

**Seismic Evaluation Report**

**for**

**Buildings 1001, 1002, 1010, and 1013**

**Onizuka Air Station**

**1080 Lockheed Way**

**Sunnyvale, CA 94089**

Prepared for

**The U.S. Air Force**

**Onizuka Air Station**

**Sunnyvale, CA 94089**

**Contract F04689-96-D-Q001, A & E Services**

Prepared by

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Mariscal Engineering and its consultants have prepared this report for the exclusive use of the USAF Onizuka Air Station (OAS) in connection with the subject buildings and under terms and conditions established by written contract. As part of our contract with the USAF OAS we performed inspections and reviewed information related to the buildings. We exercised standard care and employed typical methods for building evaluation of this kind and for the purposes of our client as stated in our contract. Substantial physical problems not described herein, however, may arise from conditions either undisclosed or inaccessible to the inspection team or not in existence during the preparation of this report. The actual costs for repairs and maintenance of conditions encountered may differ substantially from the estimated costs. This report is for the exclusive use of the USAF OAS. Any other person who uses the information on this report does so at his or her own risk and agrees that Mariscal Engineering and its consultants shall not be responsible for any damage or loss resulting from such use.

## EXECUTIVE SUMMARY

MARISCAL ENGINEERING as the prime consultant, and PAL CONSULTANTS INC., are pleased to present the Seismic Evaluation Report for Buildings 1001, 1002, 1010, and 1013 at the USAF Onizuka Air Station (OAS). We are certain that our client, the OAS, will find this report useful in its efforts to comply with Presidential Executive Order 12941, Seismic Safety of Existing Federally Owned or Leased Buildings. We recommend that the document be read completely and that we be contacted for any clarification that may be required.

The OAS is a satellite testing and control facility for DOD satellites. The above buildings provide space for technical personnel and for sensitive equipment performing operations related to satellites, as well as office space for administrative operations and security. The buildings are classified as essential facilities which requires them to remain undamaged and operational during and after design earthquakes. The four buildings cited above are considered within Risk Group A.

On the basis of our review of available OAS records, as-built drawings and previous soils studies, we conducted field evaluations and seismic analyses of these buildings. Some important soil characteristics and building deficiencies are identified.

We have found that building 1001 is susceptible to partial damage from a strong (design) earthquake that may induce limited soil liquefaction as well as affect the steel frame. To a lesser degree, the risk of soil liquefaction is also present for the other three buildings. Building 1002 cannot sustain a strong earthquake without suffering damages due to the steel frame conditions and mutual slamming effects of the twin adjacent structures that form the building. Building 1010 is considered structurally safe and has the least risk for earthquake damage. Building 1013 is also considered structurally safe except for the liquefaction risk indicated above. Minor nonstructural damages are expected in all of the four buildings.

In summary, the buildings cannot sustain a strong earthquake without experiencing certain damages. Therefore they do not satisfy requirements imposed by the current building occupancy category.

The buildings will have to undergo seismic rehabilitation if their current building occupancy categories are not changed. An alternative to seismic rehabilitation is to downgrade the occupancy category to a building that will experience damage, unlikely to cause collapse, but will not be operational and will need repairs after a major earthquake. In any case, we recommend that OAS adopts measures to eliminate the existing seismic hazards to building occupants.

The rehabilitation work needed to upgrade the buildings to acceptable seismic safety standards as well as the costs have been estimated. Due to the extent of the work anticipated, we believe OAS will require developing a relocation plan to vacate some offices for a period of construction which is undetermined at this time.

We have achieved the objective of the OAS, which is to evaluate the seismic safety of these buildings and comply with Presidential Executive Order 12941. The report is accompanied with a tabulated data chart which will be added to the general comprehensive data base that OAS is preparing for its entire facility.

We express our thanks to OAS for the opportunity to provide our services for this evaluation.

# STATEMENT OF WORK

for

ARCHITECT-ENGINEER SERVICES

Project No. WMSJ 94-1043

SEISMIC EVALUATION OF BUILDINGS

at

ONIZUKA AIR STATION

26 September 1996

## 1. OBJECTIVE

The objective of this study is to initially evaluate four buildings at Onizuka Air Station for potential earthquake-related risk to human life posed by a building or building component. This portion of the study is to be used in the overall analysis and inventory of OAS buildings to comply with Executive Order 12941, Seismic Safety for Existing Federally Owned or Leased Buildings. The evaluation shall reference the methods of the NEHRP Handbook for the Seismic Evaluation of Existing Buildings (FEMA-178/June 1992) as modified by Air Force Engineering Technical Letter (ETL) Structural Evaluation of Existing Buildings for Seismic and Wind Loads. Geologic hazards, the building's structural system, foundation, and non-structural elements shall be evaluated. The results of the evaluation shall be presented in a report which lists those elements that do not meet the basic acceptance criteria, assesses the consequences of the failure of the elements, and states the Architect-Engineer (A-E's) judgment of the potential life safety hazard. In addition, this study will evaluate geologic hazards at the site of the four buildings and provide a "program level" estimate of the cost for the recommendations to rehabilitate or upgrade buildings.

## 2. SCOPE

Work scope and the evaluation criteria includes field investigations, calculations, analyses, engineering, reports and completion of the ICSSC Database for as described in reference 3.9 below. The A-E shall provide all services, tools, equipment, and transportation required to evaluate the buildings and to prepare the written report. The final report shall address overall conceptual seismic status of the evaluated buildings with respect to structure, foundation, site geology, and non-structural elements, provide the completed ICSSC database, and provide a detailed schedule of the design and study work necessary to prepare a complete seismic retrofit contract as described below.

### 3. REFERENCE DOCUMENTS

A. The following documents and publications are to be used as references for this statement of work.

3.1. Inventory, Screening, Prioritization, and Evaluation of Existing Buildings for Seismic Risk, Engineering Technical Letter, Air Force Civil Engineering Support Agency, 18 August 1993.

3.2. Structural Evaluation of Existing Buildings for Seismic and Wind Loads, Engineering Technical Letter, Air Force Civil Engineering Support Agency, September 1994 (Draft).

B. The following documents are to be used as reference only. (Not to be complied with specifically.)

3.3 FEMA 156/July 1988, Typical Costs for the Seismic Rehabilitation of Existing Buildings, Volume I - Summary. Federal Emergency Management Agency.

3.4 FEMA 157/September 1988, Typical Costs for the Seismic Rehabilitation of Existing Buildings, Volume II - Supporting Documentation. Federal Emergency Management Agency.

3.5 FEMA 178/June 1992, NEHRP Handbook for the Seismic Evaluation of Existing Buildings, Federal Emergency Management Agency.

3.6 FEMA 222/January 1992, NEHRP Recommended Provisions for the Development of Seismic Regulations for New Buildings, Part 1: Provisions, Federal Emergency Management Agency. (Includes Maps).

3.7 FEMA 223/January 1992, NEHRP Recommended Provisions for the Development of Seismic Regulations for New Buildings, Part 2: Commentary, Federal Emergency Management Agency.

3.8 Seismic Design for Buildings, AFM 88-3, Chap 13, October 1992.

3.9 ICSSC RP 5/October 1995, ICSSC Guidance on Implementing Executive Order 12941 on Seismic Safety of Existing Federally Owned or Leased Buildings, U.S. Department of Commerce, Building and Fire Research Laboratory, National Institute of Standards and Technology.

### 4. BACKGROUND

Onizuka Air Station is a satellite testing and control facility located at Mathilda Avenue and Moffett Park Drive in Sunnyvale, California adjacent to the Lockheed Martin Company. The four buildings to be evaluated are located on the 22 acre campus of Onizuka Air Station. They are the "Risk Group A" buildings on Onizuka Air Station. These buildings were selected for evaluation based on screening criteria in ETL 93-3 (reference 3.1). Attachment 1 is a page from the screened inventory on which these buildings are highlighted.

### 5. TASKS

#### 5.1 Geotechnical Evaluation

## SECTION 1. INTRODUCTION

### 1.1 Project Objective, Methodology and Approach

The purpose of this study is to perform the initial Seismic Evaluation of Building 1001, 1002, 1010 and 1013 at the USAF Onizuka Air Station (OAS) for potential earthquake-related damage to buildings and consequent risk to human life. These buildings are classified as "Risk Group A." Our task is to present an evaluation report with certain significant facts regarding the physical condition of these buildings, and the estimated cost of their seismic rehabilitation.

The OAS will incorporate these results into its overall analysis and inventory of OAS buildings in compliance with Presidential Executive Order 12941, Seismic Safety of Existing Federally Owned or Leased Buildings. This order is to be implemented as stated in Inventory Screening, Prioritization, and Evaluation of Existing Buildings for Seismic Risk, Engineering Technical Letter ETL 93-3, Air Force Civil Engineering Support Agency, August 1993 (Reference 1).

As stated in our scope of work, our evaluation, follows the methods laid out in the NEHRP Handbook for the Seismic Evaluation of Existing Buildings (FEMA 178/June 1992) (Reference 2), which has been modified by Air Force Engineering Technical Letter (ETL) Structural Evaluation of Existing Buildings for Seismic and Wind Loads (Reference 3). These and other references are shown in Appendix A, where our scope of work is also presented.

Our method of evaluation includes the following steps:

1. Visiting the site and the buildings to gather data and review pertinent documents of record provided by OAS.
2. Categorizing the buildings by type; selecting a set of evaluation statements corresponding to that type; reviewing the statements.
3. Conducting follow-up field work; taking photographs; inspecting critical areas.
4. Performing the analysis required for the evaluation.
5. Performing a final evaluation of the buildings.
6. Preparing the evaluation report.

We made an initial review of the OAS documents of record to determine the extent to which the existing documents conform to the design and construction standards established for buildings of this kind. (Please refer to Appendix B for a list of these documents.)

After reviewing existing drawings and categorizing the building structures according to the FEMA-178/NEHRP, we performed physical inspections in January and February of 1997. Visually evaluating the buildings, we inspected all areas except those hosting operations that are top security, because authorization to enter these areas could not be granted within the time frame scheduled for the completion of this study.

Using fieldwork questionnaires based on sets of evaluation statements per FEMA-178/NEHRP, we assessed the building elements. We examined accessible construction and compared it with existing documents. Because the scope of the inspection did not include any destructive tests, hole punching, or any kind of rupture test, any potential, latent, or inaccessible defects are excluded from this report.

It is important to note that the majority of the structural works in the buildings were completed between 20 to 35 or more years ago.

The buildings were mostly occupied as offices when we commenced our inspection. This meant that we were unable to verify fully the extent to which construction conditions comply with the existing drawings, specifications and codes. Our evaluation of the Mechanical and Electrical systems is also limited to what is visible and does not include anything concealed in the walls of the building. Our restricted ability to evaluate inaccessible conditions limits our evaluation as well.

Next, we analyzed the building structures and the geotechnical characteristics of the site. The analysis was required for the building elements that we found to be deficient according to the evaluation statements. Since these buildings are "Risk Group A"—essential facilities that must remain operational during and after an earthquake without posing potential earthquake-related risk to human life, we also gave consideration to nonstructural elements in the building.

During a subsequent evaluation of the four buildings, we determined which elements in each will need to be seismically rehabilitated. We estimated the cost involved for the rehabilitation work and tabulated the results in a chart to be included with the comprehensive analysis and inventory of OAS buildings.

## **1.2 Report Organization**

The report starts with an Executive Summary that gives the essential conclusions of our evaluation. The body of the report is presented in 10 sections. Section 1—Introduction—is presented herein. Section 2—Building Location and Description—offers a summarized description of the OAS site and gives the locations of the four buildings.

Section 3—Documents of Record—covers our review of existing information on the buildings. Section 4—Geotechnical, Site Geology and Soils—offers our evaluation of the site seismicity based on the available studies at OAS.

Sections 5, 6, 7 and 8—Site Visit, Building Evaluation, and Seismic Analysis of the Building—provide similar kinds of information about each building. In these sections we describe the circumstances under which we gathered field data; we provide our evaluation of the buildings; we show the seismic analysis criteria we used and our results; and we give a list of structural deficiencies for each building.

Section 9—Building Deficiency Mitigation and Cost of Seismic Rehabilitation—presents the list of deficiencies to be mitigated as well as the estimated cost for the seismic rehabilitation of each of the four buildings. Section 10—Conclusions and Recommendations—includes our best judgment and answers to the problem issues for each building.

We have attached eight appendices to the Report. Appendix A—Scope of Work—describes a prioritized work scope issued by OAS as well as pieces of relevant correspondence. Appendix B—Reviewed Documents of Record—lists the documents provided to us for review.

Appendix C, D, E and F—Photographs, Evaluation, Seismic Analysis, Deficiencies and Cost—show photographs; our findings during the physical inspection of the buildings; the seismic analysis; a list of found deficiencies; and costs for the seismic rehabilitation of each of the four buildings.

Appendix G—Data Base—shows the tabulated data base of the evaluation results for the buildings presented in the required format. Appendix H—Project Directory—provides information on the individuals participating in the project.