaments with identification numbers.

2.0 DOCUMENTATION SYSTEM METHODOLOGY & TECHNIQUES

2.1 General

2.1.1 Because of the complexity of the shapes of the structures and the large number of individual members in the towers and other sculptures, a labeling system shall be followed to aid in identification. See Figures A. & B., section 9, which provide the identification system for individual sculptures and for nomenclature for individual members of each sculpture.

2.2 Requirements for Documentation

WATTS TOWERS CONSERVATION BASELINE RECORD SYSTEM

A computer-based system for maintaining records of the condition of the Watts Towers sculptures has been developed by the Cultural Affairs Department, City of Los Angeles.

The system consists of the following:

A. Photographic files

1. Three tallest towers - A set of 2900 individual repair records and color photographs showing work performed by the State from 1979 to 1985 on the three tall tower sculptures. An archival set of 600 color slides taken by the City in 1989 and 1992 showing 4-foot by 4-foot square views of the West, Center and East Towers.

2. An archival set of 1100 color and black and white photographs taken by the City in 1987 and 1988 showing 4-foot by 4-foot square views of the other sculptures- Gazebo, walls, floor, Ship of Marco Polo, house facade and chimney, and small towers.

3. A set of records and black and white photographs taken by the City during emergency stabilization, inspection, test, and conservation efforts performed since 1988.

4. Microfiche sets of all the records and photographs, above, with color microfiche of the baseline photographs from 1987 through 1990.

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B. Computer files

1. Records of the 2900 repair operations on the three tallest towers and new information on stabilization, inspection, tests, and damage since 1985.
2. Records of the baseline photographs.
3. Records of subsequent emergency stabilization, inspection, test, and comprehensive reports on the conservation efforts on each sculpture.
4. Records of portions of the sculptures placed in storage for later conservation efforts.

C. Conservation History

The computer database software (Paradox) produces special reports on conservation history through queries. Please refer to the database operation handbook. Typical reports are:

- A. The frequency of use of various conservation techniques.
- B. The success or failures of conservation techniques employed.
- C. The geographic (direction, elevation, location on the site) distribution of damage and/or deterioration of the sculptures.

2.2.1 Photographs

2.2.1.1 Photographic records shall be taken using 4" by 5" black and white and color film having the best available stability and archival quality, taken in good focus, and with proper exposure, with an indication of scale, and with an identification number recorded on the negative which can assure that the portions of the monument are identified. For the 3 tallest towers, 35 mm slides of archival quality shall be used.

2.2.2 Baseline Photographs

2.2.2.1 Photographs are required of each area of each of the structures, walls, and flooring. The photographs must provide details adequate for reference should any portion of the monument suffer damage. Five archival quality prints of each photograph are currently necessary for files maintained by the State of California, City of Los Angeles, Committee for Simon Rodia's Towers in Watts, the National Trust, and for use on site at the Towers.

2.2.2.2 A computer data base is maintained, for ease of reference, which records the locations, descriptions of work performed, and dates of conservation work done on the monument. See Reference "Computer Database". The minimum information required with each photograph is:

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2.2.2.2.1 the identification of the sculpture involved (east, west, center tower, wall, etc.);

2.2.2.2.2 the identification of the specific member and location on the member;

2.2.2.2.3 a detailed description of the work accomplished, including the type of work- inspection, conservation, etc.- and the materials and techniques used;

2.2.2.2.4 the date(s) of the start and completion of the performance of the conservation or inspection work.

2.3 Inspection and Conservation Records

2.3.1 Records shall consist of inspection and conservation forms, related photographs, and computer databases regarding each conservation effort on the monument.

4/91 Upon completion of conservation of each sculpture, a comprehensive report shall be prepared, summarizing the results of the work.

2.3.2 Photographic documentation shall comply as described in section 2.2, with records taken before, during, and after any repair or conservation work.

2.3.3 Instructions for Inspection & Conservation Records

2.3.3.1 Introduction

This document contains the approved instructions for the proper maintenance of records related to the conservation of the Watts Towers. Any change to the procedures contained herein must receive prior approval from the Cultural Affairs representative, Mr. Jay Oren, before implementation of the change.

Before start of work, each inspector and conservation person must receive training, serve as an apprentice until certified, check out a tool box, and document daily all work accomplished on the proper form. Inspection and conservation personnel must use only approved tools, instruments, equipment, chemicals, procedures, and forms. Use of unapproved tools, equipment, instruments, chemicals, or procedures will result in dismissal or, under extenuating circumstances, may require the employee to be recertified.

The office foreman is responsible for all log books; computer entries; maintenance of conservation equipment and personnel tool boxes and their contents - cameras, instruments, forms, etc. ; and proper maintenance of all office supplies and equipment.

2.3.3.2 Flow of Forms & Documents

The forms used by inspectors and conservators to document the work accomplished are:

A. Preservation Worksheet - Inspection - to be filled out by inspection personnel. See "GAZINSP" or "SWAINSP" tables examples in this instruction.

B. Preservation Worksheet - Emergency Stabilization - to be filled out by conservation personnel. See "GAZEMGCY" or "SWAEMGCY" tables examples in this instruction.

C. Preservation Worksheet - Conservation - to be filled out by conservation personnel. See "GAZCONS" or "SWACONS" tables examples in this instruction.

D. Piece Form - to be filled out by inspection or conservation personnel involved in handling ornamentation or pieces which become separated from the sculptures. See "PIECELOG" table example in this instruction.

Blank forms are available in the office and are to be picked up by inspection & conservation personnel at the start of work along with the tool box. The completed form is to be turned in with the tool box at the end of each day by the inspection and conservation personnel for logging in and computer entry by the clerk.

2.3.3.3 Log Books in Office

A. Computer Diskette Log is a record of all diskettes containing Watts Towers conservation information. See "DISKLOG" table.

B. Piece Log is a record of all pieces of ornamentation or structure which has been removed or become separated from the Watts Towers. See "PIECELOG" table.

C. Inspection Photo Log is a record of all photographs taken by inspectors to document before, during, or after inspection work. See "INSPHOTO" table.

D. Conservation Photo Log is a record of all photographs taken before, during, or after conservation work. See "CONPHOTO" table.

2.3.3.4 Computer Files in Office

A. Baseline Photo File is a record in the software program, Paradox, as are all computer files listed below, of each baseline photograph including the sculpture involved, the location on the sculpture, the date taken, and the location in the microfiche file where a copy of the photograph may be found. See "GAZBASE".

B. Inspection File is a record of the information on all inspection forms processed. See "GAZINSP".

C. Emergency Stabilization File is a record of the information on all emergency stabilization forms processed. See "GAZEMGCY".

D. Conservation File is a record of the information on all conservation forms processed. See "GAZCONS".

4/91 E. Materials testing file is a record of all conservation materials tested. See "METHODS".

F. State of California Photo File is a record of the 2900 photographs of the East, Center, & West Towers taken before, during, or after repairs made between 1979 and 1985. See ETOBASE1, CTOBASE1, and WTOBASE1.

2.3.3.5 Other Records in Office

A. State of California Photo Records is a set of copies of all 2900 photographs taken of the three tall towers.

B. Microfiche of Baseline Photos is a set of microfiche of the baseline photographs taken by the City of Los Angeles beginning in April 1987.

C. Test Results is a set of data related to materials testing related to the Watts Towers since 1959.

D. Conservation Handbook is the controlling document for all conservation work on the Watts Towers.

2.3.3.5 Other Records in Office continued

E. Final conservation reports summarize all treatments applied to a sculpture which has been reviewed upon completion of conservation. Examples are reports on the Ship of Marco

3/92 Polo, Garden Spire and "A" Tower.

2.3.4 A written record shall be made of the process or processes used to accomplish each individual conservation effort with comments regarding the conditions before, during, and after the work. Reference shall be made to photographs for clear understanding of conservation work done.

2.3.5 Decorative elements, whether generic or specific, shall be shown in photographs involving conservation of the underlying members or in conservation of the embedments, themselves. Decorative elements and/or embedments shall not be removed, replaced or repaired except as described in section 4.1.4.4.

2.4 Records Availability

2.4.1 A complete set of repair records (photographic and progress reports) shall be maintained for use on site, in addition to other records kept for reference purposes.

3.0 INSPECTION TECHNIQUES

3.1 General

3.1.1 Damage to the monument may be induced by small cracks or by major motion due to seismic disturbance or wind forces on an entire sculpture. Weather effects, vandalism, accidents, or rust growth on metal reinforcements of the members of the structures are among the known causes of damage. Prompt identification of any damage to the sculptures is vital for the conservation of the works.

3.2 Macro Inspections for major movements after severe weather or seismic events

3.2.1 Each sculpture shall be accurately measured as to height, verticality, and location on the site after any significant seismic or wind event and the measurements compared with baseline measurements. Findings shall be reviewed and corrective actions determined and initiated within 30 days of the event. Locations and descriptions of any damage found during inspections shall be identified and documented as specified in 2.0.

The 1988 survey by C.W. Cook shall serve as the baseline for the verticality of the six tallest spires.

3.2.2 3 Tall Towers

3.2.2.1 The vertical linearity of each tower shall be measured for comparison with the baseline verticality measurements. As a minimum requirement, vertical alignment shall be ascertained along three axes with accuracies of +/- 1/16 " at the top of the structures.

3.2.3 Other sculptures

3.2.3.1 The vertical linearity of each sculpture shall be measured for comparison with the baseline verticality measurements. As a minimum requirement, vertical alignment shall be ascertained along three axes with accuracies of +/- 1/16 " at the top of the structures.

3.2.4 Walls

3.2.4.1 For inspections, follow the instructions in 3.3.

3.3 Micro Inspections for cracks, damage, and waterproof characteristics

5/91 3.3.1 Each sculpture shall be examined closely enough to identify all cracks 20 mm long or longer and with a depth of 2 mm or deeper in the covering over any member. Cracks found shall be identified as to location; documented on the proper form; and numbered sequentially. Methods for these inspections are optional. Acceptable methods must comply with OSHA rules. Climbing on the monument or imposing loads on the surfaces are not permitted. The priority list in 1.2 shall be generally followed.

3.3.2 Waterproofing Inspection

3.3.3 Inspections shall be performed to determine the status of the waterproof coverings over the sculptures. The life of the waterproofing materials used shall be validated

and inspection intervals set accordingly. The inspections of the 3 tall towers shall be performed beginning in mid 1988.

3.4 Recurring Inspections

3.4.1 Micro Inspections shall be conducted once during
5/91 each 5-year period, after the rainy season. See 3.4.2. The
first micro inspection was performed between September 1988
and August 1989. The formal report on the results of that
inspection is on file on the site. Inspection of the 3 tall
1/91 towers began in 1990.

3.4.2 Macro and Micro Inspections shall be conducted
after major seismic or weather events; however, Macro
Inspections shall be performed at least each 5 years. The
first macro inspection was performed by C.W. Cook in 1988. The
survey drawings are on file at the site.

3.5 Special Inspections

3.5.1 Special inspections shall be performed as
necessary to resolve unforeseen problems.

4.0 CONSERVATION TECHNIQUES

4.1.1 General

4.1.1.1 Description of Work

rev 4.1.1.1.1 Materials used in the conservation work consist
2/90 primarily of cleaning agents; bonding/adhesion agents,
6/90 consolidants; mortar; non-mortar based fill materials; steel
7/90 sections; wire, and wire mesh; polypropylene mesh for
temporary wrapping; and waterproofing compound. See 4.1.8.

4.1.1.1.2 Delivery, Storage and Handling

4.1.1.1.2.1 Deliver material to site, ready to use in
manufacturer's original, unopened container and packaging,
bearing labels as to type of material, brand name, and
manufacturer's name. Delivered materials shall be identical to
approved samples.

7/90 4.1.1.1.2.2 Store materials under cover in a dry, clean
location, off the ground. Remove from the site materials which
are damaged, have exceeded shelf life (especially adhesives
and consolidants) or are otherwise not suitable for
installation, and replace with acceptable materials. Keep
flammables away from sun and heat.

4.1.1.1.2.3 Protect aggregate and sand from contamination
from dirt and other foreign materials. Store perishable
materials in watertight structures.

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4.1.1.1.2.4 Accept, store, and take delivery of all items
2/90 which are to be furnished by suppliers or other contractors.

4.1.1.1.2.5 Note materials deliveries in Project Log and
date stamp or mark containers and packaging.

4.1.1.1.3 Job Conditions

7/90 4.1.1.1.3.1 Do not mix or place mortar in rain, when

temperature falls below 40 degrees F or in excessive heat.

7/90 4.1.1.1.3.2 Protect adjacent original material during placing of mortar and lay ground sheets over pavement beneath work to catch droppings. Remove fallen mortar from original with water, immediately.

7/90 4.1.1.1.3.3 Remove all materials to secured area at the end of each day's work. Clean all tools used for mortar mixing with water; other tools with acetone.

4.1.2 Personnel Requirements

4.1.2.1 The standard of care called for in the conservation of the Rodia Towers requires the use of skilled technical personnel. Work may not proceed without authorization by a qualified conservator or a restoration supervisor.

5/91 SECTIONS BELOW ARE OBSOLETE

Included below are job descriptions for Restoration Supervisor, Restoration Specialist, and Restoration Worker. All involved in the conservation work must serve under the direct supervision of a qualified conservator or a restoration supervisor.

4.1.2.2 Restoration Supervisor I:

Duties:

Reviews project plans, specifications, or work descriptions and estimates. Does research, verifies actual field conditions with plans, specifications, and reports to a higher authority any conditions found that vary from what is shown on the plans or described in the specifications. Recommends field changes as a result of original or existing items found during demolition or research. Preserves, where possible, all original parts of a historic building or object being restored.

Inspects the various projects authorized to him for compliance with plans, specifications, and codes; works closely with the Department of Industrial Safety and the Fire Marshal's Office where variances are required in old historic buildings.

Makes decisions and passes on restoration and construction problems relating to methods for accomplishing work, equipment used, quality of materials and workmanship with respect to historic buildings.

Coordinates with all parties involved, what parts of buildings can be preserved, what must be replaced, kinds of materials to use, finishes to be used on various materials, and how to preserve existing portions of historic buildings.

Makes material quantity calculations, requests for purchase of supplies, tools, and equipment. Originates Service Agreements and Purchases. Contacts prospective bidders for quotations and coordinates the work of contractors with time schedules of projects; inspects and passes on completion of work by contractors and vendors.

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Has general responsibilities for the control of costs on projects and the keeping of Daily Diaries, cost account records, travel expense, vehicle logs, time keeping, safety training and records, and other records as required.

Has general responsibilities for the control of costs on projects and the keeping of Daily Diaries, cost account records, travel expense, vehicle logs, time keeping, safety training and records, and other records as required.

Keeps a photo log as required of existing conditions before work, during progress of work, and at completion of work, recording all important changes, removals, additions, historic data found and restoration of historic buildings and sites.

Does research on historic buildings and sites; compiles research information into a permanent file; writes reports and makes recommendations based on research findings. Responsible for recording and identifying all historic items removed from the building for research or restoration.

Supervises, instructs in the special techniques and procedures and works with a group of Restoration Specialists and workers engaged in a project to perform the most difficult work in connection with the restoration of historic buildings, sites, artifacts and to do other work as required. Hires and lays off temporary casual employees as necessary to supplement the restoration crew to accomplish the work in an efficient manner in the time specified.

Makes frequent reports to a higher authority regarding research, progress, scheduling, construction problems, client relations, personnel, starting and completion dates, costs, important conditions and happenings.

Works closely with agency representatives to keep them informed of any necessary changes; holds starting meetings, final inspections, and makes completion reports.

4.1.2.3 Restoration Specialist: Duties: Under direction of a Restoration Project Supervisor, the Restoration Work Specialist performs a variety of skilled carpentry, masonry, and other tasks in connection with restoration, preservation, and stabilization of historic buildings and sites, checks on shoring and bracing for new foundations under old brick, adobe, and wood frame buildings; assists in plumbing existing buildings to original positions; does concrete work; makes adobe blocks; reproduces original finish on adobe, brick, and wood frame buildings; hews logs; makes shakes; lays adobe and brick to match old work and matches original carpentry work; checks on details bearing on authenticity and does research as required; consults with other craftsmen and leads less skilled assistants; assists in maintaining project safety; keeps tools, materials, and equipment in good condition and keeps simple records.

4.1.2.4 Restoration Worker: Duties: A Restoration Worker assists skilled workers in restoration and other work; assists in erecting scaffolding; sharpens, cleans and cares for tools and equipment; saws lumber and mixes mortar; carries materials, tools, and equipment to and from the job site, and cleans up after a job has been completed; assists with shoring and bracing, assists with making of adobe, brick, and concrete work; does simple research on particular phases of restoration as required.

4.1.3 Test Program

4.1.3.1 Test results performed to date are shown on pages 26 and 27, section 8 and 9, and computer file "Methods".

Additional testing requires approval of the General Manager, Cultural Affairs Department.

4.1.4 Conservation Processes

4.1.4.1 Temporary Securing of Sculpture & Embedments

rev

2/90 4.1.4.1.1 Temporary securing of loose sections of mortar and embedments shall be conducted immediately upon identification and immediately prior to proceeding with any additional conservation work. All temporary work shall be

done

without adding pigments to materials, and worksheets shall be marked noting the temporary nature of the conservation treatment. Acceptable materials for temporary conservation

include:

filtered water to clean ornaments and mortar
other chemicals as approved by this plan*
foam backer rod to fill cracks
silicones or acrylics to seal cracks
silicones or acrylics for adhesion/bonding
strapping which will not cause abrasive damage nor

rusting

polypropylene mesh
Miradur for wrapping
wire mesh, wire which will not cause abrasive damage nor
rusting
caulk which is reversible in application

*See 4.1.8 for additional material information.

4.1.4.2 Structural Repair Methods & Crack-filling

4/91

Structural repair methods for critical (major supporting) and non-critical (minor or secondary) load-carrying members are generally described in this section. Before undertaking repair

of

any cracked or broken member, a thorough inspection of the condition of the reinforcement shall be made either visually by exposing the reinforcement or by analysis of x-ray or other non-destructive techniques.

Method A: Critical members determined to require replacement

due to reinforcement loss or major cracks, spalls or failed portions - (Major vertical columns, some minor vertical columns, major horizontal bands, some

minor

horizontal bands, some radial members, all overhead connector members, center columns of sculptures, others to-be-determined by analyses.)

1. Prepare a dimensional drawing or sketch of the original

size(s) and shape(s) of all members considered for repair. Take "before" photographs. Remove the spalled historic fabric as intact as possible. Cut out or grind away the interior surface

of

the fabric to leave a thin shell of historic mortar containing

any

original ornaments. Wherever critical members intersect with another member(s), such as columns with bands and arcs with a central column, remove enough of the historic fabric on the intersecting member(s) to provide access for a structural joint between both members.

2. Remove the damaged portion(s) of the reinforcement(s) determined to require replacement. Prepare new, structural steel reinforcement(s) of equal or greater cross-sectional area and bend it (them) to the original reinforcement shape, if necessary, with a new length to permit attachments at each end. Record the size(s) of the old and new reinforcements.

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3. Provide attachments at each end of the replacement and at each intersecting member reinforcement to provide load-carrying capacity equal or greater than the strength of the original reinforcement. Welding or bolting is recommended. Record the sizes and number(s) of attachments. Take "during" photograph(s).

4. Deleted

5. Cover the new steel and exposed old steel with a) steel mesh and b) restoration mortar. Reattach the original historic fabric to the new mortar surface being careful to retain the original outside dimensions of the member. Take "after" photograph(s).

Method B: Non-critical members determined to require replacement due to reinforcement loss or major cracks, spalls or failed portions - (Ornamental arcs and bands, finials).

See Method A., steps 1. through 5., above.
6/91 Crack-filling with Jahn mortar or cement.

Structural cracks, other than hairline cracks, may be filled with the approved Portland cement mixture (see 4.1.5) or Jahn mortar. Hairline cracks may be filled (injected) with Jahn mortar M30 or may be opened wide enough to fill with Portland cement or Jahn mortar.

Jahn mortar M70 application instructions:

1. Mixing. It is unnecessary and unadvisable to add aggregate to the Jahn mortar. Smoothness can be controlled during the stage

at which the surface is worked and by the type of tool used for the purpose.

TESTS HAVE SHOWN A 50 PERCENT LOSS OF STRENGTH BY ADDING SAND.

6/91 2. Application. [PHASE I]. Proper application requires pre-wetting all surfaces and maintaining a moist environment at the repair for 5 days minimum. After the mixing is completed, trowel the mortar onto the dampened area of repair. The mortar should be applied in a bigger shape than necessary so it can later be modelled down after the skin forms. Certain shapes can be blocked out at this stage. For example, areas where there were formerly shells in the surface can be imprinted with a shell to give the general appearance of the original. It is especially important to pay attention to this when the repair follows a regular pattern like on the main spire base of the Ship of Marco Polo). One wants to avoid unwittingly producing a new pattern that would conflict with the one produced by Rodia.

Deeply cut lines in the mortar or deep designs (like a tool pattern) can be blocked out at this stage also. Immediately after application, the surface of the repair mortar should be sprayed with water until the water begins to drip off the fill. The wet mortar should then be wrapped with damp cloths and plastic wrap. Any plastic that will keep the damp cloth from drying out overnight will suffice (saran, polyethylene, etc.). It would be best to apply this on a day when there is another work day the next day; for example, on the first day of a two day work week.

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3. Application. [PHASE II]. The day after the mortar is applied, a second integral phase is required in order for the mortar to effectively cure. While essential, these steps can be carried out while other aspects of the work are being done. After the plastic is unwrapped and the damp cloths are removed, the mortar should be cut with a spatula or trowel to its proper shape. Care should be taken to follow the shape of the element and cut the shape accordingly so it is not too high at the edges. It is important to take note of the shape of individual planar surfaces: sometimes a seemingly round shape is actually squared off in places. Cutting the shape at this stage also removes the skin that will form on the surface of the mortar as part of the curing process. It is essential to remove the skin in order to get the proper surface appearance. However, this step is critical because it directly impacts the strength of the material due to its ability to absorb water. Once the proper shape is achieved, the mortar should be repeatedly watered with a spray bottle until it no longer accepts water. The strength of the mortar is directly dependent on the amount of water absorbed at this stage. As a general rule, the repair should be sprayed three times an hour on

this second day, but no less than 15 times. If one sprays the surface too soon, the mortar will sag and run off the surface. However, it is generally impossible to overwater the surface if the watering is done the day after application. If the mortar is applied and left for more than three or four days, this process be carried out must still once it is unwrapped. Otherwise the mortar will be very soft and weak. The watering should begin once the desired shape and design are achieved. To create a complicated design, block out the grid on the first day and then carve out the more complicated elements on the second day.

4. Pigmenting and sealing. The Jahn mortars can be pigmented from the surface. This makes it easier to achieve a proper color with a minimum amount of mixing and alteration of the original properties of the mortars. The color is applied as a mixture of dry pigments in water. The colors will vary in the pigmented mortars, but the greyish mortar is achieved with black, white, raw umber and a small amount of yellow ochre. The techniques for application vary, but in general it is best to use as little water as possible for the application. However, if the color achieved is too strong, a wet brush or damp rag will remove the excess pigment. After the color is completely dry, the surface can be brushed with Siline, a silane based sealer that will set the color and prevent it from being water soluble. The material is available from Cathedral Stone Company. The coloring process can be done once an entire level or area has been repaired. The coloring technique can also be used on any cement mortar which is not the proper color.

SECTION BELOW IS OBSOLETE SEE 4.1.4.2, TWO PAGES PREVIOUS

4.1.4.2 Treatment of Non-Critical Structural Members in 3 Tall Towers (From Ehrenkrantz Method A, modified)

4.1.4.2.1 Method A. This method has a high priority for conservation of severely damaged members and embedments in the 3 tall towers while restoring needed structural strength. The following procedures shall be followed only after review and approval by the Cultural Affairs Department representative.

4.1.4.2.1.1 Take conservation photographs and record information on the condition, location, date, etc.

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Secure all embedments on and adjacent to the area. Remove the spalled historic fabric as intact as possible. Cut out the interior of the original mortar covering to leave an intact exterior fabric.

4.1.4.2.1.2 Remove the corroded metallic core only if more than one-third of the original cross-sectional area of metal has been lost to corrosion. Remove and salvage the original exterior mortar adjacent to the damaged area to expose a

minimum of two inches of the original core. Remove corrosion from the ends of the existing core and coat with anti-corrosion material.

2/90 4.1.4.2.1.3 Replace the original core with a steel member with a cross-sectional area equal to or greater than that of the original core.

2/90 4.1.4.2.1.4 Lap the replacement core with the extensions of the original core and wrap tightly with steel wire, forming a splice at each end.

4.1.4.2.1.5 Coat the metallic core with Sikadur Hi-Mod bonding agent and wrap the splice tightly with steel wire cloth (mesh), previously cut to size. Take conservation photographs of the "during" condition. Record the details on materials and processes used for the repairs.

4.1.4.2.1.6 Apply additional mortar to the coated core. Place the salvaged exterior pieces onto the core. Allowance shall be made for the pieces to be solidly driven into the mortar backing to assure full bedding. Allowance shall be made at joints of individual pieces to allow excess mortar backing to be extruded from the back of applied pieces.

4.1.4.2.1.7 Fill the joints between individual pieces with the specified mortar and cure the completed repair. Take conservation photographs of the "after" condition.

SECTION BELOW IS OBSOLETE SEE 4.1.4.3, THREE PAGES PREVIOUS

4.1.4.3 Treatment of Critical Structural Members in 3 Tall Towers (From Ehrenkrantz Method B, modified)

4.1.4.3.1 Method B. This method has a low priority for conservation of severely damaged members and embedments in the 3 tall towers while restoring needed structural strength. The following procedures shall be followed only after review and approval by the Cultural Affairs Department representative.

4.1.4.3.1.1 Take conservation photographs, record start date and condition of area. Secure all embedments on and adjacent to the area. Remove the spalled historic fabric as intact as possible.

4.1.4.3.1.2 Remove the corroded metallic core and mortar cover necessary to expose a minimum of four inches of the original core which retains 90% of its original cross-sectional area. Remove corrosion from the ends of the existing core and coat with anti-corrosion material.

2/90 4.1.4.3.1.3 Replace the original core with a steel member with a cross-sectional area equal to or greater than that of the original core.

4.1.4.3.1.4 Lap the replacement core with the extensions of the original core and wrap tightly with steel wire, forming a splice at each end. Take photographs of the "during" condition. Record materials and techniques used.

4.1.4.3.1.5 Coat the metallic core with Sikadur Hi-Mod bonding agent and wrap the splices tightly with 7/90 steel wire cloth (mesh), previously cut to size.

NOTE: For horizontal bands on the Ship, connections at splices shall include a minimum of two 1/4 inch bolts to secure each end and to prevent relative movement of the cores.

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4.1.4.3.1.6 Apply additional mortar to the coated core. Build up the mortar coating to 1/8" below the original member size. 4.1.4.3.1.7 Fill the joints between individual pieces with the specified mortar and cure the completed repair. Take photographs of the "after" condition; record date and other information of note.

END OF OBSOLETED TEXT

4.1.4.3 Treatment of Embedments

4.1.4.3.1 Ornaments (embedments) used on the sculptures
can be characterized as:

4.1.4.3.1.1 Highly Specific: statuary; lettering in the
the mortar or made by use of tiles, etc.; other impressions in
the mortar; figures made of pottery or glass; recognizable pieces
of California Art Pottery, such as entire cups, dishes,
bowls,
rare bottles.

4.1.4.3.1.2 Specific: pieces of California Art Pottery;
recognizable pieces of tile; stones and rocks; mirror; sea
shells; glass.

4.1.4.3.1.3 Generic: unrecognizable pieces of pottery,
glass,
tile or pieces of bottles; colored mortar.

CLEANING OF ORNAMENTS

7/90 4.1.4.3 The cleaning of ornaments shall be done with
distilled water. Keep the water clean (change it often). Use
cotton swabs for shells, glass and small decorations with
smooth
surfaces. Mist-clean rough surfaced ornaments with hoses and
brush with soft-bristle brushes or stippling brushes to
loosen
dirt. Oily and/or greasy dirt can be cleaned with acetone or
reagent alcohol. If results are determined to be
unsatisfactory
by the Conservator, use a material on the list of approved
materials, section 4.1.4.5. Allow 24 hours between cleaning
and
consolidating.

Shell. 1). brush and vacuum surfaces with very soft brush and
motion to remove debris, dust and dirt. Do not brush too hard
or
dirt will be driven into surfaces; 2) wash with water on
cotton
swabs, using gentle motion, generally in the direction of the
grooves on the shell surface; 3) be extra careful at surface
edges as they are more vulnerable to damage and loss than
overall surface.

Stone and mortar. Can be hosed down with a filter on water
line
to remove chlorides and metallic impurities; allow at least
24
hours drying time between wet cleaning and application of
consolidant.

NOTE: Abalone, Batchelder tiles, all materials with
powdery,
friable or crumbling surfaces: DO NOT CLEAN.

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Glazed tiles and compact, non-delaminating materials. If
stains
or embedded dirt remain after initial cleaning with water
and/or
organic solvents (acetone, ethanol or xylene can be used),
clean
with Brasso or Noxon. These metal polishes (with ammonia and
a
mild abrasive) will remove film and embedded dirt. Apply with
cotton or rag and polish out dirt. Wipe afterwards with water
and ethanol.

2/90 CONSOLIDATION OF ORNAMENTS

7/90 4.1.4.4 Consolidation treatments of ornament surfaces
shall be done after cleaning (see NOTE in 4.1.4.3, above, for
exception) using the specific materials noted in 4.1.8 for
the
ornaments being treated. Safety protections and procedures
shall

be followed in consolidation treatments. See Section 6.
Safety.

For application of consolidant DF 104/B-72 mix: make sure
surface is clean and free of dust; for all materials except
shells, brush surface with acetone and allow to dry; apply
consolidant with brush from bottom to top; apply two coats 5
minutes apart, waiting between coats for drying- for shells,

one
coat may suffice; brush with xylene after application except

DO
NOT BRUSH ABALONE SHELLS WITH XYLENE; if shine develops,

brush
surface with acetone or xylene; DO NOT APPLY IF TEMPERATURE

IS
ABOVE 85F.

3/92 See Lowinger memo 3/12/92 re DF 104 discontinued by GE.

2/90 ADHESION AND RE-ADHESION OF ORNAMENTS AND
NON-STRUCTURAL CRACK-FILLING

4.1.4.5 Re-adhesion of ornaments to the base mortar,
and
adhesion of broken ornament pieces to each other shall be
done
using the specific materials noted in 4.1.4.5 for the
ornaments
being treated.

2/90 4.1.4.5.1 Only original ornaments (embedments) may be
replaced and then only if their prior location is known
through
documentation. Adhesive or Opticon UV is recommended for
readhesion where applicable in resetting into the mortar.

7/90 4.1.4.5.2 Crack-filling is limited to gaps of 3/8 inch or
less. For non-structural cracks, Dow Chemical RTV 738 is
recommended. This silicone should be mixed with pulverized
sand
no greater than 1:1. Pigmenting recipes are below. Degrease
any
exposed steel; clean crack of debris, dust and dirt; add foam
backer rod for temporary filler if crack is greater than 1/4
inch; do not apply silicone greater than 1/4 inch thick;
scrape
edges of fill flush with surrounding surfaces to avoid
peeling
later; apply only enough sand on fill surface to blend with
adjacent surfaces. Pigments for red: Indian red, raw umber
and
small amount of Rose Madder or Alizarin crimson; for grey:
Raw
umber only; for green to be determined; for yellow: Yellow
ochre, raw umber. SAFETY: MAKE SURE TO WEAR LATEX GLOVES
DURING

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PREPARATION AND APPLICATION.

4.1.4.5 Paint Coating for Steel

4.1.4.6 Water Repellent Coating

conservation of the Towers. A negative report- signifying that no significant problem surfaced during the week- shall be submitted if that is the situation.

5.3 Monthly progress reports are required, documenting progress against the plan, any significant schedule slippage and performance to the budgetary plans.

6.0 Safety Requirements

6.1 Personnel safety requirements established by OSHA shall be followed in performance of all operations by restoration personnel.

6.1.1 Scaffolding, work platforms, power tools, and other equipment employed during conservation work shall be inspected in accordance with established safety requirements.

6.1.2 Work on the sculptures shall not be done during winds exceeding 15 miles per hour nor in rain storms.

6.1.3 No visitors shall be permitted on the Towers' site during conservation work without approval of the General Manager, Cultural Affairs, and concurrence by the site supervisor.

6.1.4 Each restoration worker is responsible for immediately notifying the site supervisor and the General Manager, Cultural Affairs, of any safety hazard or potential safety hazard. A written report of any such safety hazard or hazards shall also be submitted at the earliest possible time.

7/92 6.1.5 Safety Notes

1) Make sure to wear the recommended protective clothing, masks, eye shields, and gloves. during preparation and application of treatments, cutting, grinding and/or welding, and other operations.

6.2 Hazardous Materials used on site are:

Material	Quantity on hand 11/17/89
Acetone	5 gallons
Acryl 60	1 gallon
Acryloid B-72	two 25 pound containers
Acryloid B-48N	two 25 pound containers
Alcohol-natural	10 gallons
Anti-rust Spray	six 11 ounce tubes
Chemtrete BSM 40D	4 ounces
GE DF 104/Acryloid B-72 mix	10 ounces
Hydroxide Ammonia	5 gallons
Lacquer thinner	5 gallons
Latapoxy 210	1 1/4 gallons
SikaTop 122	1 pound package

Silicone Adhesive/sealant #162 4 cartridges 10.3 fl oz
Thinner-Toluene substitute 5 gallons
Trichloroethane 1,1,1 5 gallons

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6.2 Hazardous Materials used on site are (continued):

WD 40 9 ounce can
Xylene 5 gallons
Xylene substitute 5 gallons
Zinc Renew 3 1/2 gallons
Zynolyte 1 gallon

7.0 REPAIR REFERENCE INFORMATION

7.0.1 Documentation of emergency repairs, May 1979 to July 1985.

7.0.2 Records taken during the 6 year and 2 month period (May 1979 to July 1985) of repairs performed by the California Office of the State Architect consist of about

1500

Kodak Instamatic color photographs of hundreds of repairs to the three tall towers, daily progress reports, and monthly progress reports. This information is in the computer database, see reference section, below.

6/90 7.1 Repair Listings

- 7.1.1 East Tower
See Databases ETOCONS for 1989 & subsequent repairs or ETOBASE1 for 1979-1985 data
- 7.1.2 Center Tower
See Databases CTOCONS for 1989 & subsequent repairs or CTOBASE1 for 1980-1985 data
- 7.1.3 West Tower
See Databases WTOCONS for 1989 & subsequent repairs or WTOBASE1 for 1980-1985 data
- 7.1.4 Wall
See emergency conservation databases SWAEMGCY (South Wall), NWAEMGCY (North Wall), and SWACONS and NWACONS
- 7.1.5 Gazebo

See GAZEMGCY and GAZCONS databases

7.1.6

Overheads

See OHDEMGCY and OHDCONS databases

7.1.7

"A" Tower

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See ATOCONS database and "A" Tower Conservation Report.

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7.1.8

"B" Tower

See BTOCONS database

7.1.9

Floor

See FLRCONS database

7.1.10

Chimney

See CHIEMGCY and CHICONS databases

7.1.11

Ship

5/29/92

See SHIEMGCY and SHICONS databases and Ship of Marco Polo Conservation Report.

7.1.12

House

See HOUEMGCY and HOUCONS databases

7.1.13

Barbeque

See BBQCONS database

7.1.14

Oven

See OVECONS database

7.1.15

Garden Spire (South Wall)

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See GARCONS database and Garden Spire

Conservation

Report.

7.1.16

Canopy (House)

See CANCONS database

8.0

REFERENCES AND TEST RESULTS

8.1

Computer Databases

Databases included in the conservation records are maintain-
ed in Paradox3 (Borland International) files on the IBM AT computer hard disk and on backup floppies on site. Separate databases are available for each sculpture for each operation

performed- photography, inspection, emergency stabilization, long-term conservation and graphics. Additional databases are available for conservation tests.

Photographic baseline databases have been prepared for each sculpture: GAZBASE for the Gazebo, SHIBASE for the Ship of Marco Polo, SWABASE for the South Wall, NWABASE for the North Wall, FLRBASE for the Floor, ATOBASE for the "A" Tower, BTOBASE for the "B" Tower, GARBASE for the south wall Garden Spire, HOUBASE for the House facade, CHIBASE for the Chimney, CANBASE for the Canopy, OVEBASE for the Oven and BBQBASE for the shelf-like Barbeque in the North Wall, and OHDBASE for the Overheads throughout the site. See booklet "Conservation Database Operating Instructions"

8.2 References and Test Results

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1. Conservation and Maintenance Plan Simon Rodia's Towers in Watts, State of California, May 4, 1979, C-5182C, Earl V. Carlson.
 2. Preservation Plan, November 1983, The Ehrenkrantz Group, pages 23 - 35.
 3. Prior Test Results see Appendices.
 4. Final Report 1988/1989 Summary of Watts Towers Inspection Results, September 25, 1989.
 5. 1986/1989 Summary of Watts Towers Emergency Stabilization Measures, October 1989.
 6. Site Plan & Elevation View/Dimensions
 - 7/92 7. Site Maintenance 3/86, rev 7/30/92
 8. C.W. Cook survey, 1988
 9. ANCO Engineering Reports 1988, 1989.
 10. Other reports- Soils/Geology; October 1987 Earthquake report; January 1988 Wind/Damage report; East Tower Vertical Column report on cracks; Ship Spire report; X-ray Project
 - 3/92 reports; Final reports of Ship of Marco Polo, Garden Spire, "A" Tower.
9. APPENDIX of Prior Test Results- see following pages.

Smith-Emery Company laboratory testing results, 1959, pages 54-58, Ehrenkranz plan.

Content: compression values of specimens from West Tower pedestal (base) and vertical column, condition and sizes of steel reinforcements and wire mesh in vertical columns and in base, depth of footings, size of patio floor (slab), splice description, chemical analysis of mortar sample from splice area, cement-to-sand ratio and weight in pounds per cubic foot.

Tom Wills' repair notes, 1967, pages 59-62, Ehrenkranz plan.

Content: repair mortar and epoxy used.

Memorandum from OSA, Treadwell, 1981, pages 76-79, Ehrenkranz plan.

Content: significant comments by supervisor of repair on mortar treatments and problems.

Condition Survey, 1982-3, pages 80-89, Ehrenkranz plan.

Content: analyses of conditions of sculptures, mortar, repair techniques, problems, etc.

Petrographic and Chemical Studies of Mortars, Erlin, Hime Associates, Inc., 1982, pages 90-96, Ehrenkranz plan.

Content: properties of 3/8" to 1 1/2" thick Rodia mortar

and

steel samples of bands, spokes and joints from Center, West and

East Towers, elevations 12 feet to 75 feet.

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Laboratory and On Site Testing, 1982, pages 201-217, Ehrenkranz plan.

Content: review and analyses of materials and procedures

DRAFT 3/2/86 SITE MAINTENANCE
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