



DEPARTMENT OF THE ARMY  
OFFICE OF THE ASSISTANT SECRETARY  
CIVIL WORKS  
108 ARMY PENTAGON  
WASHINGTON DC 20310-0108

AUG 11 2008

The Honorable Richard B. Cheney  
President of the Senate  
U. S. Capitol Building, Room S-212  
Washington, D.C. 20510

Dear Mr. President:

In accordance with Section 2873 of the National Defense Authorization Act for Fiscal Year 2008, enclosed is a report on alternative measures to address cracks in the monument at the Tomb of the Unknowns at Arlington National Cemetery (ANC). The report contains information about the monument in response to the provisions in subsection 2873 (a) with respect to (1) plans considered for replacement and disposal; (2) the feasibility and advisability of repair; (3) current maintenance and preservation efforts; (4) an explanation of why no repair attempt has been made since 1989; (5) comprehensive cost estimates for replacement and repair; and (6) assessment of its structural integrity.

Options for addressing the cracks are described in the report. A decision on a final course of action will not be made until our responsibilities are fulfilled under Section 106 of the National Historic Preservation Act and the National Environmental Policy Act. Also, subsection 2873(b) states that "[t]he Secretary of the Army and the Secretary of Veterans Affairs may not take any action to replace the monument at the Tomb of the Unknowns at Arlington National Cemetery, Virginia, until 180 days after the date of the receipt by Congress of the report required by subsection (a)." According to subsection 2873(c), the limitation in subsection 2873(b) does not prevent undertaking repair of the monument or acquiring marble for the repair, subject to the availability of appropriations. Accordingly, while long-term options continue to be explored, experts in the field of marble maintenance and conservation are being consulted to assist ANC in the development and implementation of a maintenance and repair plan to ensure that the existing marble is appropriately protected.

In accordance with a 2004 Memorandum of Understanding between the Department of the Army and the Department of Veterans Affairs (VA), the role of VA is limited to procurement, transportation, and sculpting of a replacement for the base, main die block, and cap of the Tomb Monument, should ANC determine that replacement is required. VA has no role in determining whether the Monument should be replaced, or in its maintenance and repair.

The Office of Management and Budget advises that, from the standpoint of the Administration's program, there is no objection to the presentation of this report for consideration of the Congress.

Very truly yours,

John Paul Woodley, Jr.  
Assistant Secretary of the Army  
(Civil Works)

William F. Tuerk  
Under Secretary for Memorial Affairs  
Department of Veterans Affairs



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AUG 11 2008

The Honorable Nancy Pelosi  
Speaker of the House of Representatives  
U. S. Capitol Building, Room H-232  
Washington, D.C. 20515

Dear Madam Speaker:

In accordance with Section 2873 of the National Defense Authorization Act for Fiscal Year 2008, enclosed is a report on alternative measures to address cracks in the monument at the Tomb of the Unknowns at Arlington National Cemetery (ANC). The report contains information about the monument in response to the provisions in subsection 2873 (a) with respect to (1) plans considered for replacement and disposal; (2) the feasibility and advisability of repair; (3) current maintenance and preservation efforts; (4) an explanation of why no repair attempt has been made since 1989; (5) comprehensive cost estimates for replacement and repair; and (6) assessment of its structural integrity.

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**REPORT ON ALTERNATIVE MEASURES TO ADDRESS CRACKS  
IN THE MONUMENT AT THE TOMB OF THE UNKNOWNNS AT  
ARLINGTON NATIONAL CEMETERY, VIRGINIA**

**REPORT TO THE CONGRESS OF THE UNITED STATES**

**AS REQUIRED BY SECTION 2873 OF PUBLIC LAW 110-181, *THE NATIONAL  
DEFENSE AUTHORIZATION ACT FOR FISCAL YEAR 2008***

**PREPARED BY:**

**THE DEPARTMENT OF THE ARMY**

**August 2008**

## EXECUTIVE SUMMARY

Alternative measures are being explored to address cracks in the Tomb of the Unknowns Monument at Arlington National Cemetery (ANC). The Tomb Monument is the four-piece marble object located over the vault containing the remains of the World War I Unknown, and is a component of the Tomb of the Unknowns. Section 2873 of the National Defense Authorization Act for Fiscal Year 2008, Public Law 110-181 (Act), directed the Secretary of the Army and the Secretary of Veterans Affairs to submit a joint report to Congress on plans to address the cracks with respect to (1) replacing the Monument and its disposal, if it were removed; (2) an assessment of the feasibility and advisability of repairing the Monument rather than replacing it; (3) a description of current efforts to maintain and preserve the Monument; (4) an explanation of why no attempt has been made since 1989 to repair it; (5) comprehensive estimates of the cost of replacement and the cost of repair; and (6) an assessment of its structural integrity.

In 1963, ANC initiated a program of monitoring and investigation of the Monument in response to the development of two parallel cracks in its main block. The cracks, which now measure nearly 48 feet in combined length, appear on all four sides of the Monument and extend almost entirely through the block. According to stone conservation experts, the cracks are not compromising the structural integrity of the stone and are repairable. ANC repaired the cracks twice, once in 1975, and again in 1989, and is now in the process of initiating another repair of the Monument. The results of studies and monitoring of the Monument over the past four decades confirm that, despite repairs, the cracks continue to lengthen and widen, which is perhaps a natural phenomenon of the material. Since 1990, a third crack has become visible, whose origins are uncertain. The Monument can be repaired again, but its condition will continue to deteriorate. Although it is not known when the Monument will reach the point of being beyond repair, the natural aging process that weathers and cracks outdoor marble makes it likely that it will need to be replaced at some point in the future. The cracking and minor erosion of the Monument have led ANC to consider various treatment options, including repairing the cracks, obtaining and stockpiling marble for future replacement of the monument, and the immediate replacement of its cap, die block, and base.

The impetus to consider various treatment options for the Monument is the culmination of over 40 years of deliberation, starting with the first report on the cracks in the early 1960s, and continuing through the two previous repairs. In evaluating whether to continue to maintain and repair the Monument or replace it, ANC is giving full consideration to its historic significance. ANC recognizes the associative qualities that link the Monument to World War I and its veterans. ANC also realizes that the Tomb of the Unknowns has come to memorialize all of the service men and women that have sacrificed their lives for this country in subsequent military conflicts that continue today. In this regard, the Tomb of the Unknowns has significance, beyond its *historic* significance, that transcends the past and present to the future. As its steward, ANC is

responsible to do what it can to ensure that the Monument stands, as unflawed and perfect as possible, in honor of the sacrifices that it represents.

To preserve the solemn dignity of the Monument for those that it honors and for future generations of Americans, ANC is considering alternative actions that could be taken. Repair of the Monument is a viable alternative, as verified by experts in the field of stone conservation. Replacement is another alternative under consideration, due to the uncertainty of obtaining suitable marble in the future. Only marble with specific qualities can be used for replacement, so the current and future existence and availability of such marble is of concern. Suitable marble is available today, but may not be in the future, and there will never be a greater quantity of suitable marble in the future than there is now. It is primarily for this reason that ANC is considering replacement of the Monument as one potential long-term solution.

There is more information in this report on the potential replacement option than there is for other options, because the replacement option is much more complex than the other options under consideration. Also, the potential replacement option has undergone the most scrutiny through the Section 106 review process. The preponderance of information on replacement should not be construed as favoring this option over the other options under consideration.

In response to ANC's request to provide a Tomb Monument replacement, the Department of Veterans Affairs (VA) entered into a Memorandum of Understanding (MOU) with the Department of the Army in 2004 that outlines respective responsibilities. VA will be responsible for the procurement, transportation, and sculpting of a replacement for the base, main die block, and cap of the Tomb Monument when and if Army decides replacement is necessary. Both agencies have compliance requirements under Section 106 of the National Historic Preservation Act and the National Environmental Policy Act (NEPA). No decision on a final course of action will be made until both agencies fulfill their respective responsibilities under both of these laws.

Furthermore, subsection 2873(b) of the Act states that "The Secretary of the Army and the Secretary of Veterans Affairs may not take any action to replace the monument at the Tomb of the Unknowns at Arlington National Cemetery, Virginia, until 180 days after the date of receipt by Congress of the report required by subsection (a)." According to subsection 2873(c), the limitation in subsection 2873(b) does not prevent the repair of the current Monument or the acquisition of blocks of marble. Accordingly, while long-term options such as continued repair, procurement of replacement marble, and immediate replacement continue to be explored, ANC is working with experts in the field of marble maintenance and conservation to develop and implement a maintenance and repair plan to ensure that the existing marble is appropriately protected. ANC will take no action to acquire replacement blocks of marble until after Section 106 and NEPA requirements are complete.



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# **REPORT ON ALTERNATIVE MEASURES TO ADDRESS CRACKS IN THE MONUMENT AT THE TOMB OF THE UNKNOWNNS AT ARLINGTON NATIONAL CEMETERY, VIRGINIA**

## **ORGANIZATION OF THE REPORT**

This report has been prepared by the Department of the Army in accordance with the provisions of Section 2873 of Public Law 110-181 (Act). The report has been reviewed by the Department of Veterans Affairs (VA) and is submitted to Congress as a joint report by the Departments. Following a brief description of the purpose of the report and the provisions of the Act, the report identifies the specific requests for information as contained in Section 2873, followed by the requested information.

## **PURPOSE**

This report provides information on alternatives to address the cracks in the Tomb Monument at the Tomb of the Unknowns at Arlington National Cemetery (ANC) in Arlington, Virginia. The Tomb Monument, as referred to in this report, is the four-piece marble object located over the vault containing the remains of the World War I Unknown at the Tomb of the Unknowns. The Tomb Monument is one component of the Tomb of the Unknowns Historic Landscape, which also includes the plaza located between the Memorial Amphitheater and the Tomb Monument, the eastern approach to the Tomb (including the steps, grass lawn, and sidewalks extending east to Roosevelt Drive), the vaults containing the remains of the World War II and Korean War unknowns, the inscribed marble covers over those vaults, and the (empty) Vietnam War unknown vault. Cracking and erosion of the Tomb Monument has led ANC to consider its repair, or the possible replacement of three of its four pieces.

Neither the Tomb of the Unknowns, nor ANC, is listed or has been evaluated for listing, in the National Register of Historic Places or the National Historic Landmarks Register. However, the Tomb of the Unknowns, including the Tomb Monument, is of transcendent national significance. The Army and ANC concur that the Tomb of the Unknowns and its associated historic landscape very likely meet the criteria for consideration as a National Historic Landmark, and are treating it as such under the Section 106 review. National Historic Landmarks are those properties that possess national significance in American history, have exceptional value in representing the ideals that shaped the nation, and have significance for all Americans. All deliberations regarding the present and future treatment of the Tomb Monument by ANC are undertaken in consideration of its historic significance, and in compliance with Section 106 of the National Historic Preservation Act of 1966, as amended, and its implementing regulations found at 36 CFR 800.

Neither the Tomb Monument nor the greater cemetery has been nominated to the National Register of Historic Places.

## **REPORT REQUIREMENTS**

The provisions of Section 2873 of Public Law 110-181, the *National Defense Authorization Act for Fiscal Year 2008*, enacted on January 28, 2008, are as follows:

(a) Report Required. Not later than 180 days after the date of the enactment of this Act, the Secretary of the Army and the Secretary of Veterans Affairs shall jointly submit to Congress a report setting forth the following:

(1) The current plans of the Secretaries with respect to--

(A) replacing the monument at the Tomb of the Unknowns at Arlington National Cemetery, Virginia; and

(B) disposing of the current monument at the Tomb of the Unknowns, if it were removed and replaced.

(2) An assessment of the feasibility and advisability of repairing the monument at the Tomb of the Unknowns rather than replacing it.

(3) A description of the current efforts of the Secretaries to maintain and preserve the monument at the Tomb of the Unknowns.

(4) An explanation of why no attempt has been made since 1989 to repair the monument at the Tomb of the Unknowns.

(5) A comprehensive estimate of the cost of replacement of the monument at the Tomb of the Unknowns and the cost of repairing such monument.

(6) An assessment of the structural integrity of the monument at the Tomb of the Unknowns.

(b) Limitation on Action. The Secretary of the Army and the Secretary of Veterans Affairs may not take any action to replace the monument at the Tomb of the Unknowns at Arlington National Cemetery, Virginia, until 180 days after the date of the receipt by Congress of the report required by subsection (a).

(c) Exception. The limitation in subsection (b) shall not prevent the Secretary of the Army or the Secretary of Veterans Affairs from repairing the current monument at the



Tomb of the Unknowns or from acquiring any blocks of marble for uses related to such monument, subject to the availability of appropriations for those purposes.

## **SPECIFIC INFORMATION REQUESTS AND THE SECRETARIES' RESPONSES**

*Section 2873 (a)(1) requests "The current plans of the Secretaries with respect to replacing the monument at the Tomb of the Unknowns at Arlington National Cemetery, Virginia."*

Alternative measures to address the cracks in portions of the Tomb Monument have been under deliberation by ANC for over 40 years, starting with the first report on the monument's cracks in the early 1960s, and continuing through two subsequent repairs. Currently, the Tomb Monument's die block (the central, 50 ton block of the monument) has two parallel, horizontal cracks, referred to as the "primary" and "secondary" cracks. The cracks have continued to lengthen since the 1960s. The dimensions of the die block are 12.48 feet on the two long sides by 6.57 feet on the two short sides by 5.15 feet in height, for a total horizontal circumference of 38.1 feet. Appendix A to the report shows the dimensions of the primary and secondary cracks as they appeared in 1990. As of July 2007, the primary crack is 30.963 feet length, representing a 2.595 foot increase since a report on a study of the Tomb Monument's condition was produced in 1990 (Oehrlein and Associates). The secondary crack has now reached a length of 16.872 feet, representing a 0.626 foot increase since 1990. Altogether, the cracks have increased over three feet in length since the 1990 study, and experts in marble conservation believe the cracks will continue to lengthen and widen. Also, a third crack has appeared since 1990, which originates at the base of the north elevation of the die block and runs perpendicular to the two main cracks.

More recently, the question of whether to repair or replace the Tomb Monument has been reviewed and studied in detail as part of ANC's compliance with Section 106 of the National Historic Preservation Act. ANC has determined that replacement of the Tomb Monument, should it happen, would have an adverse effect on the Tomb Monument, the Tomb of the Unknowns Historic Landscape, and ANC. Since April 2005, ANC has been consulting with a number of government agencies and other interested parties in an effort to reach consensus on how to address the Tomb Monument's deteriorating condition. Because of the monument's historical significance, ANC is following review procedures and requirements in accordance with Section 106. A decision will not be made on a course of action until ANC has fulfilled its responsibilities under both Section 106 and the National Environmental Policy Act (NEPA). VA also will complete any compliance requirements under its limited role of procuring the Tomb Monument replacement marble, following ANC's decision to replace it, should that alternative be implemented.

ANC began consulting with the Virginia State Historic Preservation Office (Virginia SHPO) about the treatment of the Tomb Monument in 2002, and invited the Advisory Council on Historic Preservation (ACHP) to participate in April 2005. In addition to the Virginia SHPO and the ACHP, ANC is also consulting with the Department of Veterans Affairs (VA), the National Park Service (NPS), the U.S. Commission of Fine Arts, the National Capitol Planning Commission, the National Trust for Historic Preservation, Arlington County, the APVA Virginia, and the Arlington Heritage Alliance. All options regarding the treatment of the Tomb Monument and necessary mitigation measures are being explored with these organizations.

In consultation with the parties mentioned above, ANC is considering various alternatives for addressing the Tomb Monument's cracking problem. Of great consideration in the evaluation of alternatives is the current and future availability of marble of the high quality required if the replacement option were to be pursued. The amount of suitable marble is finite, and the number of quarries is limited. Based on ANC's extensive familiarity with marble procurement, physical inspections of marble quarries and samples, and communication with past and present marble quarry operators, suitable marble may currently be available, most likely at the Yule Quarry in Colorado, where the original marble was quarried, or the Danby quarry in Danby, Vermont. The source of replacement stone will be subject to federal and VA procurement requirements. It is not certain if suitable marble will be available in the future. In the consideration of alternatives, ANC has operated under the assumption that the supply of suitable marble is limited and may not be available in the future. The availability of suitable marble is discussed at length later in this report in the response to Section 2873(a)(2).

The first alternative is to do nothing. Under this alternative, the Tomb Monument would not be repaired or replaced. According to the 1990 report on the Tomb Monument, cracking and weathering will continue to degrade the monument to the point where there will be a negative effect on visitors' experience. Due to the national historic and symbolic significance of the monument, this alternative has not been given further consideration.

Another alternative is a program of ongoing maintenance coupled with repair of the Tomb Monument as needed, similar to the maintenance program currently in place. ANC has undertaken efforts to maintain, repair and preserve the Tomb Monument for the past 70 years, including repairs in 1933, 1975, and 1989, and is initiating another repair this year. The 1990 report on the Tomb Monument's condition (Oehrlein and Associates) states that the die block's cracks will continue to lengthen and widen, and that enclosure of the stone is the only means of ensuring its perpetual preservation. With the proper materials, repair expertise, and appropriate monitoring and maintenance plans, the Tomb Monument could be repaired and returned to an acceptable appearance. The last repair lasted longer than was predicted. Repairing the cracks would allow the preservation of the existing Tomb Monument, minimizing any adverse effects to this historic property and maintaining the integrity of historic landscape. However, since the existing cracks only can be cosmetically covered up and will continue to lengthen and widen over time, repairing the Tomb Monument to the exemplary standards required for a memorial of its

transcendent dignity would require an ongoing program of grouting, regrouting, cosmetic touch-up, monitoring, and maintenance.

A third alternative involves another repair, combined with the procurement of suitable marble that would be secured and stored for replacement of the monument sometime in the future, when repairs are no longer effective. Under this alternative, when a final repair fails and the monument cannot be repaired again, suitable marble will already be on hand for replacement. This alternative would allow for the preservation of the original Tomb Monument in its original location for the longest time possible. However, this alternative creates various issues and risks that could jeopardize the successful future replacement of the monument. This alternative would necessitate the issuance of two contracts, one contract for the procurement of the stone now, and a second contract (at what could be a considerably later date) for the sculpting and/or installation of the stone. If a latent defect was found in the replacement stone some years from now, the stone supplier and stone sculptor could argue over responsibility for the defect, resulting in legal issues, delays, and costs to the government, that could impede and jeopardize the successful implementation of this alternative. In addition, utilizing two contractors also increases the opportunity for miscommunication and decreased responsiveness, also putting the implementation of this alternative at risk. The stored replacement stone would have to be moved twice, increasing the risk of damage and mishandling. Most importantly, if a latent defect in the stone was to be discovered years from now, or the replacement stone was to be damaged during transport or installation, there might no longer be the opportunity to acquire additional replacement marble.

The final alternative is replacing the monument's base, die block and capstone. The die block would be replaced with an approximately 55-ton block of white marble, possibly from the Yule Quarry in Marble, Colorado (where the original marble was extracted), or another quarry with similar high-quality marble. The base and capstone also would be replaced to ensure consistency of color. The concrete vault containing the remains of the World War I unknown, and the remains themselves, would not be altered in any way under this option, nor would the existing marble plinth that surrounds the vault's curb. The vault and monument foundation are made of concrete and have been described as "massive" (Oehrlein 1990). The footings measure 16 feet 2 inches by 9 feet 6 inches, and extend to a depth of 20 feet. The vault walls and cover range from 2 feet 4 inches to 7 feet thick. Due to the massive size of the vault, removal and replacement of the Tomb Monument will not affect the integrity of the vault nor the remains it contains. In addition, neither the World War II or Korean War unknowns' remains and vaults, or the Vietnam vault, which are located in separate graves to the west of the Tomb of the Unknowns, would be disturbed in any way.

Under this final alternative, VA would procure replacement marble following federal and VA acquisition regulations. At this time, it is contemplated that the contract would require furnishing an acceptable stone and having an artist recreate the original design as closely as possible. If any defects or flaws are detected in the marble during finishing or installation, they could be addressed at that time, as opposed to years later, so this alternative provides the best opportunity to obtain suitable marble while it is available.

By making use of the current availability of suitable marble, this alternative ensures that the Tomb Monument will maintain a high quality condition and appearance for a long period of time. The negative aspects of this alternative are that the original Tomb Monument would not be retained in its original location, causing a loss of its historic integrity of location, setting, association, and feeling, and it could be physically damaged during its relocation.

ANC is continuing to carefully consider the various alternatives to address the Tomb Monument's deterioration under Section 106 procedures, particularly in light of the recent comments from the public and historic preservation groups that favor maintenance and preservation of the original Tomb Monument. Full consideration is being given to input from the consulting parties and the public. As required by Section 106, ANC is taking into account how each of the alternatives could affect the Tomb Monument. The purpose of the Section 106 process is to "assess effects and seek ways to avoid, minimize or mitigate any adverse effects on historic properties." Therefore, ANC is weighing and balancing historic preservation along with other factors, in order to reach a solution that best serves the overall public interest.

Although a decision has not been made, at an earlier point in the Section 106 review of this project ANC had determined that the replacement alternative best met the cemetery's mission for the long-term preservation of the Tomb of the Unknowns, while also recognizing that replacing portions of the Tomb Monument would have an adverse effect to this historic property. Specifically, removal and replacement of portions of the original monument would diminish the integrity of the monument's design, materials, workmanship, and association with the Tomb of the Unknowns Historic Landscape and ANC. To mitigate those adverse effects, ANC and VA developed a number of stipulations in a draft Programmatic Agreement (PA) that, if approved by the consulting parties, would govern the implementation of the replacement project, should it occur. These draft measures have been developed in consultation with the parties to this undertaking, in meetings and through written comments on the draft PA. Mitigation measures, including those relating to the potential disposition of the original monument, should it be replaced, were contemplated and are summarized below, although the Section 106 consultation process has not yet resolved these matters.

The proposed draft mitigation of adverse effects resulting from the potential replacement of the Tomb Monument involves the implementation of the replacement project and the disposition of the original monument. The Tomb Monument would be reconstructed in kind, utilizing Subject Matter Experts (SMEs) in the drafting of all contract requirements and specifications to assist in the preparation of the solicitation(s) for replacement of the Tomb Monument, including marble quarrying and extraction; hewing, sculpting, finishing, repair, and transportation; and for the removal of the original stones and installation of the new stones. ANC would ensure that the public is afforded opportunity to understand the process and to experience the creation of the Tomb replacement, through the use of video broadcast, web-casting or other broadcast medium. ANC would update the existing interpretive sign located adjacent to the Tomb of the Unknowns to describe the Tomb Monument replacement project. ANC would evaluate the National Register eligibility of the original

Tomb Monument and the Tomb of the Unknowns Historic Landscape after implementation of the project. Finally, ANC has developed draft procedures to preserve the original Tomb Monument for the inspiration and benefit of the people of the United States. If it is decided to pursue the replacement alternative, all of these measures would be implemented in consultation with the parties to the draft PA. In addition, all replacement actions would conform to the Secretary of the Interior's Standards for the Treatment of Historic Properties, and with the requirements 36 CFR 79, *Curation of Federally-Owned and Administered Archaeological Collections*, as closely as possible.

*Section 2873 (a)(1)(B) requests "The current plans of the Secretaries with respect to disposing of the current monument at the Tomb of the Unknowns, if it were removed and replaced."*

The final disposition of the original monument, if it were to be replaced, has been discussed in detail with the consulting parties during the Section 106 review process of this project, although the parties have not reached consensus. In general, it is the intent of ANC to preserve the original Tomb Monument, if it is replaced, for the inspiration and benefit of the people of the United States. ANC's overall goal is to identify a suitable and appropriate repository for the original Tomb Monument, commensurate with its national significance. The repository should allow public access to the monument, and provide a secure and stable environment to ensure its long-term preservation.

Agreement has not been reached among the Section 106 consulting parties on the mitigation of adverse effects resulting from replacement of the original Tomb Monument, and it is expected that it will take considerable time to do so. ANC has contacted several organizations to find a suitable repository for the original stone, and the draft PA attempts to provide stipulations that will require ANC to continue consultation with the parties to the Section 106 review as final arrangements are made.

A number of actions must take place before the disposition of the original Tomb Monument is finalized, should the replacement alternative be selected. Requirements for curating the original monument must be developed, and repositories meeting those requirements need to be identified. The suitable repositories must be contacted regarding their interest in receiving the monument, and a final repository must be selected. A binding agreement must then be executed between ANC and the receiving facility. Based on informal discussions with the Smithsonian, it appears as though potential repositories may not be interested in negotiating for the receipt of the monument before it actually is available ("available" being defined as, at a minimum, a contract awarded for the replacement). However, no such contract may be awarded until after ANC has completed its Section 106 and NEPA requirements.

In view of the cracks in the die block (albeit non-structural), the original Tomb Monument may be damaged during its removal, transport, and reinstallation at a new facility, thereby compromising its historic significance. Relocating the historic tomb from

its location must also be addressed as an adverse effect. ANC developed another stipulation in the draft PA that covered this contingency.

ANC has considered requests to display the original stone at the cemetery, perhaps in a second monument area. However, ANC does not have an appropriate location for placement of the original monument, and having two monuments would detract from the significance of the Tomb of the Unknowns. Having two Tomb Monuments at ANC also may confuse the public. Finally, creating a new area for a second monument results in less space in the cemetery for gravesites in which to bury service members in the future.

*Section 2873 (a)(2) requests "An assessment of the feasibility and advisability of repairing the monument at the Tomb of the Unknowns rather than replacing it."*

ANC repaired the Tomb Monument in 1933, 1975, and 1989; and has initiated steps toward another repair this year. ANC and the consulting parties agreed that, before a decision to repair or replace the monument is made, ANC should reexamine preservation through repair. It was also agreed that the reconsideration of repairs to the monument must involve people with expertise in stone preservation and conservation. Repair of the Tomb Monument, conducted in accordance with the Secretary of the Interior's Standards for the Treatment of Historic Properties, would not result in an adverse effect to the Tomb Monument, unlike replacement, which would have an adverse effect.

In July 2005, a thorough inspection of the Tomb Monument was undertaken by SMEs in the field of stone conservation and repair. The experts, accepted by the Section 106 consulting parties at the time, included Dr. Dennis Montagna and Mr. Richard Pieper. Ms. Shelley Sass participated in later discussions. Dr. Montagna, who is currently the National Park Service's representative in the Section 106 consultation, directs the National Park Service's Monument Research & Preservation Program. Dr. Montagna holds a Master's degree in Art History from the University of Wisconsin and a PhD from the University of Delaware. Dr. Montagna is a former chair of the American Institute for Conservation's Architecture Specialty Group and serves as an advisor to the Save Outdoor Sculpture! organization. Mr. Pieper is an architectural conservator specializing in the conservation of masonry materials. Mr. Pieper is Director of Preservation at Jan Hird Pokorny and is an Adjunct Professor at the Columbia University Graduate School of Architecture, Planning and Preservation. Ms. Sass is an architectural conservator who specializes in stone and masonry conservation planning and implementation. In addition to her private practice, Ms. Sass is Program Coordinator and Adjunct Professor for the graduate conservation program at New York University's Institute of Fine Arts Conservation Center. The experts were identified through the Section 106 consultation process as being appropriate to provide information on the Tomb Monument's condition and potential for repair.



To facilitate ANC's decision making process, questions were developed regarding the monument's potential stabilization, repair, and maintenance; these questions were then provided to the SMEs. The questions were designed to provide ANC with the information necessary to make an informed decision regarding repair or replacement of the Tomb Monument. The questions were designed to provide general information on the current condition of the Tomb Monument, and to determine if a new repair would differ substantially from previous repairs, perhaps through the use of new technologies developed after the last repair in 1989. The questions, and the SMEs' answers, are provided as Appendix C to this report.

After reviewing the above information, ANC determined that, with the proper materials, repair expertise, and appropriate monitoring and maintenance plans, the Tomb Monument could be repaired again and returned to an acceptable appearance. It is possible that the Tomb Monument could be successfully repaired several more times. The most recent repairs conducted in 1989 were successful. The grout mixture used then is nearly identical to what would be recommended today, with the exception of applying the lime to a greater depth. However, it is expected that the cracks will continue to widen and lengthen over time and new cracks will become visible, thereby requiring more grout (both horizontally along the length of the cracks, and vertically along their widths), to maintain the monument's appearance. It is ANC's belief that the Tomb Monument's cracks cannot be repaired indefinitely without the monument acquiring a patched, worn, and shabby appearance, which is the antithesis of its purpose and contrary to ANC's mission of maintaining a dignified, fitting memorial to our country's fallen soldiers.

In addition, the monument continues to weather. Erosion of the monument's surface does not currently have a negative effect on the visitor's experience. The 1990 report on the Tomb Monument's condition stated that within 10 to 20 years (i.e., 2000 to 2010), the Tomb Monument might erode to the point that it will have a negative effect on visitors' experience. The 1990 report on the monument's condition did not take into account the reduction in sulfur dioxide levels since the passage of the Clean Air Act in 1990. Although erosion from air pollution may have decreased since 1990 it has not been eliminated, so it still is a concern. As stated in the 1990 report, "If this particular stone is significant, then enclosure of the stone and protection from the weather is the only means of ensuring its long term preservation" (Oehrlie 1990:31). The report goes on to state that "If this particular stone is not significant, then a plan should be formulated for quarrying and storing a replacement stone" (Oehrlie 1990:31).

Although the Tomb Monument could be repaired again, it is likely that replacement will be required at some point in the future. The impetus for considering replacement of the Tomb Monument now, rather than later, is the uncertainty of obtaining suitable marble in the future. The uncertainty is twofold, involving both the future existence of suitable marble, as well as the future availability of such marble. In other words, to successfully replace the Tomb Monument, it is necessary that marble of the required quantity and quality not only physically exist in a quarry, but also that the quarry be open and operating so that the marble can be extracted. By way of illustration, this report will consider the Yule Marble Quarry as an example of the potential difficulty of obtaining

suitable replacement marble. Solicitations for replacement marble, should it be required, will not be limited to the Yule Quarry, but rather to all quarries with high-quality marble similar to the existing monument.

The original stone for the Tomb Monument was quarried from the Yule Marble Quarry in Marble, Colorado. (For a comprehensive description of Yule marble, please see the U.S. Geological Survey's 1999 Bulletin #2162, *Colorado Yule Marble- Building Stone of the Lincoln Memorial*, by Elaine S. McGee). The Tomb Monument's die block was the largest single piece of marble ever quarried at that time. When the die block was created in 1930, the Yule Marble Quarry was the only quarry in the U.S. where a block of the required size could be procured (McGee 1999:4). The same situation may exist today, which could eliminate other quarries as potential sources of replacement stone. While there currently is a considerable amount of marble at Yule, not all of that marble is of the quality required for a replacement monument. The Yule Marble Quarry contains various grades of marble, only one of which (formerly called "Snowdrift Sculpture Select") is sufficiently free of pronounced veining and inclusions to make it suitable for use as replacement marble. This high-quality marble represents a minority of the available marble at Yule.

During the original extraction of marble for the Tomb Monument, it took three attempts before an "unflawed" block of suitable marble was procured for the die block. In recent years, workers at the Yule Marble Quarry have attempted to obtain a suitable piece of marble that could be used to replace the die block. On two occasions, they thought they had found a suitable block, only to discover on closer inspection that the blocks were flawed (The Aspen Times, August 6, 2005). It is readily apparent that the current existence of suitable marble for replacement is limited at Yule. With the continued operation of the Yule Marble Quarry, the existence of marble from this source, as well as other known sources of marble, will diminish.

Obtaining appropriate marble for the replacement project requires not only that it exist, but also that it be available. Currently, the Yule Marble Quarry is in operation, including a section of the quarry that produced the original marble. However, based on its operational history, it is not certain how long this quarry will continue to operate. Since its inception in ca. 1906, the Yule Marble Quarry has ceased operation or declared bankruptcy at least three times. Most notably, the quarry was closed for 47 years between 1941 and 1988, and closed again 10 years later. The Yule Marble Quarry has been closed more years than it has been open. It is reasonable to expect that, at some future date, the Yule Marble Quarry may not be available for procuring replacement marble that is suitable for the Tomb of the Unknowns Monument. The Danby Quarry in Danby, Vermont, may also have marble in the appropriate quantity and of the appropriate color.

While there is a risk that a replacement block of Yule marble, or perhaps any monolithic block of marble that size, may crack, there are technologies and extraction methods available today to minimize that risk. The high-quality Yule marble that might be used for the Tomb Monument replacement has a bedding plain that lies at an approximately 45 degree angle to the quarry floor. In order to fabricate a rectangular block with a bedding

plain horizontal to the long axis of the block, as would be required for a new monument, an oversized block must first be extracted.

Once removed from the quarry face, the triangular “corners” of this block are then trimmed, which requires rolling the block repeatedly to expose each corner. The original Tomb Monument was rolled in such a manner, but without the benefit of any protective cushioning, so that each roll produced a shock to the stone. According to the former owner of the Yule Marble Quarry, these shocks very likely exacerbated the incipient cracking of the original monument. Solicitation specifications for fabricating a new monument will require that the block be properly cushioned as it is rolled, to prevent shocking the stone. Additionally, specifications will require that once the block has been extracted from the quarry, it will be subject to seismic testing to locate and assess both hidden and visible cracks. These tests can read the internal geology of the new block to rule out as many ‘predetermined’ flaws as possible. Technologies such as these, not available when the original monument was quarried, will enable blocks with existing flaws to be rejected, so that a replacement block can be identified that has as low a risk of cracking as possible. If a suitable replacement block is not obtainable, ANC would revisit the repair option, and perhaps consider obtaining marble from foreign quarries or the use of other types of stone.

Replacement of portions of the Tomb Monument would have a negative impact to the historic significance of the Tomb of the Unknowns. Replacement would result in the physical removal and alteration of a portion of the Tomb of the Unknowns and its associated historic landscape, and would change the character of the memorial’s physical features. Removal and replacement of all or portions of the original monument will diminish the integrity of the monument’s design, materials, workmanship, and possibly its association with the Tomb of the Unknowns. In accordance with the requirements of Section 106 and in consultation with the Virginia SHPO and other consulting parties, ANC has determined that replacement of portions of the Tomb Monument would have an adverse effect upon the original Tomb Monument, the Tomb of the Unknowns Historic Landscape, and ANC.

ANC is mindful of its responsibilities for preserving and maintaining historic resources, and understands the principles of historic preservation. ANC would prefer to maintain the original Tomb Monument, and has undertaken numerous measures to do that since 1933, when the first cosmetic flaw to the monument was observed. Other historic properties within ANC’s stewardship are protected and maintained in a similar way. For example, ANC is currently undertaking a multi-year rehabilitation of the U.S.S. Maine Memorial. The renovation is being conducted with assistance from the National Park Service and is being performed in accordance with Secretary of the Interior’s *Standards for Rehabilitation* (36 CFR Part 67), in consultation with the Virginia State Historic Preservation Office. ANC acknowledges the historic significance of the original Tomb Monument, and, along with the VA and the other consulting parties, has drafted a Programmatic Agreement to govern the mitigation of the adverse effects resulting from its replacement, if that option is chosen. Historic preservation is an important mission for ANC, but in this unique circumstance, ANC believes that the goals of historic

preservation need to be weighed against maintaining the solemn dignity of the Tomb of the Unknowns. ANC's responsibilities include the long-term future of the cemetery, and ANC must ensure that later generations of American citizens are afforded the opportunity to appreciate the Nation's commemoration of the Unknowns in the manner that the monument's original creators intended; namely, unblemished. That is why ANC is considering implementation of actions today that may be foreclosed in the future. ANC has a unique, perhaps one-time opportunity to replace the cracked monument stone with marble from the original quarry and from the same marble vein, or perhaps from another quarry with the same quality marble. Continuing to repair the Tomb Monument, knowing that appropriate replacement marble may not be available in the future, would be a disservice to the public trust.

On the other hand, strong arguments have been made to continue a regimen of repair and ongoing maintenance in order to preserve the original Tomb Monument. The final decision regarding whether to repair or replace the Tomb Monument will be made in accordance with our responsibilities for historic preservation, and in full consideration of the views of the public, the consulting parties and historic preservation advocates.

*Section 2873 (a)(3) requests "A description of the current efforts of the Secretaries to maintain and preserve the monument at the Tomb of the Unknowns."*

The Army and ANC are solely responsible for the maintenance of the Tomb. The Tomb Monument is inspected every year by ANC to monitor the existing cracks. The Tomb Monument is currently cleaned by hand each spring, using soft brushes and a mild detergent. Potentially harmful cleaning treatments, such as power washing, have been discontinued. The Tomb Monument is subject to a regular maintenance cycle that provides for repair of the cracks as needed (which in the past has been approximately every 12 years), and another repair of the cracks has been initiated. This repair is subject to its own Section 106 review and is part of the cyclical maintenance that is needed to preserve the Tomb Monument while long-term options, including continued repair, are explored.

Regarding the new repair of the Tomb Monument, ANC has been working with conservation experts at the National Park Service's National Center for Preservation Technology and Training to assist in developing repair guidelines and specifications. These draft specifications have been provided to the consulting parties for review and comment. All repairs to the Tomb Monument will be performed in accordance with 36 CFR 68, The Secretary of the Interior's *Standards for the Treatment of Historic Properties* and other appropriate guidelines. ANC will assemble a panel of technical experts, including architectural and stone conservators, engineers, and other relevant specialists, as appropriate, to assist us in all aspects of contract development, source selection, treatment execution, and quality control for the proposed repair.

*Section 2873 (a)(4) requests "An explanation of why no attempt has been made since 1989 to repair the monument at the Tomb of the Unknowns."*

Past repairs to the Tomb Monument lasted approximately 10 to 12 years before signs of grout failure (shrinkage and discoloration) became apparent. According to experts in marble repair who were consulted for this project, 7 to 10 years, or 12 years with proper maintenance, is the expected length of time for a successful repair to last. The previous repair of the Tomb Monument lasted until 2002, when the grout began to show the first signs of deterioration. In 2002 ANC also became aware of the availability of replacement marble and began contemplating the possible replacement of the Tomb Monument. ANC did not think it was appropriate to expend funds to repair the monument in 2002 when there was a possibility that it would soon be replaced. Deterioration has now reached the point where another repair is needed. Until a long-term course of action is decided upon, ANC is currently working with the National Park Service's National Center for Preservation Technology and Training, experts in the field of marble maintenance and conservation, to develop and implement a maintenance plan that ensures that the existing marble is appropriately protected.

*Section 2873 (a)(5) requests "A comprehensive estimate of the cost of replacement of the monument at the Tomb of the Unknowns and the comprehensive cost of repairing such monument."*

Approximate costs for replacing the Tomb Monument are provided below. The cost estimate for the project's Section 106 compliance is our best estimate of the time and labor associated with fulfilling the stipulations in the draft Programmatic Agreement (PA) that we are developing to mitigate the adverse effects of replacing the Tomb Monument, should that alternative be implemented. The costs for the contract solicitation and management are likewise our best estimate for issuing and managing a contract of this magnitude. The cost estimate includes transportation of the original pieces of the monument to a repository, but does not include costs for installation of the original monument in a repository, or for the long-term curation of the original monument. Both estimates are based on prior experience with both implementing Section 106 PAs and managing contracts. Comprehensive cost estimates for completion of the Section 106 process will not be obtainable until a final alternative is selected and all mitigation measures, should they be required, are determined. The costs below are only a preliminary estimate and should not be considered final or binding in any way.

- Procure new marble- \$50,000
- Transport marble (quarry-finishing/sculpting-ANC)- \$40,000
- Finish new cap, block, and base; sculpt new block- \$1,500,000
- Install new marble and remove old marble- \$250,000
- Comply with Section 106 PA- \$300,000
- Contract solicitation and management- \$80,000

Total estimated cost- \$2,220,000

Approximate costs for repairing the Tomb Monument are as follows:

Remove old grout and install new grout- \$50,000

Contract solicitation and management- \$15,000

Total estimated cost- \$65,000

*Section 2873 (a)(6) requests “ An assessment of the structural integrity of the monument at the Tomb of the Unknowns.”*

The 1990 study of the Tomb Monument conducted by Oehrlein and Associates included visual inspection, photogrammetry, and radar thermography examination of the die block. At that time, the cracks extended around the Monument for a combined distance of 44.6 feet (the total horizontal circumference of the die block is 38.1 feet). The radar thermography analysis was, in general, inclusive, but did verify that the primary crack is not surficial, but extends partially through the block and will eventually extend completely through the block. The 1990 report assumes that the secondary crack also is not surficial. However, the cracks do not pose a threat to the structural integrity of the monument.

The cracks now appear on all four sides of the Tomb Monument, for a combined distance of nearly 48 feet. A new crack has appeared since 1990 at the base of the north elevation of the die block. The crack is perpendicular to the two main cracks and extends 7.25 inches up the side of the die block. As stated in the 1990 report on the Tomb Monument's condition, the monument retains its structural integrity, despite the cracks. There is enough internal topography in the cracks to prevent the monument's collapse from sheer forces. The problem created by the monument's cracking is solely aesthetic.

According to experts in marble conservation and repair consulted for this project, there is a minor risk that the bas-relief figures on the east elevation of the Tomb Monument could fall, but the risk is low and could easily be reduced by injecting a small amount of adhesive in the future.



## REFERENCES CITED

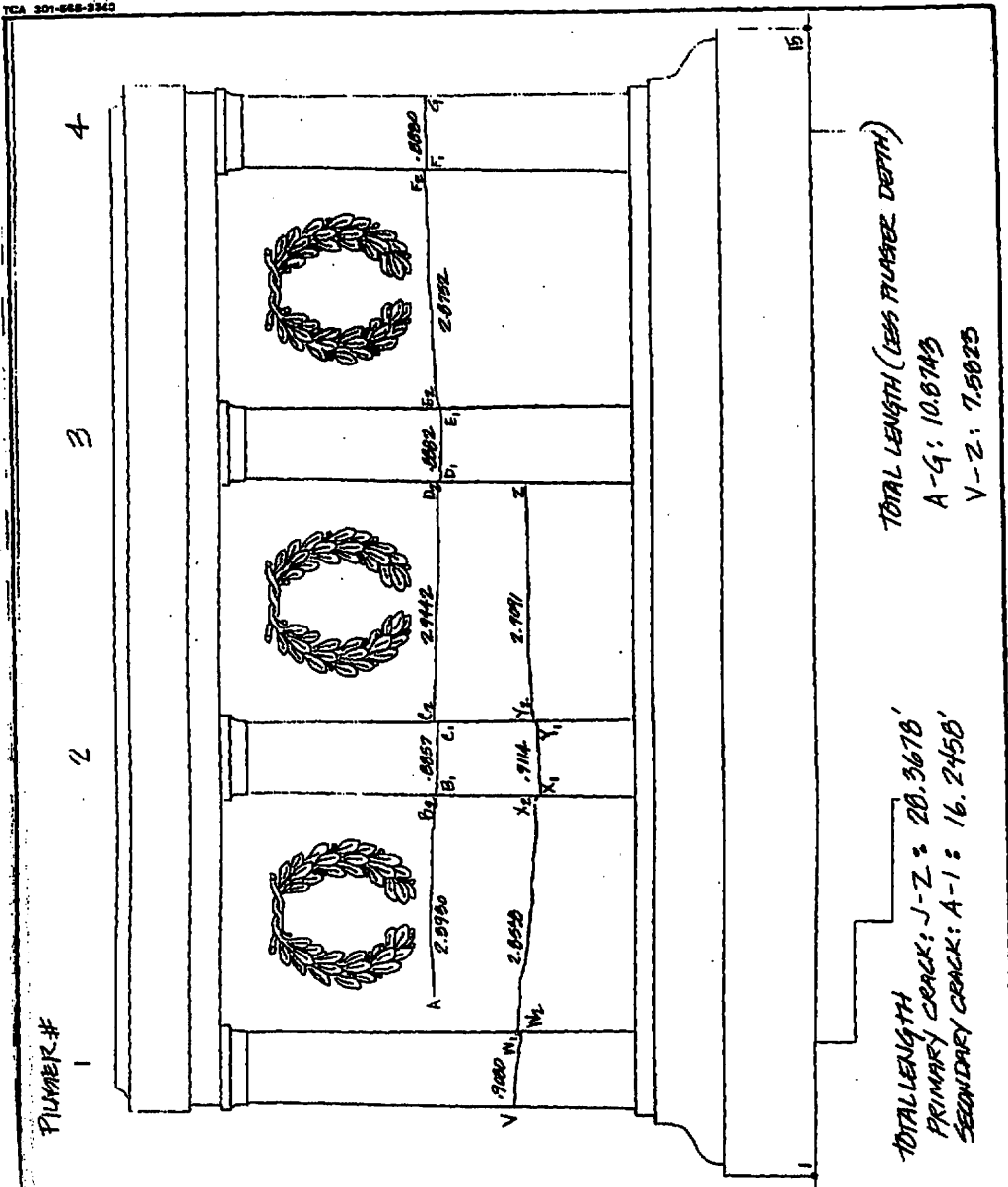
McGee, Elaine S.

1999 *Colorado Yule Marble- Building Stone of the Lincoln Memorial*. U.S. Geological Survey Bulletin 2162. U.S. Government Printing Office, Washington.

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1990 *Study for the Repair of the Tomb of the Unknown Soldier, Arlington National Cemetery, Arlington, Virginia*. Report prepared for the U.S. Army Corps of Engineers, Baltimore District.

Appendix A  
1990 Drawings of the Tomb Monument



TOTAL LENGTH (LESS FLASHER DEPTH)  
 A-G: 10.8743  
 V-Z: 7.5823

TOTAL LENGTH  
 PRIMARY CRACK: J-Z = 20.3678'  
 SECONDARY CRACK: A-I = 16.2458'

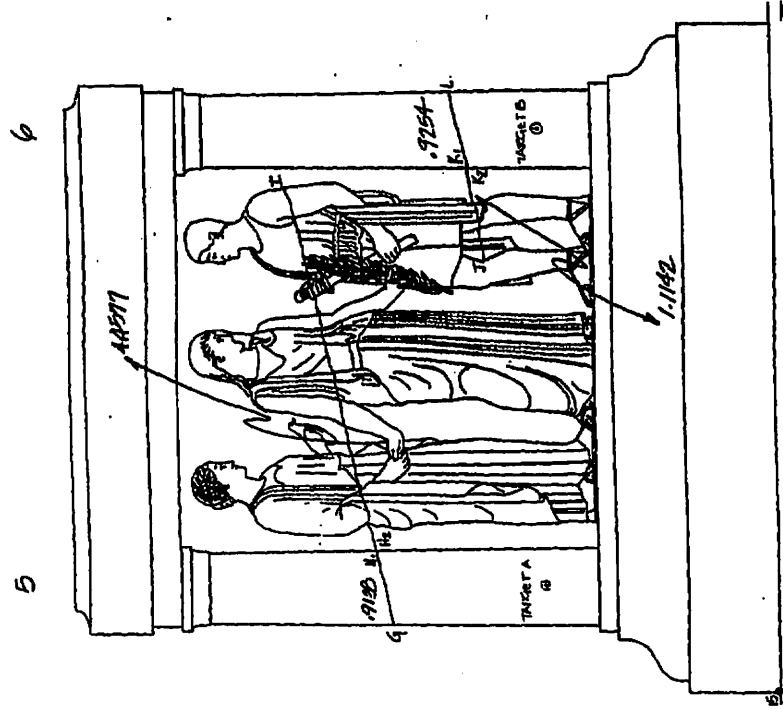
**OEHRLEIN &  
 ASSOCIATES  
 ARCHITECTS**

**TOMB OF THE UNKNOWN SOLDIER  
 SOUTH ELEVATION  
 Crack Length Measurements**

DATE: 10/90

SCALE: NTS

V-1  
 SHEET NO.



G-1 : 5.3715  
 J-L : 2.0396

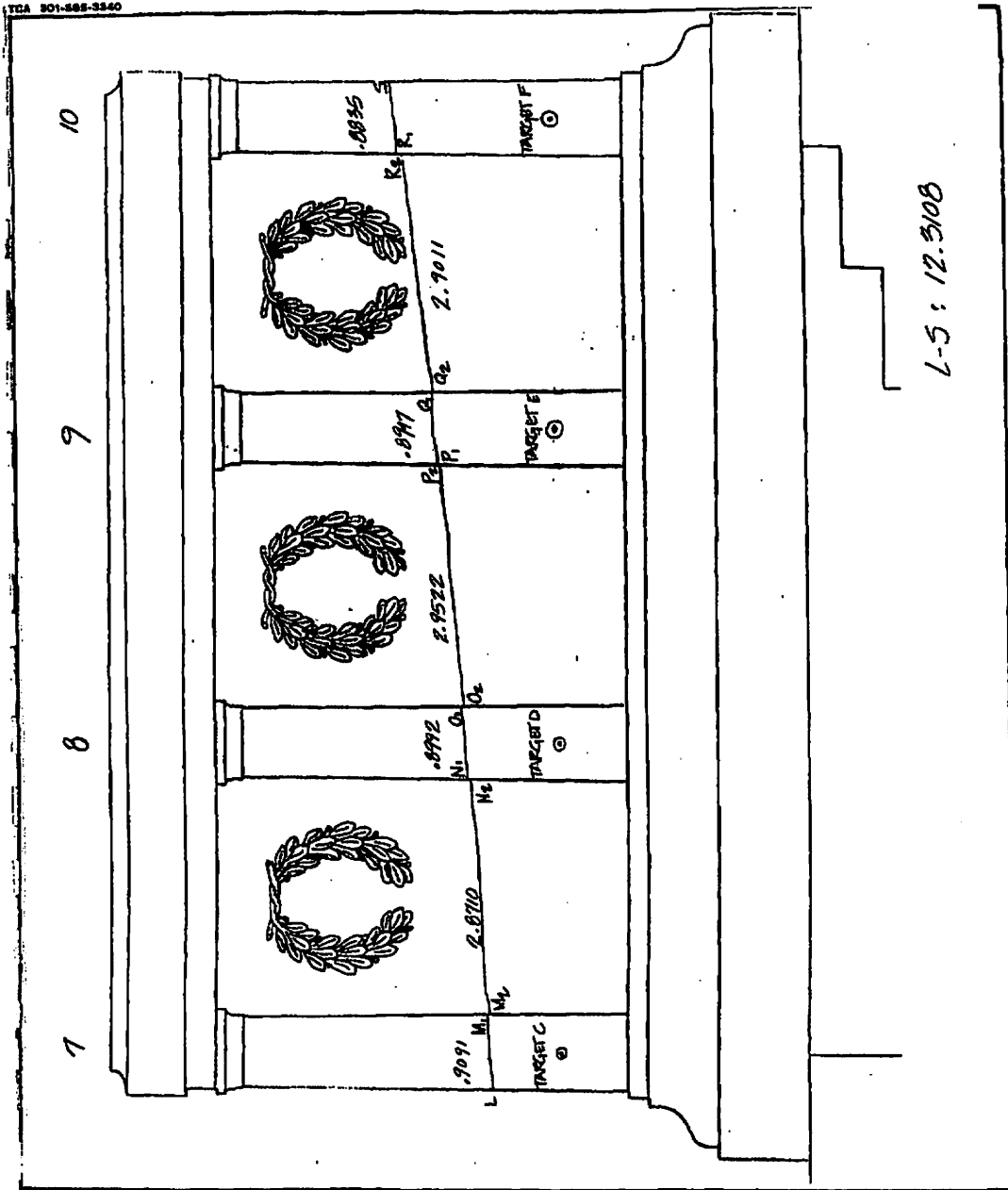
**OEHRLEIN &  
 ASSOCIATES  
 ARCHITECTS**

**TOMB OF THE UNKNOWN SOLDIER  
 EAST ELEVATION  
 Crack Length Measurements**

DATE: 10/90

SCALE: NTS

V-2  
 SHEET NO.



L-5 : 12.3108

**OHRLEIN & ASSOCIATES ARCHITECTS**

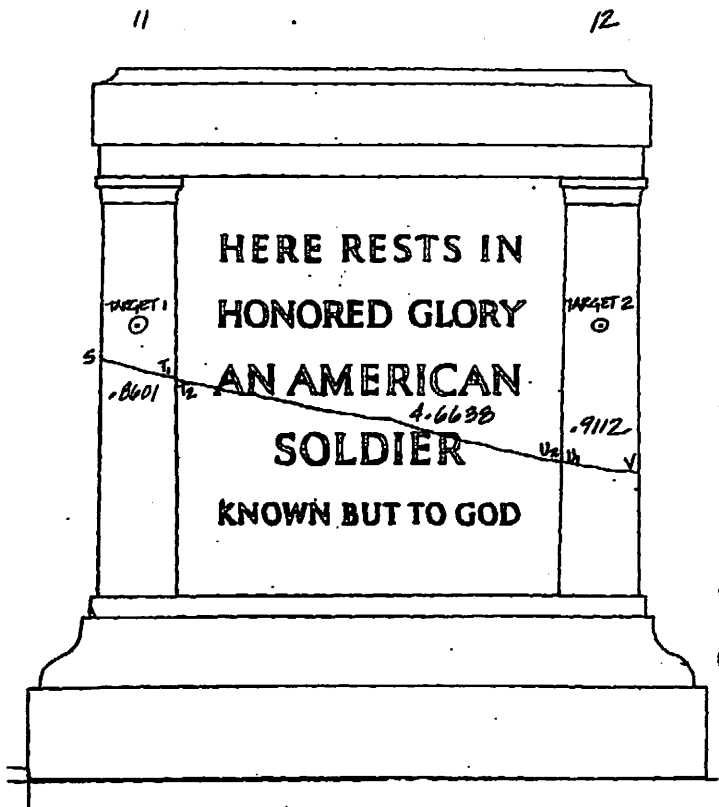
**TOMB OF THE UNKNOWN SOLDIER  
NORTH ELEVATION  
Crack Length Measurements**

DATE: 10/90

SCALE: NTS

V-3  
SHEET NO.

TM 31-21-2-10



S-V: 6-4351

OEHLEIN &  
ASSOCIATES  
ARCHITECTS

TOMB OF THE UNKNOWN SOLDIER  
WEST ELEVATION  
Crack Length Measurements

DATE	10/90
SCALE:	NTS

V-4  
SHEET NO.



**Appendix B**

**Memorandum of Understanding between the Departments of the Army and Veterans Affairs for the Tomb Replacement project, dated November 2004.**

**Memorandum of Understanding  
Between  
The United States Department of the Army  
and  
The United States Department of Veterans Affairs**

**I. Parties.**

The parties to the Memorandum of Understanding (MOU) are the United States Department of the Army (Army) and the United States Department of Veterans Affairs (VA).

**II. Authority.**

Under title 38 of the United States Code (U.S.C.), section 2306(a)(1), the Secretary of Veterans Affairs shall furnish, when requested, appropriate Government headstones or markers at the expense of the United States for the unmarked graves of any individuals buried in a national cemetery. The term "national cemetery" includes Arlington National Cemetery. 32 CFR § 553.4. VA policy is to replace headstones and markers under certain circumstances, such as those cracked, broken, or destroyed due to natural causes. M40-2, National Cemeteries—Administration, Operation and Maintenance, dated May 1, 1984. VA Department of Memorial Affairs Manual 40-3, Chapter 4, Paragraphs 4.01-4.06, describes specific standard markers and certain special markers to be furnished by VA for use in specific situations. Replacement of the base, main die block, and cap of the Tomb of the Unknown Soldier would involve providing a marker not contemplated by Manual 40-3.

On December 19, 2002, the VA Acting Under Secretary for Memorial Affairs granted a one-time exception to existing policy for replacement of the base, main die block, and cap of the Tomb of the Unknown Soldier at Arlington National Cemetery.

The Compensation and Pensions appropriation in Pub. L. No. 108-7 provides, in pertinent part, funds for the "payment of . . . burial benefits . . . and for other benefits as authorized by law (38 U.S.C. 107, 1312, 1977, and 2106, chapters 23, 51, 53, 55, and 61."

The Secretary of the Army has oversight authority for operation and maintenance of Arlington National Cemetery. See 32 C.F.R. § 553.4.

It is VA policy to protect and preserve historic properties. Cultural Resource Management, VA Directive 7545, para. 1.b..

**III. Purpose.**

The purpose of the MOU is to provide the cooperative framework in which the parties will successfully collaborate to replace damaged parts of the Tomb of the Unknown Soldier (Tomb), which is a unique and historic memorial of great significance to our Nation in remembrance of those who lost their lives in defense of our Country. In response to a written request from the Superintendent of Arlington National Cemetery (under the jurisdiction of the Department of the Army), for the replacement in-kind of the base, main die block, and cap of the Tomb, VA will provide a replacement of the parts specified based upon the authorities listed in Section II of this memorandum.

---

The Tomb was installed in 1931 and has deteriorated to the extent that a replacement of damaged parts is deemed necessary by the Superintendent, Arlington National Cemetery. According to the Superintendent, the Tomb has developed two large parallel cracks that extend through the full length of the stone and repair of the cracks is not feasible. Replacement of the base, main die block and cap of the Tomb located above the grave of the Unknown Soldier of World War I is consistent with existing VA National Cemetery Administration policy regarding replacement of deteriorated or damaged headstones or markers.

**IV. Responsibilities.**

In fulfilling the objectives of the MOU, the parties agree, subject to applicable legal limitations, to participate and be responsible for the following activities.

**A. VA will:**

1. Be responsible for solicitation, award, and funding of the contract to include procurement, transportation, manufacturing / sculpting.
2. Fulfill the function of the official Contracting Officers Technical Representative (COTR) for the contract.
3. In consultation with Army, ensure satisfactory craftsmanship and condition of Tomb replacement materials, inscription, and other services necessary for final completion and delivery of the Tomb replacement.
4. Be responsible for responding to questions regarding the contracting process and its status from Congressional Committees, stakeholders, the media, and the general public.
5. Be responsible for transporting the finished product from the manufacturer to Arlington National Cemetery.

**B. Army will:**

1. Develop a comprehensive Statement of Work (SOW) with precise specifications and measurements for the original Tomb. Army will be responsible for developing new technical specifications as part of the SOW, if original specifications are not obtainable. The Tomb has deteriorated since its original installment; measurements of the current stone block would be imprecise and not the same as original specifications. The SOW will identify all aspects of construction and quality assurance for materials and workmanship. As the Army has requested that the Tomb be replaced in-kind, the statement of work and specifications must indicate original measurements.
2. Develop contract requirements to include specific evaluation, selection, and performance criteria for contract award and language to determine final product acceptability, as well as provide the appropriate technical expertise to assist VA in determining fulfillment of all portions of contract terms.

3. Provide reasonable access to the original Tomb for NCA officials and contractors during all phases of Tomb replacement.
4. Be responsible for reviewing the merits of and making the decisions on whether or not to accept any donations of resources or services, e.g., donated marble and transportation of donated marble to the selected contractor site for manufacture.
5. Be responsible for completing any necessary National Environmental Policy Act (NEPA) and National Historic Preservation Act (NHPA) compliance, and all other requirements related to the Tomb's historic significance.
6. Contact veteran service organizations, historical organizations, regional design-oversight commissions and other stakeholders to inform them of the proposed action and obtain their input and/or support.
7. Be responsible for responding to questions regarding how the decision to replace the Tomb was made, preservation requirements, installation, and proper disposition of the original Tomb from Congressional Committees, stakeholders, the media, and the general public.
8. Be responsible for the installation of the replacement Tomb and the removal and disposition of the original Tomb, and of all components that are to be replaced.

**C. Both Parties Agree To:**


1. Have their public affairs offices work together to develop a communications plan that identifies the types of materials to be developed to clearly explain both VA's and Army's roles in this endeavor through all phases of the process. The communications plan will also determine responsibilities for the proposed filming project to document the replacement from start to finish.
2. Have their Federal Historic Preservation Officers coordinate with each other and their respective agencies for the development and review of any necessary NEPA and NHPA compliance documentation to ensure consistent understanding of issues and solutions.
3. Provide immediate notice to the other party in the event knowledge is acquired that an occurrence, or other factor, will materially affect the rights and responsibilities of the other party as detailed in this MOU.

**V. Timeframe:**

VA will proceed with its contract support once Army has provided the necessary specifications and SOW. From the date VA submits the contract solicitation for proposals to the time the replacement is delivered to Arlington National Cemetery, the overall timeframe is expected to be 2 years. This is subject to the availability and delivery of an appropriate piece of marble.

VI. Effective Date:

This MOU shall become effective on the date of signature and shall remain in effect until completion of the procurement process, unless amended or extended any time by mutual written agreement. *Either party, upon a 60-day notice to the other party, may terminate the MOU at any time.*

  
Secretary of Veterans Affairs

  
Secretary of the Army

11/12/04  
Date

OCT 29 2004  
Date

**Appendix C**

**Questions and Answers from Stone Conservation Subject Matter Experts**



The following questions regarding the stabilization, repair, and maintenance of the Tomb Monument were prepared by Mr. John C. Metzler, Superintendent, Arlington National Cemetery; Ms. Katherine Basye Welton, Program Manager for Arlington National Cemetery, U.S. Army Corps of Engineers, Baltimore District; and Mr. Scott C. Watson, Cultural Resource Program Manager, U.S. Army Corps of Engineers, Baltimore District. The questions were reviewed for appropriateness and thoroughness by the following individuals, who also provided answers to the questions: Dr. Dennis Montagna, Director, Monument Research & Preservation Program, National Park Service; Mr. Richard Pieper, Director of Preservation, Jan Hird Pokorny Associates and Adjunct Professor, Columbia University Graduate School of Architecture, Planning and Preservation; and Ms. Shelley Sass, President, Sass Conservation, Inc. and Adjunct Professor, New York University, Institute of Fine Arts Conservation Center.

## TOMB OF THE UNKNOWN MONUMENT

### ARLINGTON NATIONAL CEMETERY

#### QUESTIONS REGARDING STABILIZATION, ASTHETIC REPAIR, AND MAINTENANCE OF THE MONUMENT

##### Stabilization

**1) Can the cracks (horizontal and vertical) be prevented from lengthening, or will they continue to grow?**

Technically no, but what we're seeing in the horizontal cracks is existing cracks becoming visible. The fissures/cracks were most likely formed during mining, carving, or transport, or could be a result of natural flaws in the stone. As the stone is static and not undergoing any stress right now, it is safe to say that what we're seeing are 'internal' cracks becoming apparent. Things such as pressure washing may expedite the cracking, as will freeze/thaw to some degree.

The vertical ones on the north side are a bit more puzzling – we're not sure what caused them, and aren't sure of the rate of growth.

**2) Can the cracks be prevented from widening?**

No – what we're seeing is the edge of the crack – the microfracture – slightly wearing away due to weathering or previous grout preparation techniques. The crack is only 'widening' on the surface, and there's no evidence of the entire depth of the crack widening.

**3) Can new cracks be prevented from occurring?**

Referring back to question 1, there are no real 'new' cracks – just internal cracks that are making themselves apparent.

There is question about the vertical cracks, which warrant additional investigation.

**4) What is the likelihood of the vertical and horizontal cracks intersecting, and what would result from that intersection?**

As the cracks are deep and not surface cracks, if the vertical and horizontal were to connect, most likely nothing will happen.

**Aesthetic Repair**

**5) Can existing hairline cracks be grouted at this time?**

Very very fine hairline cracks can't be grouted, but 'normal' hairline cracks can be. However, since the crack isn't wide enough to 'hold' the grout, it will erode faster than grout will in wider cracks.

**6) How long before the hairline cracks would be wide enough to grout?**

Depends...cleaning of the Tomb could force the widening of hairline cracks by forcing dirt/water/etc into the crack.

**7) Would injection ports be required to slow the cracks, prevent new cracks, or treat hairline cracks?**

This kind of repair is not seen as practical for the cracks on the Tomb – it's more for architectural stone. However, on some areas, grout could be injected with a hypodermic needle to obtain the maximum penetration in the smaller cracks.

**8) What grout mixture (lime/sand with biocide?) would be most appropriate?**

The secret to the grout is to have it be sturdy enough to withstand the elements, but soft enough to be easily removed. Weathering and cleaning are the enemies of grout.

The grout mixture would be perfected for the monument, but it would be a lime based fill versus synthetic. The lime would have fine aggregate (sand) to match the color/texture of the marble. A biocide would be applied on the outer edge of the grout to reduce mold/mildew growth.

Adhesive, a bonding type of filler, would be used only in areas like the figures on the east side of the monument.

**9) In what significant ways would a new repair differ from previous repairs?**

The most recent repairs were seen to be very successful. The grout mixture is nearly identical to what would be recommended today, with the exception if applying the lime deeper.

**10) How long do you think it would take to completely regROUT all the existing cracks?**

Based on working at night when the cemetery is closed and completely removing all evidence of repair from the site every morning, it is estimated that it will take 2 weeks to complete the removal and replacement of grout. It is recommended that this work be done in the spring or fall, as most filler requires temperatures between 50 and 80 degrees.

## Maintenance

**11) How long will the crack repairs last, before the new grout would discolor, shrink, or otherwise fail and require replacement?**

It is estimated that the repairs would last 7-10 years, but could last 12 years with a carefully tailored maintenance plan. An appropriate aggregate (most likely sand) would minimize the shrinking of the filler, and cleaning would reduce the discoloration.

**12) When a hairline crack has widened to the point where it could be grouted, would all of the other cracks then need to be regouted, to insure a uniform appearance?**

No – spot treatment can be done on an as-needed basis without removing existing grout.

**13) Is there any way to prevent enlargement of the cracks when removing old grout?**

Yes – have a person skilled in monument repair perform the removal.

**14) What would be the preferred cleaning protocols to prevent or lessen the enlargement of the cracks?**

The recommendations put forth in the 1990 study are still good – steam cleaning is the preferred cleaning, and a twice-a-year cleaning is good.

A successful repair *must* have successful maintenance

## General

**15) What is the likelihood that a new block of marble would crack?**

By consulting a quarry expert for the least-impact methods for removal, this may be minimized. However, due to the geological forces put on the stone, the cutting, and removal of the block, it is likely that a stone of this size will eventually crack.

There are tests that can be performed to read the internal geology of the new block to rule out as many ‘predetermined’ flaws as possible.

**16) Have there been any repairs to marble (in the Mid-Atlantic region or elsewhere) that are similar to the repairs now proposed that ANC staff could inspect?**

Yes-

-Sculptures at the Pennsylvania State Capitol (Danby Marble) were completed 5 years ago.

-Washington Square Arch in NYC (1 year ago)

-Possibly some work on Lincoln Memorial

**17) Is there any known sealant that can be applied to the entire tomb to protect it?**

No – this will soil the surface even more.

**18) What is the risk that the figures on the East side will fall off?**

There is a risk, but it is easy to fix with injecting a small amount of adhesive. There is low risk for major damage on this side.